The Federative Republic of Brazil
The Government of State of Para

The Preparatory Survey For Belem Metropolitan Bus Transport System Project In The Federative Republic of Brazil

Final Report

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List of Abbreviations

2003 F/S	Feasibility Study on the Improvement of Transport System in the Metropolitan Area of Belem in the Federative Republic of Brazil
2009 F/S	The Preparatory Survey for Belem Metropolitan Bus Transport System Project
ABNT	Brazilian Association of Technical Rules
ANEEL	National Agency of Electric Energy
APA	Environmental Protected Reserves
ARCON	Para State Agency of Regulation and Control of Public Services
AUSTROADS	Association of the Authorities of Transport and Traffic of Australia and New Zealand
BID	Interamerican of Development Bank
BIRD	World Bank
BMA	Belem Metropolitan Area
BNDES	Brazil Development Bank
BRT	Bus Rapid Transit
CDM	Mecanismo de Desenvolvimento Limpo
CDP	Pará Dock Company
CEF	Federal Savings Bank of Brazil
CER	Certified Emission Reduction
COEMA	Para State Council of Environmental Management
COFIEX	Commission of External Financings
COHAB/PA	Para State Habitation Company
CONAMA	Federal Council of Environment
CONSEMA	State Council of Environment
CP	Public Consortium
CTBel	Transport Company of Belem Municipality
CTM	Transport Consortium of Recife Metropolitan Area
D/D	Detail Design
DEMUTRAN	Municipality Department of Transports and Traffic
DEPHAC	Department of Cultural Historic Heritage, Autistics and Cultural
DETRAN	State of Para Department of Transit
DNER	National Department of Highways
DNIT	National Department of Road Transport Infrastructure
E/N	Exchange Notes
EIA/RIMA	Environmental Impact Assessment / Environmental Impact Report
ELETRA	Eletra Industrial Ltd
FUMBEL	Cultural Foundation of Cultural Heritage of Belem
GDP	Gross Domestic Product
IBGE	Institute of Geographic and Statistics in Brazil
ICMS	State Transfer Taxi
IEE	Initial Environmental Examination
IPHAN	Federal Institute of Historic and Cultural Heritages and National Artistic
IRR	Internal Rate of Return
ISS	Municipal Service Tax
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
L/A	Loan Agreement
LI	License for Installation
LO	License for Operation
LP	Preliminary License
LRT	Light Rail Transit
METRA	Metra Metropolitan Transport System Ltd

MME	Federal Ministry of Mine and Energy
MZ	Macro Zone
NGPR	Para Rural Program Division
NGTM	Nucleus of Administration of Metropolitan Transport
NPV	Net Present Value
NUCAP	Finance Division
OD	Origin and Destination
ODA	Official Development Assistance
PCA	Environmental Control Plan
PDTU	Master Plan Study on Urban Transport in Belem
PMA	Municipal City Hall of Ananindeua
PMB	Municipal City Hall of Belém
RAP	Resettlement Action Plan
RCA	Environmental Control Report
SCF	Standard Conversion Factor
SEAIN	Department of International Affairs
SECTAM	Executive Secretariat of Science, Technology and Environmental
SECULT	Para State Secretariat of Culture, Sports and Tourism
SEFA	Para State Secretariat of Finances
SEMA	Para State Secretariat of the Environment
SEOP	Para State Secretariat of Public Works
SEPE	State Secretariat of Strategic Projects
SESAN	Belem Secretariat of Sanitation
SETRAN	Executive Secretariat of Transports
STN	Federal Secretariat of Treasury
SWR	Shadow Wage Rate
TAC	Terms of Livelihood Adjustment
TOR	Term of Reference
TTC	Travel Time Cost
UFPA	Federal University of Para
UNAMA	Amazonia University
VAT	Value Added Tax
VOC	Vehicle Operating Cost

Outline of the Study

OUTLINE OF THE STUDY

1. BACKGROUND OF THE STUDY

JICA undertook the Feasibility Study on the Improvement of Transport System in the Metropolitan Area of Belem (hereafter referred to as the F/S Study) in 2003. After the completion of the F/S Study in 2003, the proposed transport system project did not go into immediate implementation. In 5 years after the completion of the F/S Study, the socio-economic and transport conditions in the study area changed substantially, and it was thought necessary to update the study. The Para State Government, after consultation with the municipalities of Belem and Ananindeua, requested JICA for an updating study.

Through consultations with the related government departments and other agencies, JICA became aware of the importance of the requested study and understood the urgent need of reviewing the entire project in the updated socio-economic context. In order to expedite uninterrupted and efficient preparations toward project implementation, JICA agreed to undertake the Preparatory Survey for Belem Metropolitan Bus Transport System Project in the Federative Republic of Brazil (hereafter referred to as the Study).

2. PURPOSE OF THE STUDY

The purpose of the present Study is to review and update the F/S Study and collect the relevant information needed for applying the transport system improvement project to the Japan's ODA Loan. The Study reviews the appropriateness of the component projects, narrows them down to those financeable by JICA and prepares documentary information needed for JICA approval.

3. PROJECTS STUDIED

The study projects and suitable project for Japan's ODA loan are shown below.

1) Distribution of Projects Selected for Review

The selected project is the trunk bus system projects.

- Roads for trunk bus introduction: Av. Almirante Barroso, BR-316, Av. Augusto Montenegro, Av. Independencia, Av. Mario Covas, trunk bus priority lanes in the Centro of Belem and in Icoaraci

2) Projects Suitable for Japan's ODA Loan

The projects judged suitable for Japan's ODA Loan concern the trunk bus system, but exclude Av. Independencia and Av. Mario Covas in order to expedite the project implementation as early as possible. They are grouped as Y-net projects because of their Y shape on the road network. Av. Independencia is omitted from next consideration. If the avenue is included, the total amount of borrowing will exceed the ceiling set for a State Government to apply for external loans.

- Projects suitable for Japan's ODA Loan: Av. Almirante Barroso, BR-316, Av. Augusto Montenegro, trunk bus priority lanes in the Centro and in Icoaraci

3) Projects Financeable by Japan's ODA Loan

The Y-net projects are narrowed down further to three, after excluding Av. Augusto Montenegro and trunk bus priority lanes in Icoaraci. They are grouped as I-net projects in view of their I-shape.

- Three projects for Japan's ODA Loan: Av. Almirante Barroso, BR-316 and the trunk bus priority lanes in the Centro

4. STUDY DURATION

The Study was commenced on March 2009 and completed on February 2010.

5. OUTLINE OF STUDY

The target year is 2018, with 2013 for the short term and 2025 for the long term.

(1) Proposed Trunk Bus System

Proposed trunk bus system is to provide a rapid, mass and low fare transpsit system. The trunk bus system is operated 1) on segregated busway excluded ordinary vehicles, 2) with a large articulated bus, 3) at bus stop facilities liked a railway station which segregate bus passengers from ordinary person, 4) with longer bus stop spacing than that of conventional bus, 5) in a system purchased bus ticket before boarding to take shorter boarding and alighting times, 6) in the integrated fare system without additional bus fare at transfer, and 7) by operation of new trunk bus company.

(2) Trunk Bus Facilities

The bus facilities are composed of the following.

1) Trunk Busway: trunk bus exclusive road, trunk bus exclusive lane, trunk bus priority lane are constructed.
2) Trunk Bus Terminal and Station: 4 terminals and 3 stations are constructed.
3) Bus Stop Facility: bus stops are established at every 500m to 1km of space.
4) Bus operation and maintenance facility (depot): 4 depots are constructed.

(3) Project Cost

The portion eligible for JICA financing totals ¥22,479 million, including payments of interests and commissions during construction. The cost of Package 1-2 (the remainder of the Y-net development) is estimated by adding price escalation, physical contingency, administration cost, taxes and payments of interests and commissions. Table 1 summarizes the cost estimation in terms of the foreign and the local currency components. The expected JICA loan would account for 43.9% of the total cost of the Y-net development.

Table 1 Project Cost for Phase I: Y Shape

Items	Total		
	Foreign Currency (Million JPY)	Local Currency (Million BRL)	Total (Million JPY)
JICA Finance Portion	2,017	491	22,479
Brazil Portion	0	689	28,677
Total	2,017	1,180	51,156

(4) Project Implementation

The implementation scheduling should be completed by 2013.

(5) Trunk Bus Operation and Management

In consultation with relevant organizations, NGTM of the state government has been working on the organizational structure and policy of the public consortium. The basic assumptions are as follows.

1) The State Government of Para and the participating municipalities jointly set up a public consortium.

2) The state government invests in the construction of infrastructure and facilities necessary to run the trunk bus services.

3) The public consortium formulates the plan of trunk bus operation.

4) A private bus company is licensed to run the trunk bus services.

(6) Environmental and Social Consideration

The trunk bus system proposed in the present Study is to be operated on the existing arterial roads. In this respect, it is arguably suggested that the system will be unlikely to add some adverse impact of appreciable magnitude upon the present roadside environment. The State Secretariat of Environmental Management (SEMA) is aware that the proposed system will bring only a minor impact on the roadside environment. While the present Study was on going, the secretariat in fact decided to apply the PCA (Environmental Control Plan) procedures for environmental licensing (LI: Installation License), which is less complicated than the EIA (environment impact assessment) procedures.

The conclusion at this stage is that the implementation of the trunk bus system will bring impacts of some adverse import on the environment but that the impacts will be of the kinds effectively actionable by appropriate measures.

As for involuntary resettlement, because the development of trunk bus routes is proposed on the existing roads, the implementation does not call for sizable land acquisition and resettlement of local inhabitants. However, the land appropriation at some sites for bus terminals and stations, bus depots and the interchange will require small-scale relocation.

(7) Economic and Financial Evaluation

1) The project proposed for Belem shows a high 18.9%, indicating satisfactory feasibility. The sensitivity analysis shows that the project feasibility would not be seriously affected either by a 80% increase in cost or a 36% drop in benefit. In case of only Y-net projects, the economic internal rate of return would be 13.8%, appreciably higher than 12%.

2) The financial analysis of the entire project estimates the F-IRR of 6.6%. The rate suggests that the project would be implementable as a non-profit public service by the government authorities with a concessional ODA loan as Japan’s ODA Loan. However, the rate is too low to justify the private sector investment inclusive of infrastructure development.

3) By using the PPP scheme in which the government takes care of the necessary infrastructural development and the private interest operates the trunk bus service, the project is expected to have a high internal rate of return, 22.6% after tax.

4) In case of only Y-net projects, the economic IRR would be down to 13.8%, while the running of the bus company under the PPP scheme would drop from the F-IRR of 38.1% to 27.7%. Both the economic and the financial feasibility of the project remain adequate nonetheless.

(8) GHGs Emission Reduction

1) The total emission reduction by the CDM implementation of the trunk bus project is 360,900 t/CO2eq. The annual average emission is 36,090 t/CO2eq.

2) Assuming the credited ratio of 50% as ascertained by the monitoring and the deduction of two commissions, the expected acquisition of CER will vary from US$0.5 to 3.2 million.

CHAPTER 1
Background

1. BACKGROUND

1.1. BACKGROUND OF THE STUDY

The metropolitan area of Belem consists of five cities in the northern part of the Federal Republic of Brazil. The five municipalities of Belem, Ananindeua, Marituba, Benevides and Santa Barbara do Para have the aggregated population of about 2.05 million. In recent years, urbanization and population growth have been especially pronounced in Ananindeua.

In 2002, approximately 75% of the peak-hour passengers used bus transport in the metropolitan area of Belem. The public transport by bus had been very important for the metropolitan livelihood but suffering from the growing congestion and severe traffic slowdowns. The public transport system had been inadequately managed and inefficiently operated in the face of the expanding demand. Moreover, the bus fleet in operation were mostly antiquated and regarded as one of the causes of air pollution by their emissions.

The Government of the State of Para realized the urgent need of a project which would serve to improve the problem of public transport in the metropolitan area of Belem and requested JICA to work on such a project. JICA subsequently agreed to undertake the Feasibility Study on the Improvement of Transport System in the Metropolitan Area of Belem (hereafter referred to as the F/S Study) in 2003. The F/S Study covered a number of road projects and the bus transport improvement, which would contribute together to the systemic improvement of urban transport in the metropolitan area.

After the completion of the F/S Study in 2003, the proposed transport system project was formally approved and renamed as VIAMETROPOLE by the Para State Government, but did not go into immediate implementation. In 5 years after the completion of the F/S Study, the socio-economic and transport conditions in the study area changed substantially, and it was thought necessary to update the study. The Para State Government, after consultation with the municipalities of Belem and Ananindeua, requested JICA for an updating study.

Through consultations with the related government departments and other agencies, JICA became aware of the importance of the requested study and understood the urgent need of reviewing the entire project in the updated socio-economic context. In order to expedite uninterrupted and efficient preparations toward project implementation, JICA agreed to undertake the Preparatory Survey for Belem Metropolitan Bus Transport System Project in the Federative Republic of Brazil (hereafter referred to as the Study).

1.2. PURPOSE AND SCOPE OF THE STUDY

(1) Purpose of the Study

The purpose of the present Study is to review and update the F/S Study and collect the relevant information needed for applying the transport system improvement project to the Japan's ODA Loan. The Study reviews the appropriateness of the component projects, narrows them down to those financeable by JICA and prepares documentary information needed for JICA approval.

(2) Study Area

The study area consists of three municipalities of Belem, Ananindeua and Marituba in the metropolitan area of Belem.

(3) Target Years

The target year is 2018, with 2013 for the short term and 2025 for the long term.

(4) Projects Studied

The present Study selectively examines the projects proposed in the F/S Study. The projects chosen for review are nine, as shown in Table 1.2-1. They are evaluated from the viewpoint of their suitability to JICA application and then narrowed down to those financeable by the Japan's ODA Loan.

1) Distribution of Projects Selected for Review

The selected projects consist of those related to the trunk bus system and the road development projects, distributed in the study area as shown in Figure 1.2-1. The Para State Government recently applied to other lending institutions on two road projects. Accordingly, the results of their review are presented not in the main body of this study report but in the annex.

- Roads for trunk bus introduction: Av. Almirante Barroso, BR-316, Av. Augusto Montenegro, Av. Independencia, Av. Mario Covas, trunk bus priority lanes in the Centro of Belem and in Icoaraci
- Road development: Av. Joao Paulo II and Estr. de Pedreirinha

2) Five Projects Suitable for Japan's ODA Loan

The projects judged suitable for Japan's ODA Loan concern the trunk bus system, but exclude Av. Independencia and Av. Mario Covas in order to expedite the project implementation as early as possible. They are grouped as Y-net projects because of their Y shape on the road network. Av. Independencia is omitted from next consideration. If the avenue is included, the total amount of borrowing will exceed the ceiling set for a State Government to apply for external loans.

- Five projects suitable for Japan's ODA Loan: Av. Almirante Barroso, BR-316, Av. Augusto Montenegro, trunk bus priority lanes in the Centro and in Icoaraci

3) Three Projects Financeable by Japan's ODA Loan

Five Y-net projects are narrowed down further to three, after excluding Av. Augusto Montenegro and trunk bus priority lanes in Icoaraci. They are grouped as I-net projects in view of their I-shape.

- Three projects for Japan's ODA Loan: Av. Almirante Barroso, BR-316 and the trunk bus priority lanes in the Centro

(5) Methodology of Analysis and Evaluation

The scope of the Study consists of the following two parts.

1) Examination and analysis of nine selected projects
2) Analysis and evaluation of three projects financeable by Japan's ODA Loan (**Y-net projects**), including the preparation of various data and information to be submitted in JICA application

The following four chapters of the present report deal with the said scope of study.

a) Chapter 5 Passenger Demand on the Trunk Bus System: passenger demand

b) Chapter 6 Project Implementation Planning: project costing

c) Chapter 8 Environmental and Social Consideration: analysis of environmental impacts and relocation compensation for land and buildings

d) Chapter 9 Effects of Project Implementation: project impacts and economic and financial analysis

e) Chapter 10 CDM Project Application: analysis and calculation of GHGs emission reduction

Table 1.2-1 Process of Project Selection for Japan's ODA Loan

Road Name	Trunk Bus Introduction	Terminal Station	Fleet Depot	Projects Selected for Review	Projects for Japan's ODA Loan	Projects Financeable by Japan's ODA Loan	Color Shown In Figure 1.2-1
1. Trunk Bus Introduced Roads:							
1) Av. Almirante Barroso	Exclusive lanes			○	○	●	Orange
2) BR-316	Exclusive road	Marituba, Aguas Lindas	Marituba	○	○	●	Red
3) Av. Augusto Montenegro	Exclusive road	Tapana, Mangueirao		○	○		Red
4) Icoaraci Area	Priority lanes	Icoaraci	Icoaraci	○	○		Green
5) Centro Area	Priority lanes			○	○	●	Green
6) Av. Independencia	Priority lanes	Cidade Nova	Cidade Nova	○			Green
7) Av. Mario Covas	Priority lanes	Conqueiro	Conqueiro	○			Green
2. Road Development Projects:							
8) Av. Joao Paulo II				○			Pink
9) Estrada Pedreirinha				○			Pink

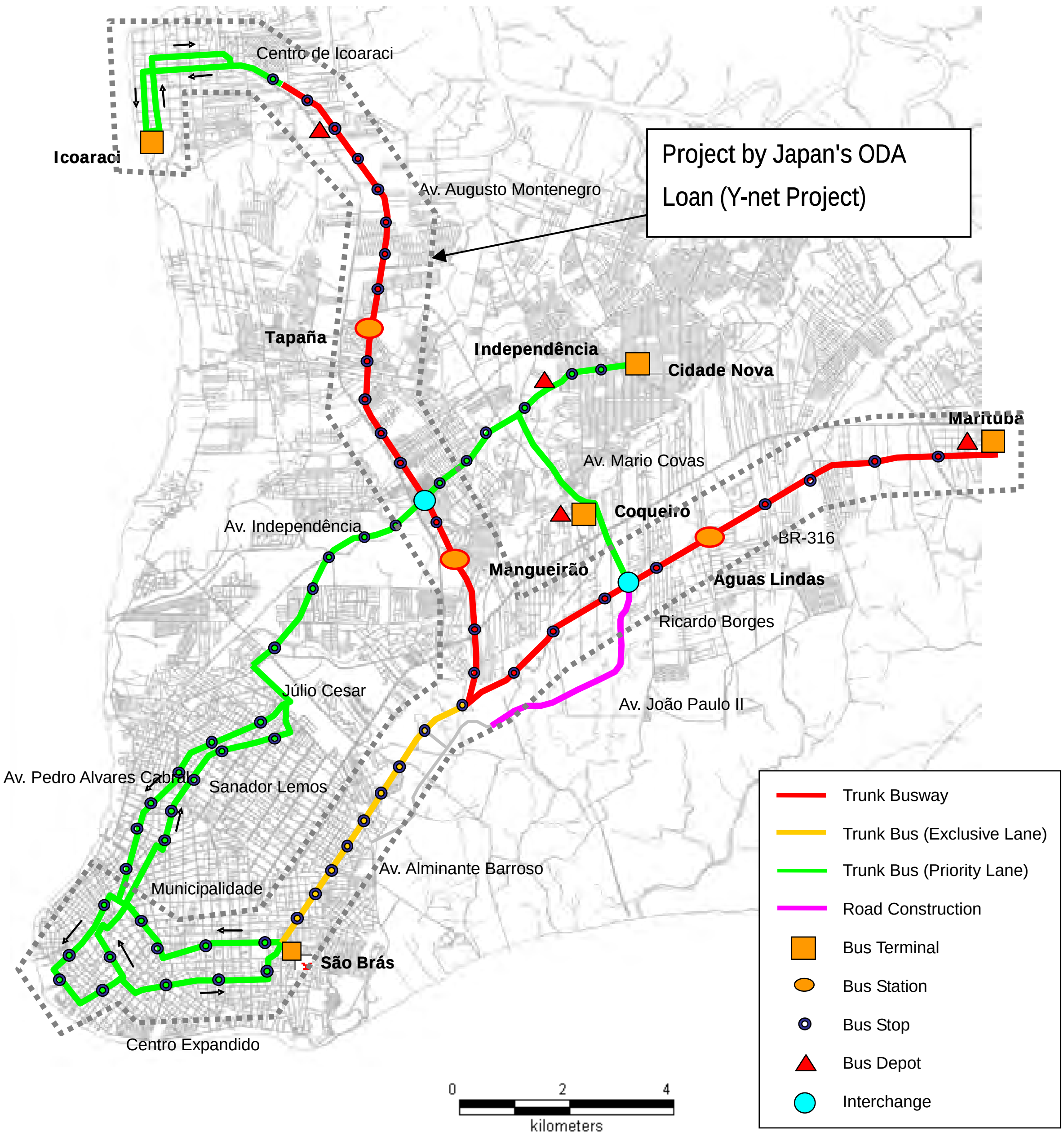


Figure 1.2-1 Location of Projects Selected for Review

1.3. OUTLINE OF THE STUDY

The schedule of the Study per task is shown by the flow chart in Figure 1.3-1.

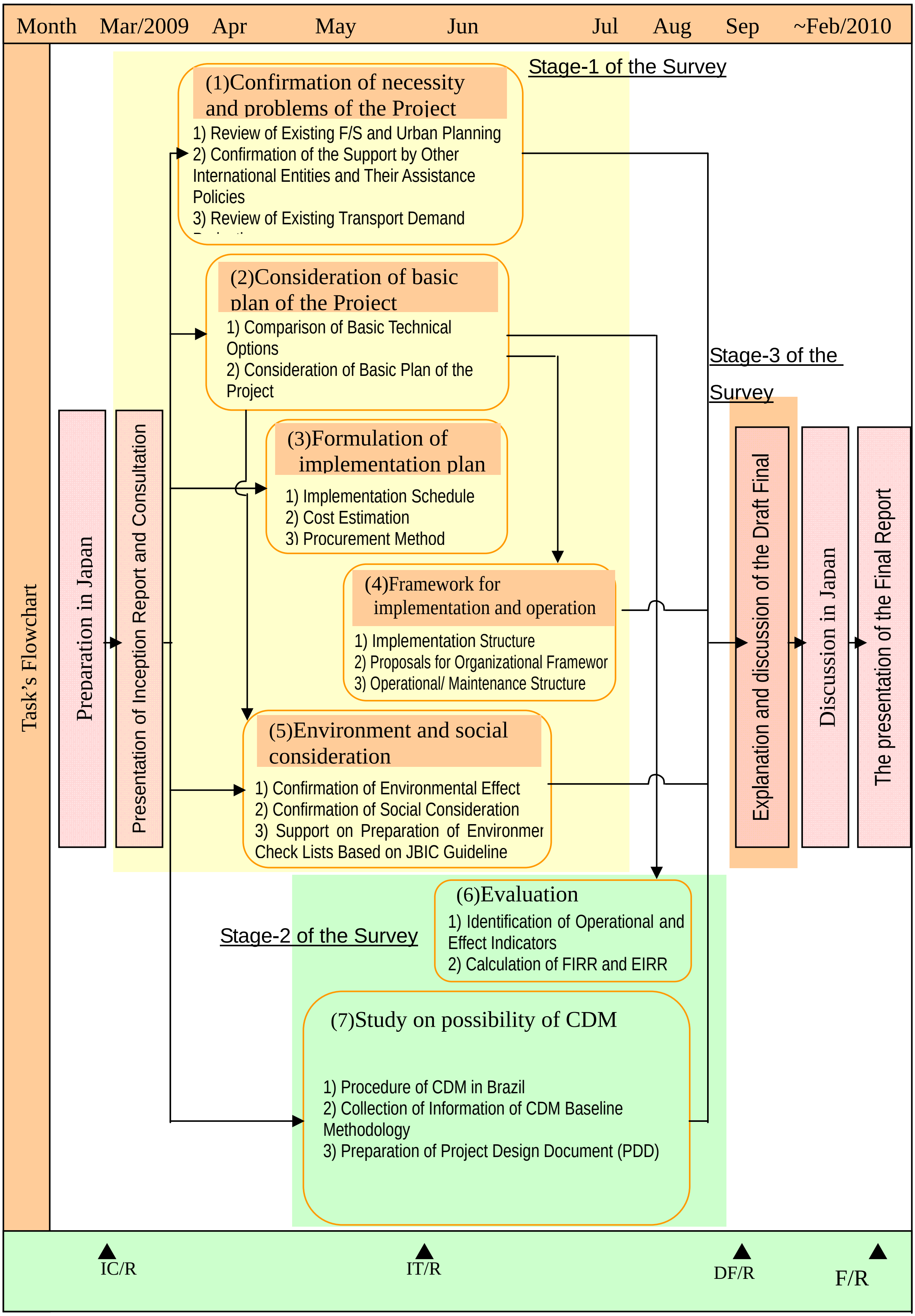


Figure 1.3-1 Flow Chart of the Study

CHAPTER 2
General Conditions In The Study Area

2. GENERAL CONDITIONS IN THE STUDY AREA

2.1. SOCIO-ECONOMIC CONDITIONS

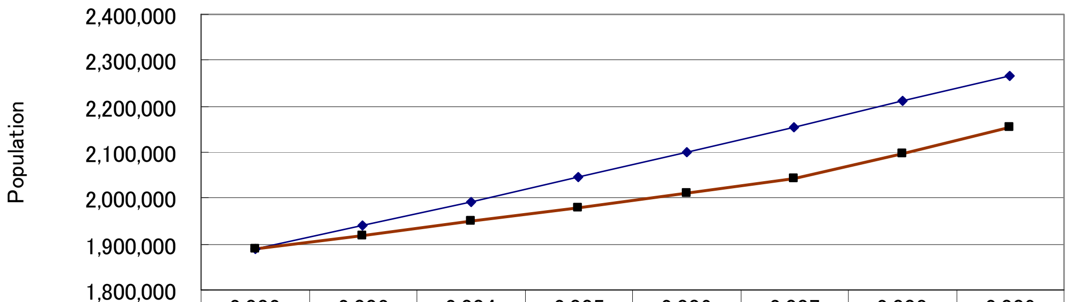
The Study traces demographic and socio-economic changes since 2003 when the F/S Study was conducted and adjusts the frame used for forecast by the latter. Socio-economic data after 2002 are collected and compared with the F/S forecast. The differences are analyzed and used to update the forecast of the future socio-economic trend.

(1) Population

In 2007, the Institute of Geographic and Statistics in Brazil (IBGE) carried out a national household sample survey called Pesquisa Nacional de Amostragem Domiciliar (PNAD) and used the findings to estimate the municipal populations of Benevides, Marituba and Santa Barbara do Paras, among others. IBGE otherwise estimated the populations of Belem and Ananindeua. Table 2.1-1 shows the populations of five municipalities in 2007. The demographic trend of their aggregate population since 2002 is compared with the forecast by the F/S Study in Figure 2.1-1. The night time population for 2009 is estimated from the 2007 figure by applying the growth rate per annum during 2000 – 2010 as estimated by PDTU2001. The annual figures in between 2002 and 2007 are then interpolated. The aggregate population in the study area (five municipalities) has been growing at a slower pace than the forecast of the F/S Study.

Table 2.1-1 Populations of Five Municipalities in 2007

Municipality	Population in 2007
Belem	1,408,847
Ananindeua	484,278
Marituba	93,416
Benevides	43,282
Santa Bárbara do Pará	13,714
Total	2,043,537



	2,002	2,003	2,004	2,005	2,006	2,007	2,008	2,009
2003F/S	1,888,959	1,939,469	1,991,330	2,044,578	2,099,250	2,155,383	2,210,617	2,267,266
This Study	1,888,959	1,918,910	1,949,335	1,980,243	2,011,641	2,043,537	2,097,691	2,153,280

Year

2003F/S This Study

Figure 2.1-1 Growth of Population: Comparison between the Present Study and the 2003 F/S

(2) Per Capita GRDP

IBGE calculated the nominal GRDPs during 2003 – 2006 of five municipalities in the metropolitan area of Belem. By using the deflator derived from the nominal and the real GDPs up to 2008 given by the Central Bank of Brazil (BCB), the real GRDPs during 2003 - 2006 are calculated for the respective municipalities (Table 2.1-2). Per capita GRDP of the metropolitan area grew by 4.1% per annum over the period.

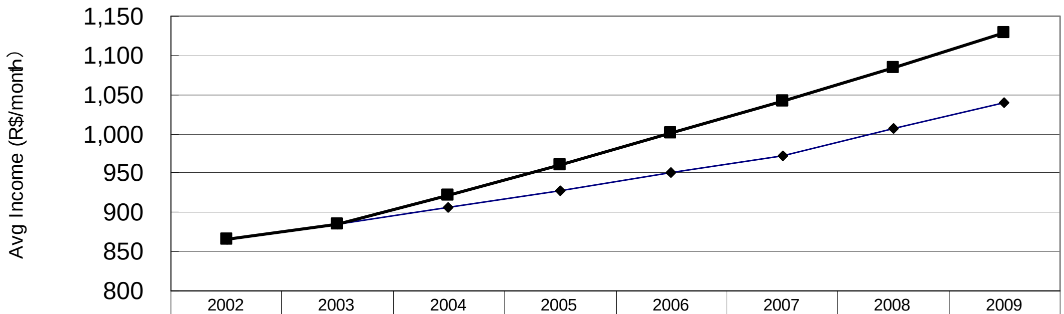
Table 2.1-2 Growth of Per Capita GRDP (2003 – 2006)

Year		2003	2004	2005	2006
Real GDP (1,000R$)	Ananindeua	1,528,819	1,890,013	2,172,091	2,465,657
	Belem	8,838,679	10,348,720	11,277,478	12,520,332
	Benevides	144,302	163,073	218,864	327,260
	Marituba	226,910	287,692	303,285	324,224
	Sta. Barbara	33,186	32,991	36,415	42,678
	Total	10,771,896	12,722,489	14,008,133	15,680,151
Deflator[1)]		0.7406	0.8001	0.8578	0.9105
Nominal GRDP (1,000R$)		14,545,096	15,900,863	16,330,346	17,220,544
Population[2)]		1,918,910	1,949,335	1,980,243	2,011,641
Per Capita GRDP (R$)		7,580	8,157	8,247	8,560

Notes: 1) 2008 price
2) JICA team estimates

(3) Monthly Household Income

The monthly household income for 2009 is obtained by applying the annual growth rate of per capita GRDP (4.1%) to the 2003 income figure used by the F/S Study. Figure 2.1-2 compares the growth of monthly income between the present Study and the 2003 F/S Study. The average household income estimated by the present Study is R$1,130 per month in 2009, higher by 8.6% than the estimate given in the F/S Study.



	2002	2003	2004	2005	2006	2007	2008	2009
2003F/S	865	886	907	928	950	973	1,006	1,040
This Study	865	886	922	960	1,000	1,042	1,085	1,130

year

2003F/S This Study

Figure 2.1-2 Growth of Monthly Household Income: Comparison between the Present Study and the 2003 F/S Study

(4) Socio-economic Trend after the 2003 F/S Study

The foregoing comparison in terms of demography and income indicates the nature of the change that took place since 2003. As summarized in Table 2.1-3, the night time population for 2009 is smaller by 5.0% than the F/S forecast, whereas the average monthly income is higher by 8.6%. The annual growth of night time population drops by 0.8 point, while that of monthly income rises by 1.2 points. The aggregate population of the study area grew more slowly than the F/S forecast, whereas the average income increased more rapidly.

Table 2.1-3 Comparison of Basic Socio-economic Indicators

		2002	2009	2009/2002	Annual Growth Rate
Population	2003 F/S	1,888,959	2,267,266	1.20	2.6%
	Present Study	1,888,959	2,153,280	1.12	1.9%
	Difference	0.0%	-5.0%	-	-0.8 point
Average Household Income (R$ /month)	2003 F/S	865	1,040	1.20	2.7%
	Present Study	865	1,130	1.31	3.9%
	Difference	0.0%	+8.6%	-	+1.2 points

(5) Population by Macro Zone

The distribution of population in 2009 is shown in Figure 2.1-3, in which OD zones are integrated into macro zones. The most populous macro zone is Cidade Nova with its population of 273,000, followed by Guama (264,000), Bengui (200,000) and Sacramenta (195,000). The least populated macro zone is Ilhas with only 500 inhabitants, followed by Embrapa (2,000) and Aura (3,000).

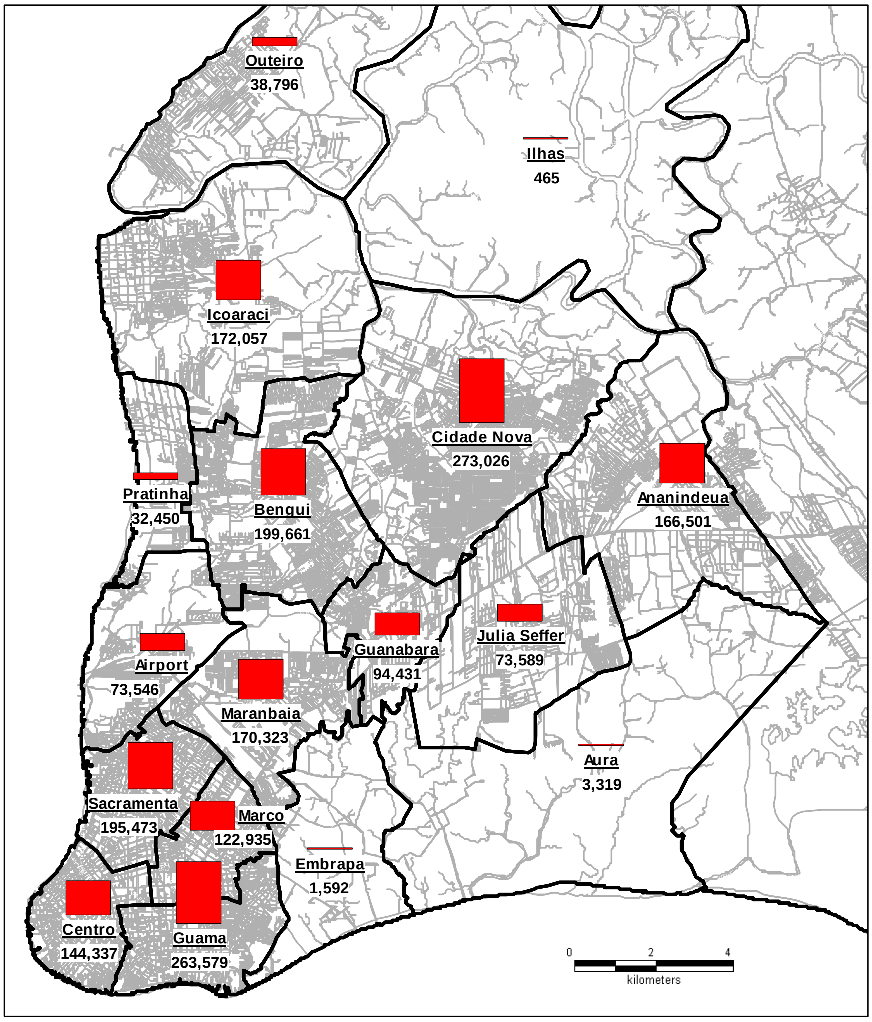


Figure 2.1-3 Population Distribution by Macro Zone in 2009

2.2. PRESENT TRAFFIC CONDITIONS

2.2.1. SUPPLEMENTARY TRAFFIC SURVEY

(1) Outline of the Survey

In order to update the 2002 data of traffic conditions, the supplementary survey was carried out in two ways: namely, the screen and the cordon line survey and the traffic counting at selected spots on major arterials

The vehicular and the passenger traffic volumes were observed across the screen and the cordon lines. In addition, vehicular traffic volume was surveyed at the observation spots on the major arterial roads. The scope of the survey largely conformed to the F/S Study. The number of modes, however, was increased to eight from seven in the F/S Study. It was deemed necessary to understand the traffic behavior of vans known as combi which were increasingly used for busing people without proper registration. The survey took four months.

1) Observation spots: 13 in total (8 spots on two screen lines, 3 spots on the cordon line and 2 spots on major arterials)
2) Subjects of observation: modal vehicular and passenger traffic (8 modes)
3) Duration of observation: 24 hours at 4 spots, 14 hours (6:00 ~ 20:00) at 9 spots

Figure 2.2-1 shows the counting locations which are in the same spots as in the F/S Study to ensure the comparability of traffic data.

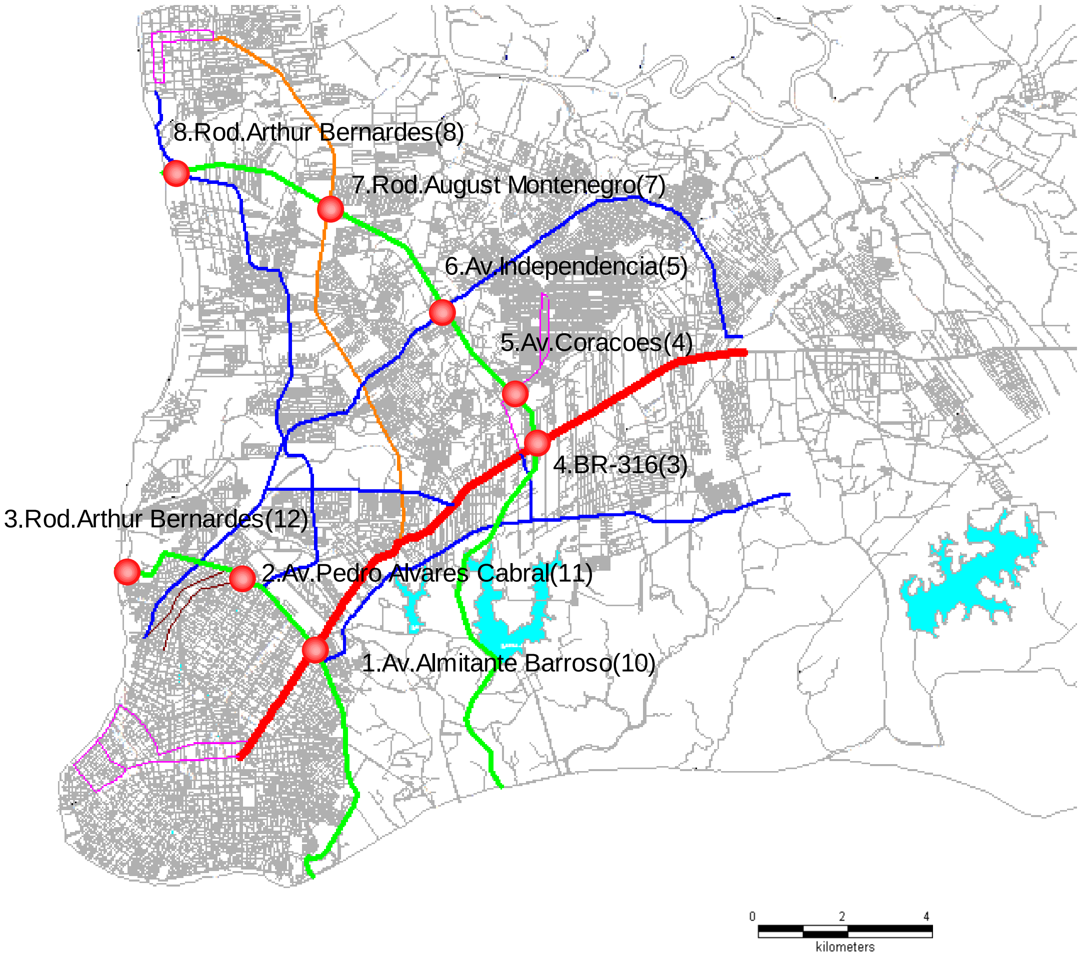


Figure 2.2-1 Two Screen Line Locations of the Supplementary Survey

(2) Traffic Volume Crossing Two Screen Lines

1) Daily Traffic

The daily traffic (24 hours) of vehicles and passengers counted at 8 spots on two screen lines are tabulated by route, direction and mode in Table 2.2-1. In addition, the average passenger occupancy per vehicle is calculated by direction and mode and shown in the same table.

On Screen Line-1, the daily vehicle traffic is about 86,000 inbound and about 85,000 outbound, totaling 170,000 vehicles. On Screen Line-2, the total daily traffic is 194,000 vehicles, inbound 98,000 and outbound 95,000. The daily traffic across Screen Line-2 is larger by 12,000 vehicles inbound and 11,000 vehicles outbound, or a total of 23,000, than the traffic across Screen Line-1.

The daily passenger volume, on the contrary, is larger on Screen Line-1, numbering 439,000 inbound and 458,000 outbound, totaling 897,000 persons. The data on Screen Line-2 are 410,000 inbound and 408,000 outbound, totaling 818,000 passengers. The passengers crossing Screen Line-1 are larger by 30,000 inbound and 50,000 outbound, totaling 80,000 persons.

The average occupancy per vehicle across Screen Line-1 is 1.8 – 2 persons for passenger car, about 35 passengers for bus, 14 – 16 for microbus and 6 – 8 for combi/van. The data across Screen Line-2 are 1.9 persons for passenger car, 41 – 43 passengers for bus, 15 for microbus and 9 for combi/van.

To sum up the comparison, the occupancy of public transport (bus) is significantly larger across Screen Line-2 than Screen Line-1.

2) Hourly Traffic

The hourly vehicle traffic volume during 14 hours (6:00 – 20:00) of counting is shown by direction across two screen lines (Figures 2.2-2 and 2.2-3). Table 2.2-2 shows the vehicles and the passengers crossing two screen lines during the morning (7:00 – 8:00) and the evening (18:00 – 19:00) peak hour.

The inbound traffic volume across Screen Line-1 peaks in the morning hour from 7:00 to 8:00 during 14 hours of counting, reaching 7,900 vehicles (peak ratio of 9.3%) and 63,400 passengers (peak ratio of 14.4%).

Similarly, the inbound traffic volume across Screen Line-2 peaks in the morning hour, reaching 8,400 vehicles (peak ratio of 8.5%) and 45,700 passengers (peak ratio of 11.2%).

Table 2.2-1 Vehicle Traffic Volume and Average Occupancy per Vehicle across Screen Lines

	Location Number	Direction	P.Car / Van	Bus	Micro Bus	Combi / Van	Truck	Taxi	Motor cycle	Bicycle	Total
(1) 24 hours Vehicle Volume											
Screen - 1	1	Inbound	29,307	5,424	1,348	1,672	1,611	1,472	3,223	2,183	46,240
		Outbound	30,787	5,503	1,412	2,058	2,219	2,161	4,292	2,335	50,767
	2	Inbound	20,489	1,946	63	997	1,703	1,826	2,906	952	30,882
		Outbound	15,987	1,951	149	723	1,121	1,908	2,623	1,117	25,579
	3	Inbound	4,963	460	24	191	449	686	1,083	680	8,536
		Outbound	4,466	476	16	211	408	779	1,139	668	8,163
	Total	Inbound	54,759	7,830	1,435	2,860	3,763	3,984	7,212	3,815	85,658
		Outbound	51,240	7,930	1,577	2,992	3,748	4,848	8,054	4,120	84,509
Screen - 2	4	Inbound	21,417	2,144	778	2,917	4,881	751	3,719	1,430	38,037
		Outbound	20,787	2,137	863	2,480	4,940	708	3,472	1,547	36,934
	5	Inbound	11,240	774	648	698	523	927	1,924	365	17,099
		Outbound	10,981	875	480	351	457	736	1,630	540	16,050
	6	Inbound	7,510	117	25	309	607	532	2,431	2,921	14,452
		Outbound	6,248	135	13	321	466	413	2,165	2,266	12,027
	7	Inbound	13,106	939	612	1,846	1,576	510	3,051	1,614	23,254
		Outbound	13,811	1,094	721	2,056	1,752	540	3,574	1,607	25,155
	8	Inbound	2,163	205	27	289	356	211	1,025	1,057	5,333
		Outbound	2,078	206	12	299	351	234	1,059	1,009	5,248
	Total	Inbound	55,436	4,179	2,090	6,059	7,943	2,931	12,150	7,387	98,175
		Outbound	53,905	4,447	2,089	5,507	7,966	2,631	11,900	6,969	95,414
(2) 24 hours Passenger Volume											
Screen - 1	1	Inbound	53,600	216,878	18,576	11,890	3,335	2,693	3,223	2,183	312,378
		Outbound	67,277	203,239	23,397	20,946	4,510	4,198	4,292	2,335	330,194
	2	Inbound	39,499	39,749	703	3,325	4,045	3,432	2,906	952	94,611
		Outbound	26,599	56,515	2,032	2,404	2,631	4,032	2,623	1,117	97,953
	3	Inbound	7,999	19,314	326	624	940	1,152	1,083	680	32,118
		Outbound	7,590	17,485	52	550	945	1,478	1,139	668	29,907
	Total	Inbound	101,098	275,941	19,605	15,839	8,320	7,277	7,212	3,815	439,107
		Outbound	101,466	277,239	25,481	23,900	8,086	9,708	8,054	4,120	458,054
Screen - 2	4	Inbound	40,177	86,792	9,823	23,240	8,658	1,126	3,719	1,430	174,965
		Outbound	42,574	89,633	13,802	27,856	10,544	1,847	3,472	1,547	191,275
	5	Inbound	22,568	35,131	9,807	5,209	1,196	1,597	1,924	365	77,797
		Outbound	20,737	36,010	8,814	2,474	957	1,142	1,630	540	72,304
	6	Inbound	15,680	6,214	399	2,214	1,240	809	2,431	2,921	31,908
		Outbound	9,793	3,697	43	758	1,009	717	2,165	2,266	20,448
	7	Inbound	25,085	39,360	10,434	21,445	3,554	769	3,051	1,614	105,312
		Outbound	24,458	44,288	9,025	16,555	3,595	986	3,574	1,607	104,088
	8	Inbound	3,963	10,190	223	2,223	701	362	1,025	1,057	19,744
		Outbound	4,039	9,417	164	2,837	744	407	1,059	1,009	19,676
	Total	Inbound	107,473	177,687	30,686	54,331	15,349	4,663	12,150	7,387	409,726
		Outbound	101,601	183,045	31,848	50,480	16,849	5,099	11,900	6,969	407,791
(3) Average Occupancy											
Screen - 1	Total	Inbound	1.85	35.24	13.66	5.54	2.21	1.83	1.00	1.00	
		Outbound	1.98	34.96	16.16	7.99	2.16	2.00	1.00	1.00	
Screen - 2	Total	Inbound	1.94	42.52	14.68	8.97	1.93	1.59	1.00	1.00	
		Outbound	1.88	41.16	15.25	9.17	2.12	1.94	1.00	1.00	

Table 2.2-2 Peak Hour Traffic across Screen Lines and Peak Ratio

Screen Line	Types	Direction	Peak Hour	Volume (Peak Hour)	Volume (24hr)	Peak Ratio by 24hr
1	Vehicles	Inbound	7:00-8:00	7,932	85,658	9.3%
		Outbound	18:00-19:00	6,646	84,509	7.9%
	Passengers	Inbound	7:00-8:00	63,368	439,107	14.4%
		Outbound	18:00-19:00	49,734	458,054	10.9%
2	Vehicles	Inbound	7:00-8:00	8,359	98,175	8.5%
		Outbound	17:00-18:00	7,122	95,414	7.5%
	Passengers	Inbound	7:00-8:00	45,721	409,726	11.2%
		Outbound	18:00-19:00	32,947	407,791	8.1%

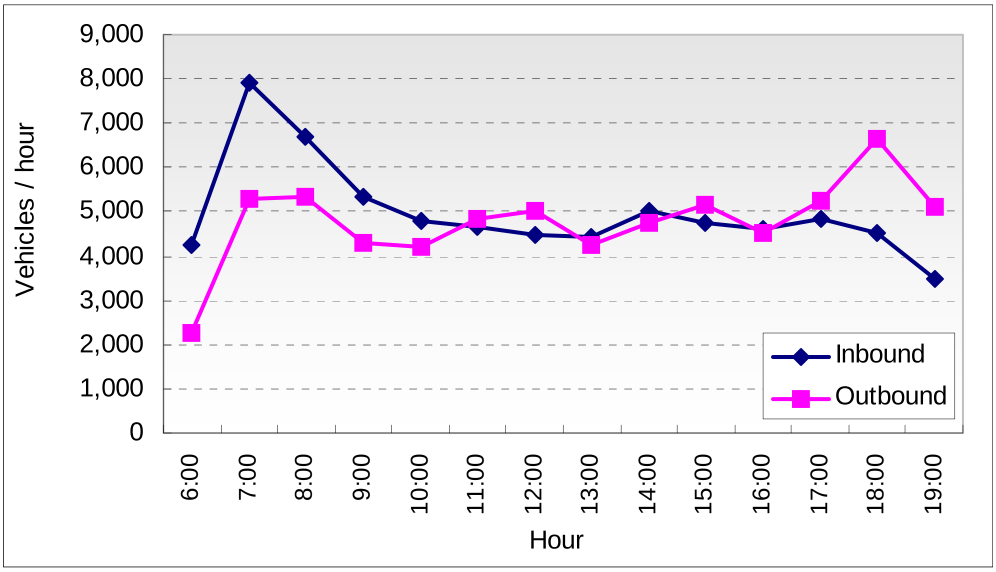


Figure 2.2-2 Hourly Vehicle Traffic across Screen Line-1 during 14 Hours

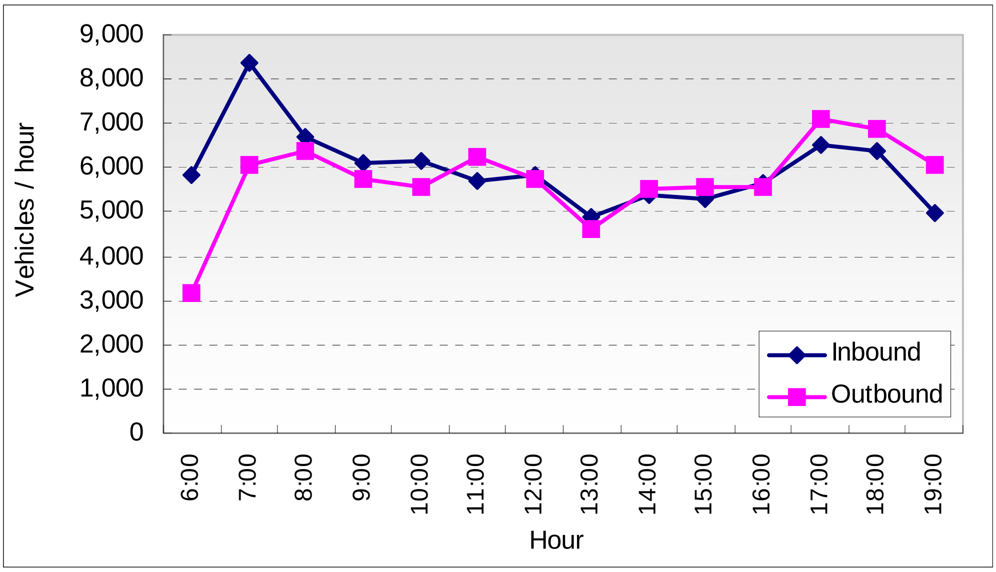


Figure 2.2-3 Hourly Vehicle Traffic across Screen Line-2 during 14 Hours

3) Mode Shares

a) Total Daily Traffic

Figure 2.2-4 shows the mode shares of the passenger volume during 24 hours of counting inbound across two screen lines. Across Screen Line-1, 70% of the daily passenger traffic volume is carried by three types of buses and 25% by passenger cars and taxis. The same data across Screen Line-2 are 64% and 27%.

The fact that the various buses carry the bulk of passengers, accounting for well over 60%, applies to both of the screen lines. The difference is found in the shares among bus types. Across Screen Line-1, the share of bus is overwhelmingly large. Across Screen Line-2, the shares of microbus and combi/van are appreciably larger than across Screen Line-1. It is clear that the passenger preference differs between two screen lines.

b) Peak Hour Traffic

The inbound passenger traffic volume across Screen Line-1 during the morning peak hour is predominated by three types of buses, accounting for 82% of the total. The share of passenger cars and taxis is 15%. The same data across Screen Line-2 are 71% and 22%.

To sum up, the aggregate share of buses is appreciably higher, and that of passenger car and taxi is lower, in the morning peak hour than in the daily total. The reliance on public transport is more pronounced during the peak hour.

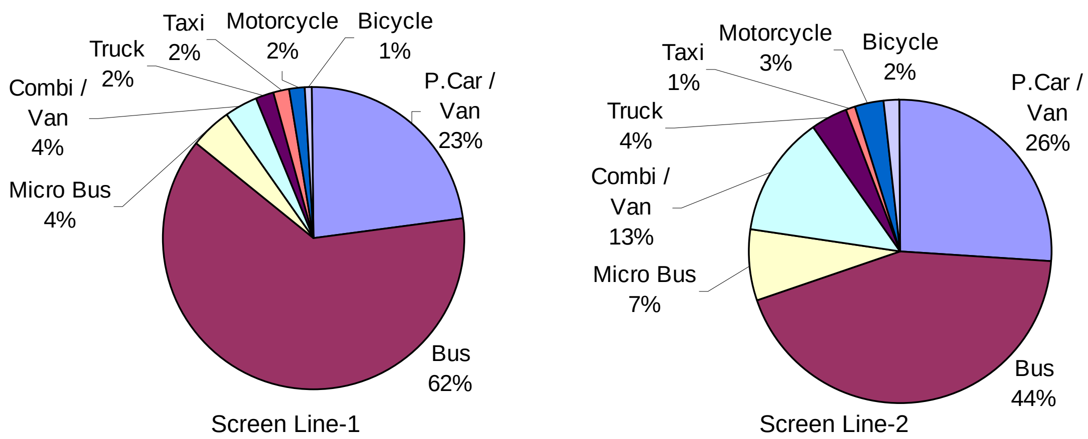


Figure 2.2-4 Mode Shares of Daily Inbound Passengers (24 Hours)

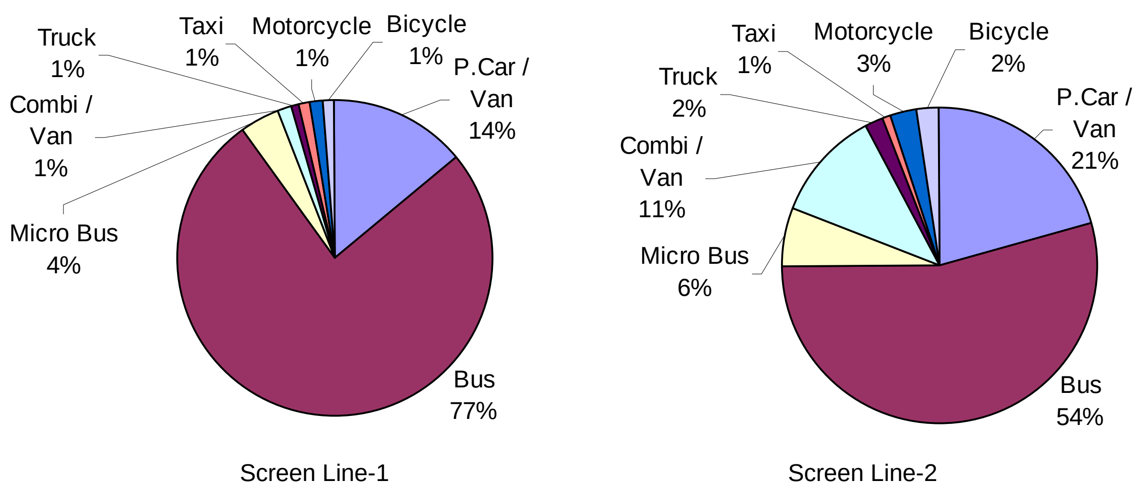


Figure 2.2-5 Mode Shares of Inbound Passengers during Morning Peak Hour

(3) Traffic Volume on Major Arterials

Tables 2.2-3 and 2.2-4 show the daily traffic volume of vehicles and passengers on three arterials of Av. Almirante Barroso, BR-316 and Av. Augusto Montenegro. Tables 2.2-5 and 2.2-6 show the peak hour inbound traffic of vehicles and passengers. The survey findings are described for each of the arterials.

1) Av. Almirante Barroso

The daily traffic volume on Av. Almirante Barroso totals 97,000 vehicles, consisting of 46,200 inbound and 50,800 outbound. The mode composition of the vehicular traffic is 66% for car and taxi and 18% for bus, microbus and combi/van. In terms of passengers, the total daily traffic is

642,600 persons, consisting of 312,400 inbound and 330,200 outbound. 77% of the passengers travel by three types of buses and 20% by car and taxi.

The inbound traffic during the morning peak hour (7:00 – 8:00) is 4,100 vehicles (peak ratio of 8.9%), of which 62% is made up by passenger cars and taxis and 14% by various buses. In terms of passengers, the inbound traffic totals 45,600 persons (peak ratio of 14.6%), with 87% shared by various buses and 10% by cars and taxis. The inbound flow of passengers is appreciably more concentrated in the peak hour than the vehicular traffic.

2) BR-316

The daily traffic reaches 75,000 vehicles, of which 38,000 are inbound and 36,900 outbound. Cars and taxis account for 58% and various buses make up 15%. The passengers reach 366,200 persons per day, of which 175,000 are inbound and 191,300 outbound. 69% of the passengers rely on various bus services and 23% rode cars and taxis.

During the morning peak hour, the inbound vehicles add up to 2,800 (peak ratio of 7.4%), of which cars and taxis make up 49% and various buses 16%. The inbound passengers total 19,000 persons (peak ratio of 10.8%), of which 76% travel by buses and 18% by cars and taxis. The hourly traffic records during 14 hours show that the inbound passengers are at the peak during three hours from 6:00 to 9:00 in the morning and that the outbound passengers during three hours from 17:00 to 20:00.

3) Av. Augusto Montenegro

The avenue shows a total daily traffic of 48,400 vehicles, 23,300 inbound and 25,200 outbound. Cars and taxis account for 58% and various buses 15%. The passengers total 209,400 persons per day, 105,300 inbound and 104,100 outbound. The aggregate share of buses is 67% and that of cars and taxis 24%.

The inbound traffic during the morning peak hour totals 2,000 vehicles (peak ratio of 8.5%), of which 59% is cars and taxis and 10% buses. The passengers are 11,000 persons (peak ratio of 10.5%), of which 74% travel by buses and 19% by cars and taxis.

The hourly traffic data during 14 hours show that the inbound peaking occurs during two morning hours from 6:00 to 8:00 and that the outbound peaking is found during four hours from 17:00 – 21:00. The observation spot on the avenue is located closer to the suburbs than the ones set up on two other arterials. For this reason, the peaking of the inbound passenger traffic in the evening is a little more pronounced than on two other arterials mentioned above. Because of the longer distance of the suburbs from the city center, the peaking of passenger traffic starts early in the morning and lasts longer in the evening on the avenue.

Table 2.2-3 Daily Vehicle Traffic on Three Arterial Roads

Name		Location Number	Direction	P.Car / Van / Taxi	Bus / Micro Bus / Combi / Van	Truck / Others	Bicycle	Total
Av.Almirante Barroso		1	Inbound	30,779	8,444	4,834	2,183	46,240
		1	Outbound	32,948	8,973	6,511	2,335	50,767
		1	Total	63,727	17,417	11,345	4,518	97,007
	Vehicle Composition	1	Inbound	67%	18%	10%	5%	100%
		1	Outbound	65%	18%	13%	5%	100%
		1	Total	66%	18%	12%	5%	100%
BR-316		4	Inbound	22,168	5,839	8,600	1,430	38,037
		4	Outbound	21,495	5,480	8,412	1,547	36,934
		4	Total	43,663	11,319	17,012	2,977	74,971
	Vehicle Composition	4	Inbound	58%	15%	23%	4%	100%
		4	Outbound	58%	15%	23%	4%	100%
		4	Total	58%	15%	23%	4%	100%
Av. Augusto Montenegro		7	Inbound	13,616	3,397	4,627	1,614	23,254
		7	Outbound	14,351	3,871	5,326	1,607	25,155
		7	Total	27,967	7,268	9,953	3,221	48,409
	Vehicle Composition	7	Inbound	59%	15%	20%	7%	100%
		7	Outbound	57%	15%	21%	6%	100%
		7	Total	58%	15%	21%	7%	100%

Table 2.2-4 Daily Passenger Traffic on Three Arterial Roads

Name		Location Number	Direction	P.Car / Van / Taxi	Bus / Micro Bus / Combi / Van	Truck / Others	Bicycle	Total
Av.Almirante Barroso		1	Inbound	56,293	247,344	6,558	2,183	312,378
		1	Outbound	71,475	247,582	8,802	2,335	330,194
		1	Total	127,768	494,926	15,360	4,518	642,572
	Vehicle Composition	1	Inbound	18%	79%	2%	1%	100%
		1	Outbound	22%	75%	3%	1%	100%
		1	Total	20%	77%	2%	1%	100%
BR-316		4	Inbound	41,303	119,855	12,377	1,430	174,965
		4	Outbound	44,421	131,291	14,016	1,547	191,275
		4	Total	85,724	251,146	26,393	2,977	366,240
	Vehicle Composition	4	Inbound	24%	69%	7%	1%	100%
		4	Outbound	23%	69%	7%	1%	100%
		4	Total	23%	69%	7%	1%	100%
Av. Augusto Montenegro		7	Inbound	25,854	71,239	6,605	1,614	105,312
		7	Outbound	25,444	69,868	7,169	1,607	104,088
		7	Total	51,298	141,107	13,774	3,221	209,400
	Vehicle Composition	7	Inbound	25%	68%	6%	2%	100%
		7	Outbound	24%	67%	7%	2%	100%
		7	Total	24%	67%	7%	2%	100%

Table 2.2-5 Inbound Peak Hour Vehicle Traffic on Three Arterial Roads

Name	Location Number	Peak Hour	Item	P.Car / Van / Taxi	Bus / Micro Bus / Combi / Van	Truck / Others	Bicycle	Total	Peak Ratio by 24hr
Av.Almirante Barroso	1	7:00-8:00	Volume	2,558	582	487	503	4,130	8.9%
			Composition	61.9%	14.1%	11.8%	12.2%	100.0%	-
BR-316	4	7:00-8:00	Volume	1,372	449	729	259	2,809	7.4%
			Composition	48.8%	16.0%	26.0%	9.2%	100.0%	-
Av. Augusto Montenegro	7	7:00-8:00	Volume	1,155	189	462	168	1,974	8.5%
			Composition	58.5%	9.6%	23.4%	8.5%	100.0%	-

Table 2.2-6 Inbound Peak Hour Passenger Traffic on Three Arterial Roads

Name	Location Number	Peak Hour	Item	P.Car / Van / Taxi	Bus / Micro Bus / Combi / Van	Truck / Others	Bicycle	Total	Peak Ratio by 24hr
Av.Almirante Barroso	1	7:00-8:00	Volume	4,678	39,798	592	503	45,571	14.6%
			Composition	10.3%	87.3%	1.3%	1.1%	100.0%	-
BR-316	4	7:00-8:00	Volume	3,396	14,500	824	259	18,979	10.8%
			Composition	17.9%	76.4%	4.3%	1.4%	100.0%	-
Av. Augusto Montenegro	7	7:00-8:00	Volume	2,105	8,141	627	168	11,041	10.5%
			Composition	19.1%	73.7%	5.7%	1.5%	100.0%	-

(4) Comparison of the 2009 Survey Findings with the F/S Study

1) *Overall Comparison*

Tables 2.2-7 and 2.2-8 compare the traffic conditions by dividing the results of the 2009 supplementary survey by those of the 2002 survey carried out by the F/S Study. Both the vehicular and the passenger traffic per day across Screen Line-1 did not change very much, as shown by the respective ratios in the two tables. In contrast, a substantial increase is found in the vehicular and the passenger traffic across Screen Line-2.

Av. Almirante Barroso shows a drop in the vehicular and the passenger traffic but the drops are slight as indicated by the respective ratios of 0.93 and 0.97. Vehicles and passengers travelling on BR-316 increased substantially, with the respective ratios standing at 1.40 and 1.42. Av. Augusto Montenegro shows the largest increase in the vehicular (ratio of 1.66) and the passenger traffic (ratio of 1.96).

Table 2.2-7 Changes in Daily Vehicle Traffic between 2002 and 2009 Surveys

Ratio (2009/2002)

	Cars	Public Buses	Total
Screen Line-1	1.01	1.16	1.03
Screen Line-2	1.53	1.72	1.56
Av. Almirante Barroso	0.88	1.14	0.93
BR-316	1.34	1.71	1.40
Av. Augusto Montenegro	1.50	2.83	1.66

Table 2.2-8 Changes in Daily Passenger Traffic between 2002 and 2009 Surveys

Ratio (2009/2002)

	Cars	Public Buses	Total
Screen Line-1	0.87	1.00	0.96
Screen Line-2	1.56	1.60	1.59
Av. Almirante Barroso	0.82	1.02	0.97
BR-316	1.24	1.50	1.42
Av. Augusto Montenegro	1.64	2.11	1.96

2) *Modal Composition*

Figures 2.2-6 and 2.2-7 compare the modal composition in 2003 and 2009 of the daily (24 hours) inbound passenger traffic across two screen lines.

Across Screen Line-1, the share of microbus/combi increased from 1% to 8%, with the respective shares of passenger car/van and bus showing a decrease, from 28% to 23% and from 67% to 63%. Apparently, passenger preferences shifted significantly over the period of 2003 – 2009. In aggregated modal composition, the share of car and taxi has dropped from 29% to 25%, whereas the aggregate share of bus, microbus and combi increased from 68% to 71%. This arguably indicates the beginning of a shift from private means of travel to public transport.

Across Screen Line-2, the share of microbus/combi jumped from 2% in 2003 to 21% in 2009, depressing the share of bus from 62% to 43%. Passenger preferences changed greatly among the public transport modes. In aggregated modal composition, however, there is no significant shift, with the share of various buses remaining at 64% and only a slight drop in the share of car and taxi from 28% to 27%.

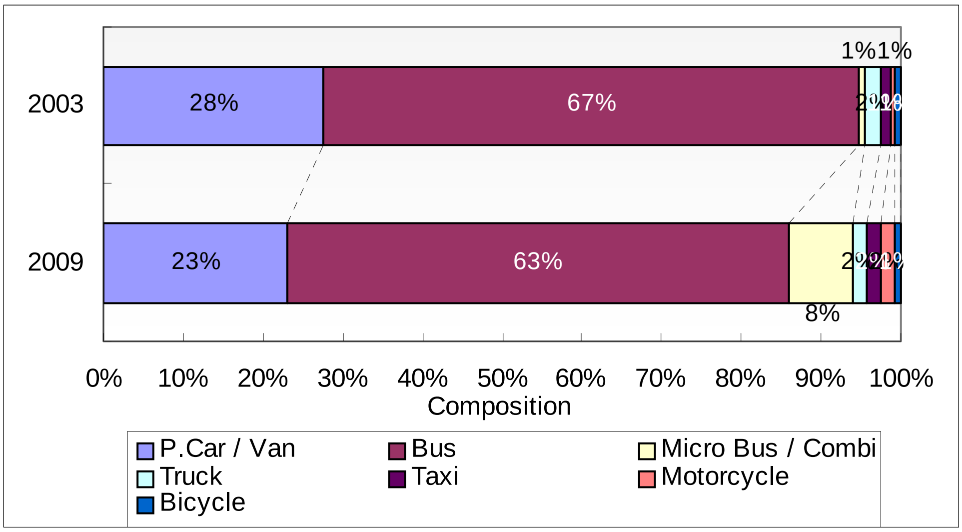


Figure 2.2-6 Comparison of Modal Composition in Daily Inbound Passengers across Screen Line-1 (2003 and 2009)

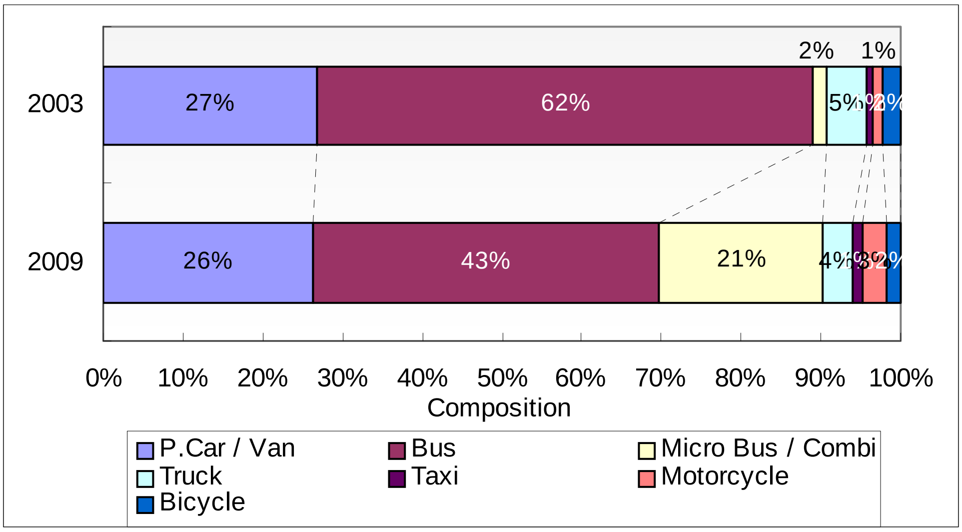


Figure 2.2-7 Comparison of Modal Composition in Daily Inbound Passengers across Screen Line-2 (2003 and 2009)

(5) Operating Speed of the Conventional Bus

The peak hour operating speed of the conventional bus was surveyed to check the current situations of congestion along bus routes. The findings were expected to provide useful information to identify the appropriate service frequency and speed for the proposed trunk bus system. The observation was done by utilizing the handy GPS information.

1) Surveyed Bus Route

The route chosen for observation starts from Icoaraci where one of the trunk bus terminals is proposed and ends at Sao Braz, passing Av. Augusto Montenegro and Av. Almirante Barroso (Figure 2.2-8).

a) Time for Observation

The time chosen for observation is around 7:00 for the morning peak hour and around 18:00 during the evening peak hour. The buses running on the route are GPS-scanned to calculate their operating speed.

b) Method of Calculation

The operating speed is calculated in a simplified manner. The positioning (coordinates) and the time spent for traveling the route are read by the portable GPS terminals, and the operating speed is calculated from the GPS readings and the distance of the route measured on the map (in 100m units). The time spent at bus stops is included in the calculation.

2) Operating Speed of the Existing Fleet

Tables 2.2-9 and 2.2-10 summarize the operating speed calculated on two roads of the bus route by direction of travel. At the peak of the morning traffic, the average operating speed of the inbound buses was 19km per hour on Av. Augusto Montenegro and 17km per hour on Av. Almirante Barroso, both below the speed of 20k/h.

The operating speed measured in 2003 had been far above 20km/h on both roads as shown in the tables. In six years, the average operating speed slowed down by 9km/h on Av. Augusto Montenegro and 12km/h on Av. Almirante Barroso.

At the peak of the evening traffic, the average operating speed of the outbound buses was 28km/h on Av. Augusto Montenegro and 18km/h on Av. Almirante Barroso. The slow outbound speed is pronounced on the latter road.

To compare with the situation in 2003, the operating speed hardly slowed down on Av. Augusto Montenegro, whereas the reduction in speed was severe on Av. Almirante Barroso, slowing down by 17km/h.

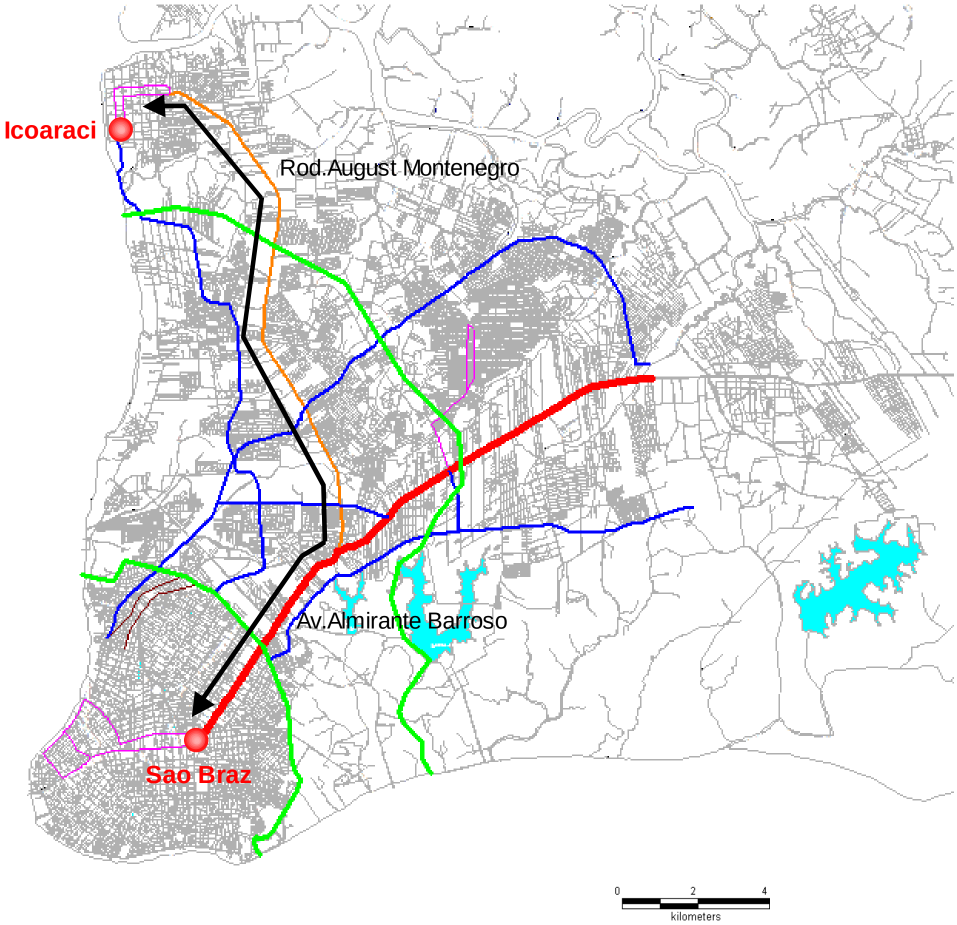


Figure 2.2-8 Bus Route Selected for Observation

Table 2.2-9 Inbound Operating Speed at Morning Peak (2003 and 2009)

Name	Bus Operation Speed (km/h) Icoaraci → Sao Braz(Inbound)		
	2003	2009	2009-2003
Av. August Montenegro	27.7	19.0	-8.7
Av. Almirante Barroso	29.2	16.8	-12.4

Table 2.2-10 Outbound Operating Speed at Evening Peak (2003 and 2009)

Name	Bus Operation Speed (km/h) Icoaraci → Sao Braz(Inbound)		
	2003	2009	2009-2003
Av. August Montenegro	31.1	28.5	-2.6
Av. Almirante Barroso	34.1	17.5	-16.6

2.2.2. Updated OD Tables

The OD tables compiled by the 2003 F/S Study are updated by incorporating the basic socio-economic changes that took place since then and the findings of the supplementary survey and observation. The present Study uses the updated version of 2009 as the base OD tables for demand forecast. The following paragraphs sum up significant changes found in the OD data over the period of 2003 – 2009.

(1) Changes during 2002 - 2009

Table 2.2-11 summarizes some significant changes that occurred since 2003. Total trips in the entire study area grew by 9% over the period of 2003 to 2009. The trips by passenger car/van/taxi increased by 21%, but those by public transport (various types of buses) changed little. The population and per capita GRDP increased by 14% and 33% respectively over the period. Compared with these rates, the growth of trips did not go along. The 9% growth of total trips is half the population growth.

The growth of passenger trips by public transport was practically negligible despite the population increase. Trips by passenger car increased at the annual rate of 2.8%, and yet this growth falls substantially below the performance of per capita GRDP growing at 3.9% per annum. One of the important findings of the present Study is this underperformance of transportation relative to the socio-economic changes.

As clearly shown in Table 2.2-11, the traffic forecast in the F/S Study had been higher in growth terms than what actually took place in seven years. The annual growth of 1.2% regarding total trips was almost one third of the forecast of 3.9%, whereas the annual growth of 2.7% regarding passenger car trips was not as buoyant as the forecast of 6.6%. Trips by public transport, moreover, hardly increased contrary to the growth forecast of 2.4% per annum.

Table 2.2-11 Salient Changes in Socio-economic and Traffic Conditions during 2003 - 2009

Item	Present Study				2003F/S Annual Growth
	2002	2009	2009/2002	Annual Growth	
Population	1,888,959	2,153,280	1.14	1.9%	2.60%
Growth of per capita GRDP	―	―	1.33	3.9%	2.70%
Number of Cars	81,833	131,337	1.60	7.0%	-
Car Ownership （vehicles/1000persons）	43	61	1.42	5.1%	-
Passenger Car Trips/day	864,947	1,043,252	1.21	2.7%	6.6%
Public Transport Trips/day	1,679,885	1,724,093	1.03	0.4%	2.4%
Total Trips/day	2,544,832	2,767,345	1.09	1.2%	3.9%
Share of Passenger Car（%）	34.0%	37.7%			
Share of Public Transport（%）	66.0%	62.3%			

(2) Comparison of OD Trips between 2002 and 2009

Figures 2.2-9 and 2.2-10 compare the daily trip generation and attraction by macro zone between 2003 and 2009. The former shows the trips by passenger car/van/taxi, and the latter presents those by public transport (bus, microbus and combi/van).

As clearly shown in Table 2.2-9, the passenger car trips show a distinct concentration in the Centro area both in generation and attraction. In the suburbs, Maranbaia and Cidade Nova show some buildup of trip generation and attraction. Trips by public transport are less concentrated in the Centro area and distributed more widely in the suburbs (Figure 2.2-10).

The trip generation and attraction by passenger car grew at higher rates in the suburban macro zones of Maranbaia and Cidade Nova than elsewhere. The share of public transport trips declined in the Centro area, while it increased in the suburban macro zones of Cidade Nova, Ananindeua and Icoaraci. To recapitulate, passenger car trips have been on the increase in the Centro area and two suburban zones of Maranbaia and Cidade Nova, while the reliance on public transport has been growing sizably in the suburban macro zones.

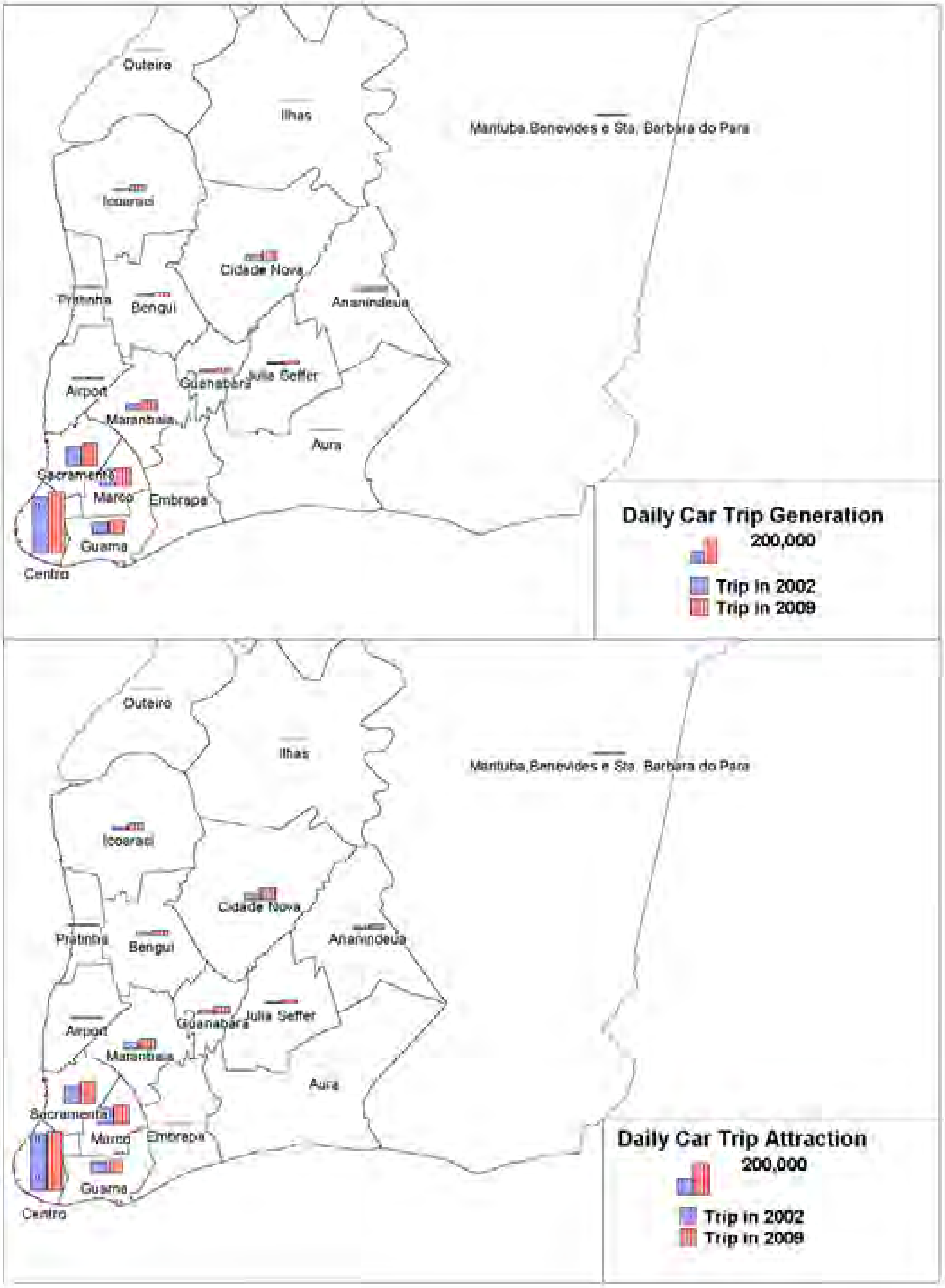


Figure 2.2-9 Daily Trip Generation and Attraction by Passenger Car (2003 and 2009)

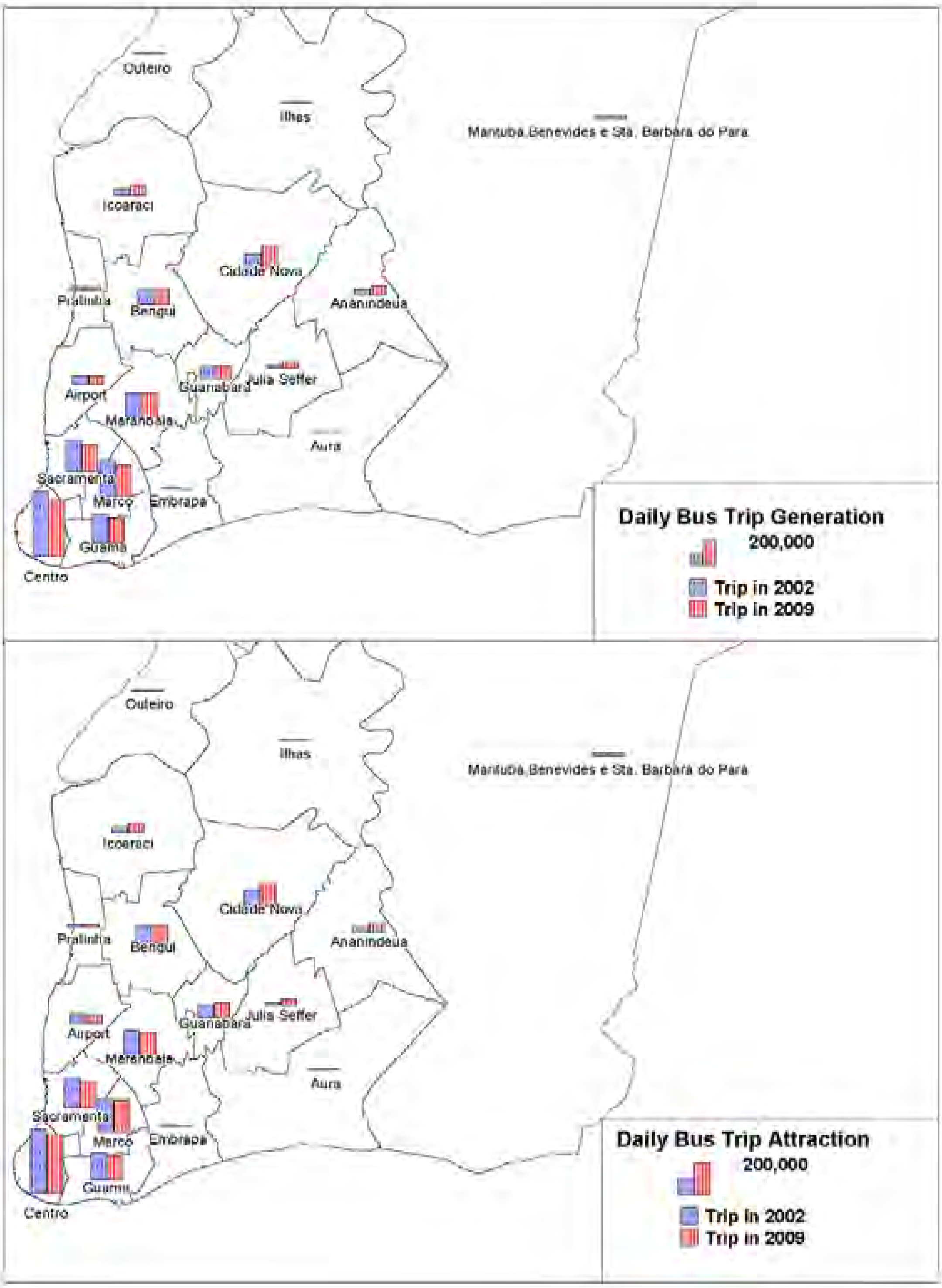


Figure 2.2-10 Daily Trip Generation and Attraction by Public Transport (2003 and 2009)

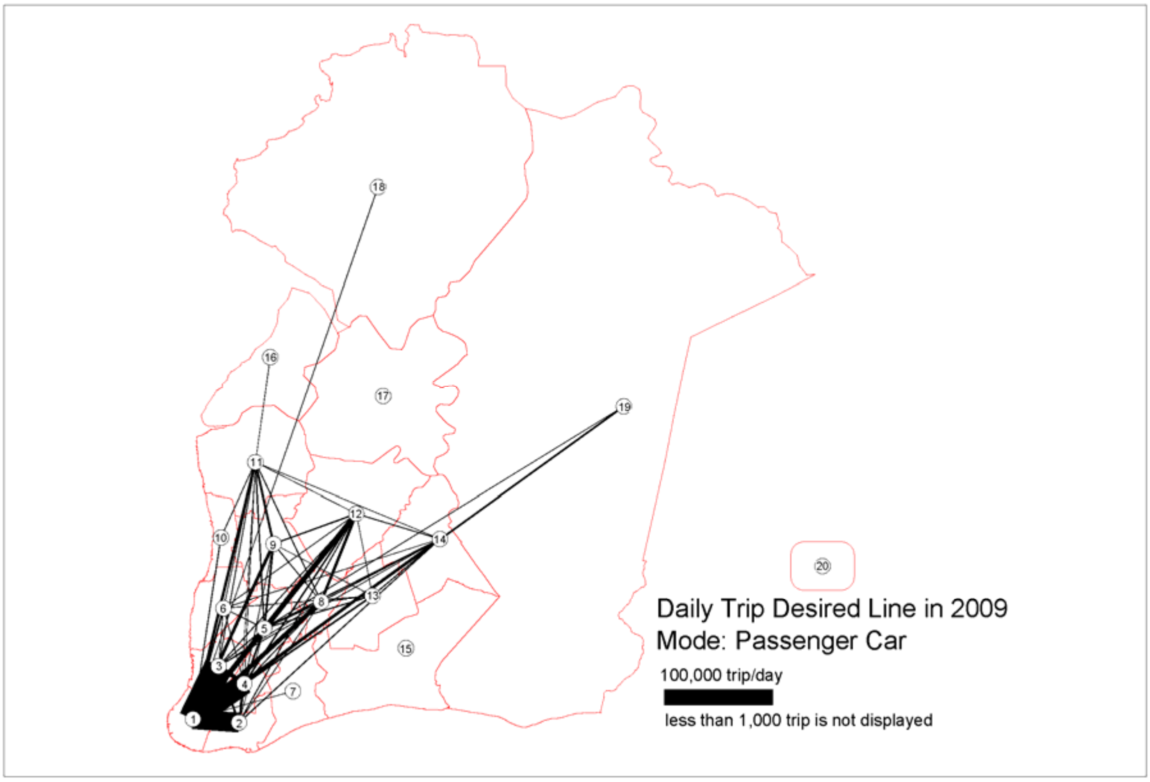


Figure 2.2-11 Desired Line of Daily Passenger Car Trips in 2009

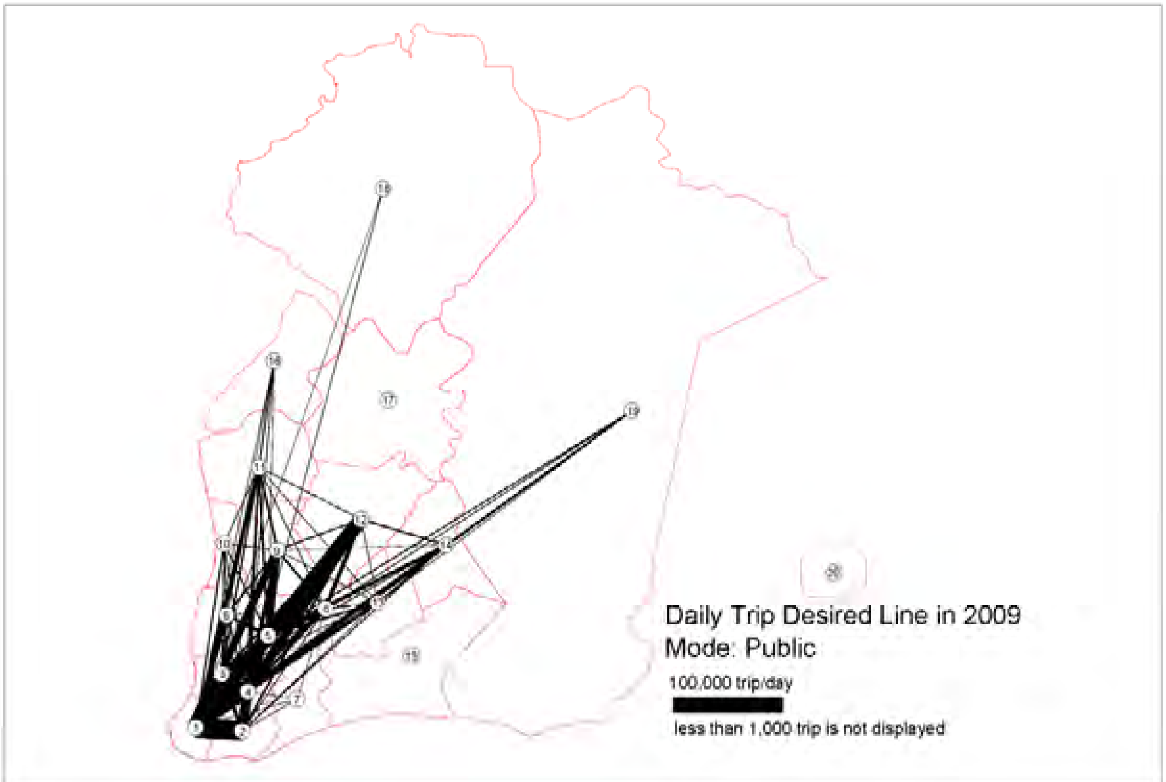


Figure 2.2-12 Desired Line of Daily Public Transport Trips in 2009

CHAPTER 3
Related Project Plans And External Financing

3. RELATED PROJECT PLANS AND EXTERNAL FINANCING

3.1. METROPOLIS ACTION PLAN

3.1.1. OUTLINE OF METROPOLIS ACTION PLAN

The Government of the State of Para formally approved 1) the bus system project and 2) the road development projects that were proposed by the F/S Study, agreeing to their large economic benefits and high financial IRRs. The projects were officially renamed as VIAMETROPOLE. After the completion of the F/S Study, some steps were taken to present the project proposals to lending institutions: namely, Dept. of Overseas Economic Cooperation of JBIC, JICA, Development Bank of Brazil (BNDES) and Inter-American Development Bank, among others. However, no formal application for financing was made to any of those institutions. In August of 2008, the State Government withdrew the name of VIAMETROPOLE and grouped the project proposals under the title of “Metropolis in Movement” and began to plan their implementation. Soon after, the State Government again changed the naming of the project proposals into “AÇÃO METRÓPOLE” or Metropolis Action Plan, which consisted of the same project proposals 1) and 2) above. The State Government decided to implement the road development projects by force account with a loan from the Bank of Brazil. Now that the inter-departmental consultation and agreement have been settled over the bus system project, the State Government has renewed its steps of applying to the Government of Japan for financing.

In the Metropolis Action Plan, the first stage of implementation consists of the road development projects to be completed by 2010. The second stage would be the bus system project, with its implementation to start in 2009 and operation to begin in 2013.

The State Government has already started the necessary institutional development. The Administration Center of Metropolitan Transport (NGTM) has been created inside the State Secretariat of Strategic Projects (SEPE) and initiated the first stage of project implementation. Regarding bus operation, it has been proposed to form a public consortium in the manner organized in Recife City, but details are yet to be decided.

3.1.2. PROJECTS IN METROPOLIS ACTION PLAN

Table 3.1-1 is the list of projects included in the Metropolis Action Plan, and Figure 3.1-1 shows their respective locations. 39 projects consist of 21 road development projects (of which No. 19 will be provided with the trunk bus priority lanes after completion) and 18 trunk bus related projects. Five projects are being implemented and two others have been completed. These projects secured the financing mostly from the Bank of Brazil and the Caixa Econômica Federal (CEF) /Federal Savings Bank. NGTM is in charge of project implementation and management.

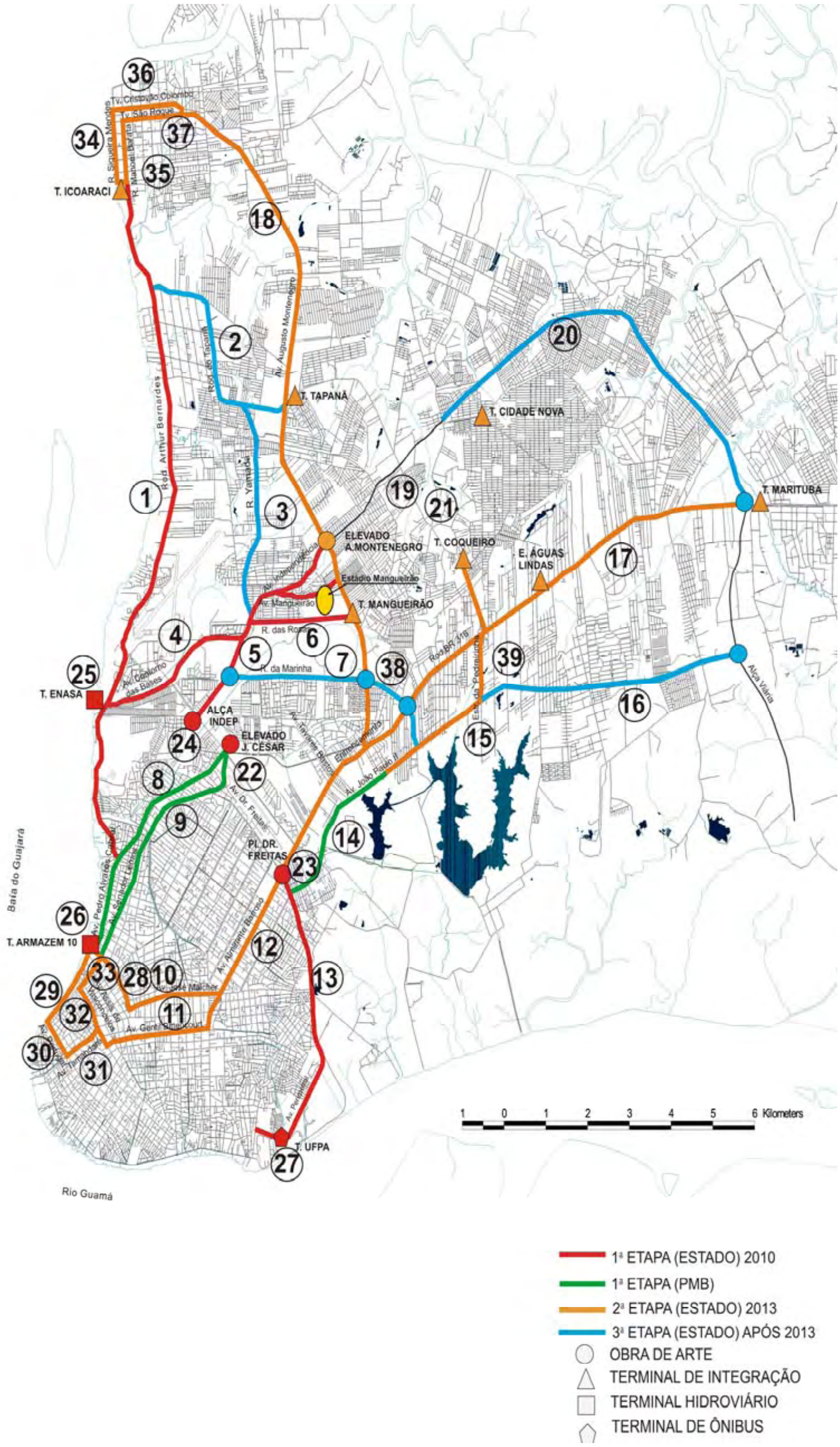


Figure 3.1-1 Locations of Metropolis Action Plan Projects

Table 3.1-1 Project List of Metropolis Action Plan

No	Road Name	Project Outline	Managing Body	Period of Implemen-tation	Present Status	Source of Finance	Km
1	Rod. Arthur Bernardes (two-way road with 2 lanes each way)	Development of the roadway including parking lane, sidewalks, bikeways, bus stop structures, etc.	SEPE[1]	2008 – 2010	Under construction	Bank of Brazil	13.8
2	Rod. do Tapana (two-way road with 2 lanes each way)	Development of the roadway including parking lane, sidewalks, bikeways, bus stop structures, etc.	SEPE	Unscheduled	Not in the pipeline	Uncommitted	4.7
3	Rua Yamada (two-way road with 2 lanes each way)	Development of the roadway including parking lane, sidewalks, bikeways, bus stop structures, etc.	SEPE	Unscheduled	Not in the pipeline	Uncommitted	4.1
4	Rod. Transmangueirao (two-way road with 2 lanes each way)	Development of the roadway including the median strip, sidewalks, bikeways, parking lane, etc.	SETRAN[2] (Road Dept.)	2008 – 2010	Under construction	Para State Government	6.9
5	Av. Independencia (new two-way road with 3 lanes each way)	Construction of the roadway including the median strip, bikeways and other structures by 2010; planning the introduction of one priority lane each way by 2012	SEPE	2008 – 2010 2012	Under construction and planning	Bank of Brazil Japan's ODA Loan planned	4.8
6	Rua das Rosas (two-way road with 2 lanes each way)	Development of the roadway including sidewalks, bikeways, parking lane, etc.	SETRAN (Road Dept.)	2009 – 2010	Under construction	Para State Government	1.3
7	Rua da Marinha (two-way road with 2 lanes each way)	Development of the roadway including the median strip, sidewalks, bikeways, parking lane, etc.	Unknown	Unscheduled	Not in the pipeline	Uncommitted	3.0
8	Av. Pedro Alvares Cabral (one-way road with 3 lanes)	Development of one priority lane for trunk bus	SEPE	2012	Improvement partly completed	Japan's ODA Loan planned	5.2
9	Av. Senador Lemos (one-way road with 3 lanes)	Development of one priority lane for trunk bus	SEPE	2012	Improvement partly completed	Japan's ODA Loan planned	5.2
10	Av. Governador Jose Malcher (one-way road with 3 lanes)	Development of one priority lane for trunk bus	SEPE	2010 – 2012	Under planning	Japan's ODA Loan planned	2.2
11	Av. Gentil Bittencourt (one-way road with 3 lanes)	Development of one priority lane for trunk bus	SEPE	2010 – 2012	Under planning	Japan's ODA Loan planned	2.8
12	Av. Almirante Barroso (two-way road with 3 lanes each way)	Development of two trunk bus exclusive lanes, one for inbound and the other for outbound traffic	SEPE	2010 – 2012	Under planning	Japan's ODA Loan planned	6.0
13	Av. Perimetral (two-way road with 2 lanes each way)	Development of the roadway including sidewalks, bikeways, bus bays and other structures	SEPE	2008 – 2010	Under planning	CEF[3] (Federal Savings Bank)	4.9
14	Av. Joao Pau II (two-way road with	Development of the roadway including the median strip,	SESAN[4] (Sanitary Dept.)	2008	Completed	CEF	3.8

	3 lanes each way)	sidewalks, bikeways, etc.					
15	Av. Joao Pau II (new two-way road with 3 lanes each way)	Construction of the roadway including the median strip, sidewalks, bikeways, etc.	SEPE	2009 – 2011	Under planning	CEF	3.3
16	Av. Joao Pau II (new two-way road with 3 lanes each way)	Construction of the roadway including the median strip, sidewalks, bikeways, etc.	Unknown	Unscheduled	Not in the pipeline	Uncommitted	6.2
17	BR-316 (two-way road with 4 lanes each way)	Development of the two-lane trunk bus exclusive road, one lane for inbound and the other for outbound traffic	SEPE	2010 – 2012	Under planning	Japan's ODA Loan planned	10.7
18	Av. Augusto Montenegro (two-way road with 4 lanes each way)	Development of the two-lane trunk bus exclusive road, one lane for inbound and the other for outbound traffic	SEPE	2012	Under planning	Japan's ODA Loan planned	13.6
19	Av. Independencia (two-way road with 2 lanes each way)	Development of one priority lane for trunk bus on the road segment completed in 2004	SEPE	Unscheduled	Under planning	Japan's ODA Loan planned	3.6
20	Av. Independencia (new road)	In the stage of project identification (road development including trunk bus lanes)	Unknown	Unscheduled	Not in the pipeline	Uncommitted	6.6
21	Av. Mario Covas (two-way road with 2 lanes each way)	Development of one priority lane for trunk bus	SEPE	2010 – 2012	Under planning	Japan's ODA Loan planned	1.3
22	Elevado Julio Cesar (new road)	Construction of a cloverleaf interchange	SEPE	2008 – 2010	Under construction	Bank of Brazil	-
23	Passagem Subterranea (new road)	Construction of a grade-separated interchange and underground passageways	SEPE	2008 – 2010	Under planning	CEF	-
24	Alca Independencia (new road)	Construction of the roadway	SEPE	2009 – 2010	Under planning	Bank of Brazil	-
25	Terminal Hidroviario Metropolitano (new road)	Construction of a ferry terminal	SETRAN (Road Dept.)	2008 – 2009	Under planning	CEF	-
26	Terminal Hidroviario Armazem 10	Project idea to improve the existing bus terminal	CPH[5] (private company)	Unscheduled	Not in the pipeline	Uncommitted	-
27	Terminal Urbano UFPA (new road)	Development of the Federal Univ.(UFPA) bus terminal, including shops and other structures	COHAB[6] (Para State Habitation Company)	2008 – 2009	Under construction	Para State Government	-
28	Av. Visconde de Sousa Franco (two-way road with 3 lanes each way)	Development of one priority lane for trunk bus	SEPE	2010 – 2012	Under planning	Japan's ODA Loan planned	1.6
29	Av. Marechal Hermes *Boulevard* Castilhos Franca (one-way road with 4 lanes)	Development of one priority lane for trunk bus	SEPE	2010 – 2012	Under planning	Japan's ODA Loan planned	1.8
30	Av. Portugal / Av. 16 de Novembro (one-way road with 3 lanes)	Development of one priority lane for trunk bus	SEPE	2010 – 2012	Under planning	Japan's ODA Loan planned	0.9
31	Av. Almirante Tamandare / Rua Gama Abreu	Development of one priority lane for trunk bus	SEPE	2010 – 2012	Under planning	Japan's ODA Loan planned	0.9

	(one-way road with 3 lanes)						
32	Av. Assis de Vasconcelos (one-way road with 3 lanes)	Development of one priority lane for trunk bus	SEPE	2010 – 2012	Under planning	Japan's ODA Loan planned	1.2
33	Rua de Belem (one-way road with 3 lanes)	Development of one priority lane for trunk bus	SEPE	2010 – 2012	Under planning	Japan's ODA Loan planned	0.3
34	Rua Siqueira Mendes (one-way road with 2 lanes)	Development of one priority lane for trunk bus	SEPE	2010 – 2012	Under planning	Japan's ODA Loan planned	1.4
35	Rua Manoel Barata (one-way road with 2 lanes)	Development of one priority lane for trunk bus	SEPE	2010 – 2012	Under planning	Japan's ODA Loan planned	1.3
36	Travessa Cristovao Colombo (one-way road with 2 lanes)	Development of one priority lane for trunk bus	SEPE	2010 – 2012	Under planning	Japan's ODA Loan planned	2.3
37	Travessa Sao Roque (one-way road with 2 lanes)	Development of one priority lane for trunk bus	SEPE	2010 – 2012	Under planning	Japan's ODA Loan planned	2.2
38	Rua de Marinha (two-wary road with 2 lanes each way)	Widening of the roadway	Unknown	Unscheduled	Not in the pipeline	Uncommitted	1.5
39	Estrada Pedreirinha (two-way road with 2 lanes each way)	Development of a trunk bus priority lane, the roadway, the median strip, bikeways, sidewalks, etc.	SEPE	2010 – 2011	Under planning	CEF	2.8

Notes: 1) SEPE: State Secretariat of Strategic Projects
2) SETRAN: Secretaria Estadual de Transporte
3) CEF: Caixa Economica Federal
4) SESAN: Secretaria Municipal de Saneamento
5) CPH: Companhia de Portos e Hidrovias
6) COHAB: Companhia de Habitacao do Estado do Para

3.1.3. STUDY PROJECTS SELECTED FOR REVIEW

The present Study reviews 19 projects selected from the project list of the Metropolis Action Plan (Table 3.1-2). Their location is shown in Figure 3.1-2.

Table 3.1-2 Projects Selected for Review

Development for Trunk Bus System	Road Name	Km	Color in Fig. 3.1-2
Exclusive Road	No. 17: BR-316	10.7	Red
	No. 18: Av. Augusto Montenegro	13.6	Red
Exclusive Lane	No. 12: Av. Almirante Barroso	6.0	Yellow
Priority Lane	No. 10: Av. Governador Jose Malcher (Centro)	2.2	Green
	No. 11: Av. Gentil Bittencourt (Centro)	2.8	Green
	No. 28: Av. Visconde de Sousa Franco (Centro)	1.6	Green
	No. 29: Av. Marechal Hermes / Boulevard Castilhos Franca (Centro)	1.8	Green
	No. 30: Av. Portugal / Av. 16 de Novembro (Centro)	0.9	Green
	No. 31: Av. Almirante Tamandare / Rua Gama Abreu (Centro)	0.9	Green
	No. 32: Av. Assis de Vasconcelos (Centro)	1.2	Green
	No. 33: Rua de Belem (Centro)	0.3	Green
	No. 34: Rua Siqueira Mendes (Icoaraci)	1.4	Green
	No. 35: Rua Manoel Barata (Icoaraci)	1.3	Green
	No. 36: Travessa Cristovao Colombo (Icoaraci)	2.3	Green
	No. 37: Travessa Sao Roque (Icoaraci)	2.2	Green
	No. 8: Av. Pedro Alvares Cabral (elsewhere)	5.2	Green
	No. 9: Av. Senador Lemos (elsewhere)	5.2	Green

	No. 19: Av. Independencia (elsewhere)	3.6	Green
	No. 21: Av. Mario Covas (elsewhere)	1.3	Green

Road Development	Road Name	Km	Color in Fig. 3.1-2
	No. 15: Av. Joao Paulo II	3.3	Pink
	No. 39: Estrada Pedreirinha	2.8	Pink

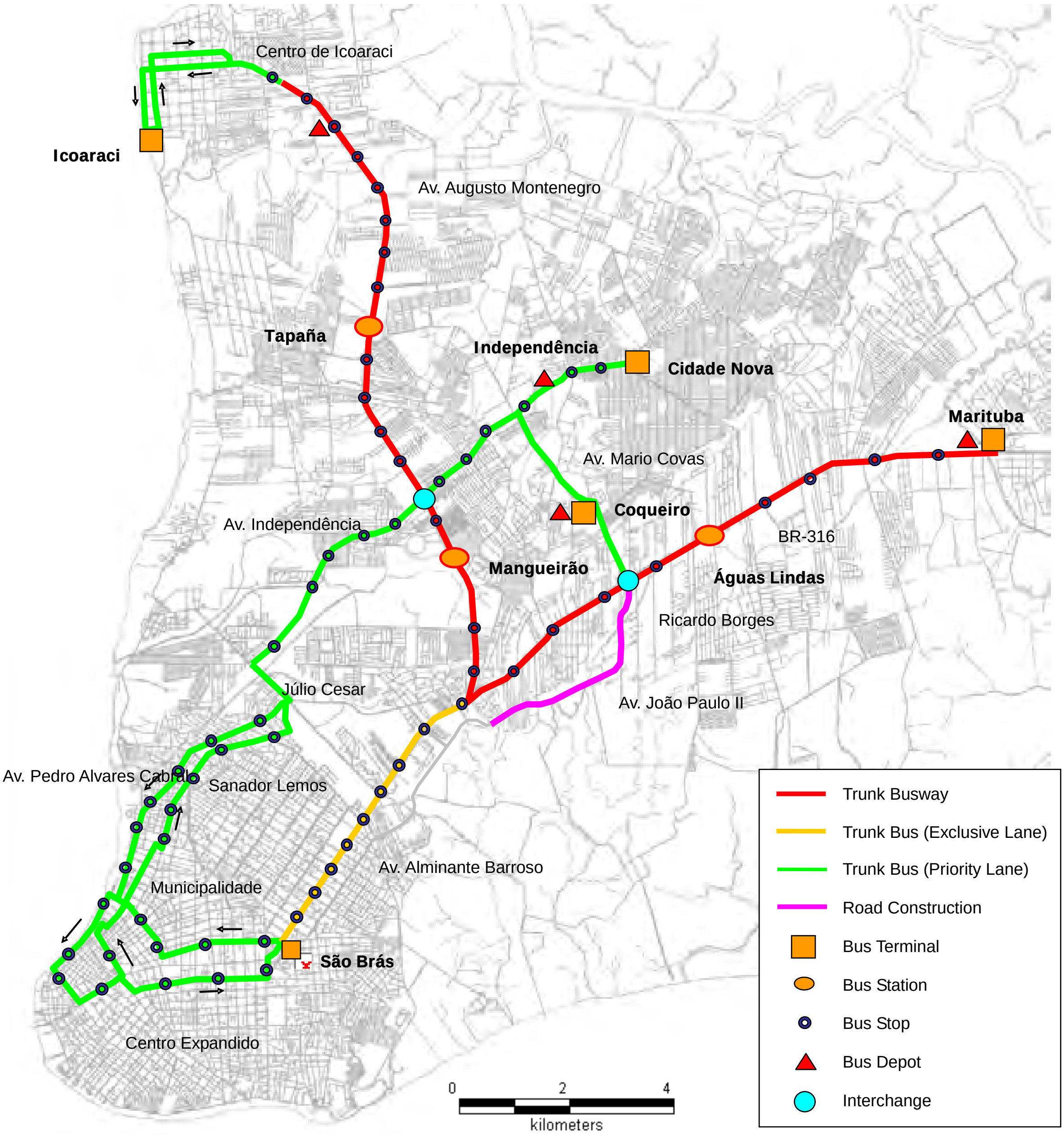


Figure 3.1-2 Location of Projects Selected for Review

3.2. FINANCING BY OTHER DONORS

3.2.1. DONOR POLICIES

(1) World Bank

The basic policy of the World Bank emphasizes the eradication of poverty and the encouragement of development and its project lending addresses a wide range of issues. In Brazil, the Bank regularly holds consultation meetings with relevant ministerial departments to decide the country policy. The partnership strategy currently effective between Brazil and the Bank covers the period from 2008 to 2011 and stresses the following five areas.

1) Education: The planned improvement of school enrolments (construction of schools) was attained as targeted for the preceding period of 2004 – 2007. The current partnership period aims at improving the educational system.
2) Poverty eradication in the northeastern region: Various supports and incentives are offered not only to individuals but also community associations and voluntary groups.
3) Urban development: The objective during 2004 – 2007 was the improvement of slum dwellings and the increased provision of access to potable water supply and drainage. The on-going partnership period focuses on the improvement of urban administration and supports the activities to upgrade urban services (housing and urban transport infrastructure).
4) Support to the Amazon Bank: The World Bank kept away from the Amazon region for a few decades, but has come back in aid of the efforts to harmonize nature conservation and development. The Bank has been working out appropriate support instruments in closer corroboration with the federal and the state governments and the private sector.
5) Administrative capability of the public sector: The support is provided to improve the administrative efficiency of the federal government ministries, the state government departments and other public sector agencies.

(2) Inter-American Development Bank

The stance of the Inter-American Development Bank for Brazil was epitomized by the following three policy objectives announced for the period of 2004 – 2007.

1) Encouragement and support to the environmentally sustainable development efforts
2) Eradication of poverty and reduction of regional and social disparities
3) Strengthening of the administrative functions of government and promotion of community participation and democracy

3.2.2. EXTERNAL AID FOR PUBLIC TRANSPORT

Multilateral and bilateral donors provide financial supports to the public transport plan in Brazil (excluding road development), as summarized in Table 3.2-1. The urban public transport in Brazil is provided by subway systems (Sao Paulo and Rio de Janeiro) and trunk bus systems. No LRT is yet in operation.

Table 3.2-1 Public Transport in Brazil and External Financing

Public Transport	City		External Finance
Railway	Sao Paulo	Purchase of railway cars	R$75 million by BNDES in 2007
		Purchase of railway cars	US$120 million, co-financed by BID, WB and JBIC
		Upgrading 160km out of the total railway extension of 261km to the Metro level, by purchasing railway cars and improving the operational system	US$550 million by WB
		Eastward extension of the railway line by CPTM (Sao Paulo Metropolitan Railway Co.)	Uncommitted
Subway	Sao Paulo	Subway development (Phase 2)	Of the total investment requirement of US$390 million, US$130 million to be financed by WB
	Rio de Janeiro	Mass transit (subway) project	Of the total investment requirement of US$220 million, US$211 million to be financed by WB
	Salvador	New extension of 12.1km and upgrading of 13.5km	The total investment requirement of R$1,136.3 million to be financed by WB and the funds of federal, state and municipal governments
	Fortaleza	Upgrading of the single track to the double tracks with electrification (43.1km), construction of 34 new stations and the purchase of 16 railway cars	The total investment requirement of R$1,526.1million to be financed by WB, JBIC and the funds of federal and state governments
	Brasilia	An extension of the subway system is under consideration but the project identification is yet to be decided.	Uncommitted
LRT	Recife	In the process of planning	The possibility of the federal government funding is being discussed
Bus System	Brasilia	A trunk bus system is under consideration but the project identification is yet to be decided.	The possibility of Inter-American Development Bank lending is considered but yet to be committed.
	Recife	Construction of busways Lending provided for bus infrastructure, not the bus system itself	Two bus roadways financed by WB in 1980
	Curitiba	Trunk busways constructed 30 years ago. New trunk busways under construction	On-going construction financed by Inter-Am. Dev. Bank
Bus Fleet	Goiania	Purchase of bus fleet Private bus companies purchase a fleet of buses in Brazil and international lending institutions do not finance such purchases.	BNDES loan to a private company

CHAPTER 4
Future Socio-Economic Frame

4. FUTURE SOCIO-ECONOMIC FRAME

4.1. FUTURE SOCIO-ECONOMIC FRAME

4.1.1. UPDATED FUTURE SOCIO-ECONOMIC FRAME

(1) Population

The future demographic frame is updated by using the annual population growth of 2.5% estimated by PDTU2001[1] for the period of 2010 – 2020. The future population in 2013, 2018 and 2025 are re-forecast from the base population of 2009 and shown in Table 4.1-1.

According to the updated forecast, the population in 2013, 2018 and 2025 would be larger by 11%, 25% and 49% respectively than the 2009 figure.

Table 4.1-1 Updated Forecasts of Population and Household Income

Year	2009	2013	2018	2025	2013/2009	2018/2009	2025/2009
Population	2,153,280	2,381,689	2,697,293	3,210,617	1.11	1.25	1.49
Avg. Income （R$ / month）	1,130	1,337	1,656	2,233	1.18	1.47	1.98

(2) Monthly Household Income

The monthly household income was used as the basic indicator of the economic frame in the F/S Study of 2003. The updating is done by using the annual per capita GRDP growth of 4.3% estimated by PDTU2001. The results of re-forecast from the 2009 figure are shown in Table 4.1-1. The average monthly household income would increase 1.18 times by 2013, 1.47 times by 2018 and 1.98 times by 2025.

(3) Comparison with the 2003 F/S Study

Table 4.1-2 compares the updated frame with the forecast of the 2003 F/S Study. The updated population estimates in 2013 and 2018 are lower by 5.0% and 4.7% than those presented in the F/S Study. In contrast, the updated monthly income is higher by 11.6% and 12.8% respectively in 2013 and 2018. While the population growth is forecast by the same rate of 2.5% per annum, the average monthly income is expected in the present Study to grow at a slightly higher annual rate.

Table 4.1-2 Comparison of Basic Socio-economic Frame between the F/S 2003
and the Present Study

		2009	2013	2018	2013 /2009	Annual growth	2018 /2013	Annual growth
Population	F/S 2003	2,267,266	2,506,084	2,828,958	1.11	2.5%	1.13	2.5%
	Present Study	2,153,280	2,381,689	2,697,293	1.11	2.5%	1.13	2.5%
	Difference	-5.0%	-5.0%	-4.7%	-	0.0point	-	0.0point
Monthly Household Income (R$)	F/S 2003	1,040	1,198	1,468	1.15	3.6%	1.23	4.2%
	Present Study	1,130	1,337	1,656	1.18	4.3%	1.24	4.3%
	Difference	8.6%	11.6%	12.8%	-	+0.7point	-	+0.2point

[1] *The Update of the Master Plan for Urban Transport in the Metropolitan Area of Belem*, 2001.

4.1.2. POPULATION DISTRIBUTION BY MACRO ZONE

The Para State Habitation Company (COHAB) has a housing project of 8,000 units for the Aura area (=Zone 6002) of Ananindeua City. The construction is to start in 2009 and take a few years. By applying the current average of 4.6 members per household, the present Study presumes that the said area is to attract a population increase of 36,800 by the housing project.

Table 4.1-3 and Figure 4.1-1 show the trend of population growth by macro zone. The largest increase is expected in Aura, with its population in 2018 13.5 times as large as the 2009 figure. This reflects the implementation of the housing project during 2010 – 2013. The next in line are suburban zones of Guanabara, Icoaraci, Cidade Nova, Julia Seffer, Ananindeua and Outeiro, where the respective populations grow by 40%. The growth rate drops in the Centro area and its vicinity over the same period. The population of Bengui in 2018 shows a 20% increase over the 2009 figure, followed by Maranbaia and Aiport each with a 15% increase. Three macro zones of Centro, Guama and Sacramenta in the heart of Belem City hardly show an increase in population.

Macro zones of large residential population in 2018 are found in the suburbs, e.g., Cidade Nova with 391,000, Icoaraci with 247,000, Ananindeua with 239,000 and Bengui with 242,000.

Table 4.1-3 Trend of Population Growth by Macro Zone

Macro Zone		2009	2013	2018	2025	2013 /2009	2018 /2009	2025 /2009
1	Centro	144,337	144,597	147,483	150,008	1.00	1.02	1.04
2	Guama	263,579	264,804	270,976	276,875	1.00	1.03	1.05
3	Sacramenta	195,473	196,382	200,958	205,334	1.00	1.03	1.05
4	Marco	122,935	123,507	126,386	129,139	1.00	1.03	1.05
5	Maranbaia	170,323	180,402	196,585	219,347	1.06	1.15	1.29
6	Airport	73,546	77,709	84,447	93,888	1.06	1.15	1.28
7	Embrapa	1,592	1,599	1,637	1,672	1.00	1.03	1.05
8	Guanabara	94,431	110,290	135,161	177,785	1.17	1.43	1.88
9	Bengui	199,661	215,992	241,954	281,829	1.08	1.21	1.41
10	Pratinha	32,450	34,370	37,453	41,789	1.06	1.15	1.29
11	Icoaraci	172,057	201,079	246,589	324,617	1.17	1.43	1.89
12	Cidade Nova	273,026	319,080	391,298	515,115	1.17	1.43	1.89
13	Julia Seffer	73,589	86,002	105,466	138,839	1.17	1.43	1.89
14	Ananindeua	166,501	194,586	238,626	314,136	1.17	1.43	1.89
15	Aura	3,319	41,109	44,797	49,984	12.39	13.50	15.06
16	Outeiro	38,796	45,339	55,602	73,195	1.17	1.43	1.89
17	Ilhas	465	467	478	489	1.00	1.03	1.05
18	Mosquiero	23,774	25,180	27,440	30,617	1.06	1.15	1.29
19	Marituba, Benevides, Sta. Barbara do Para	103,426	119,195	143,957	185,959	1.15	1.39	1.80
	Total	2,153,280	2,381,689	2,697,293	3,210,617	1.11	1.25	1.49

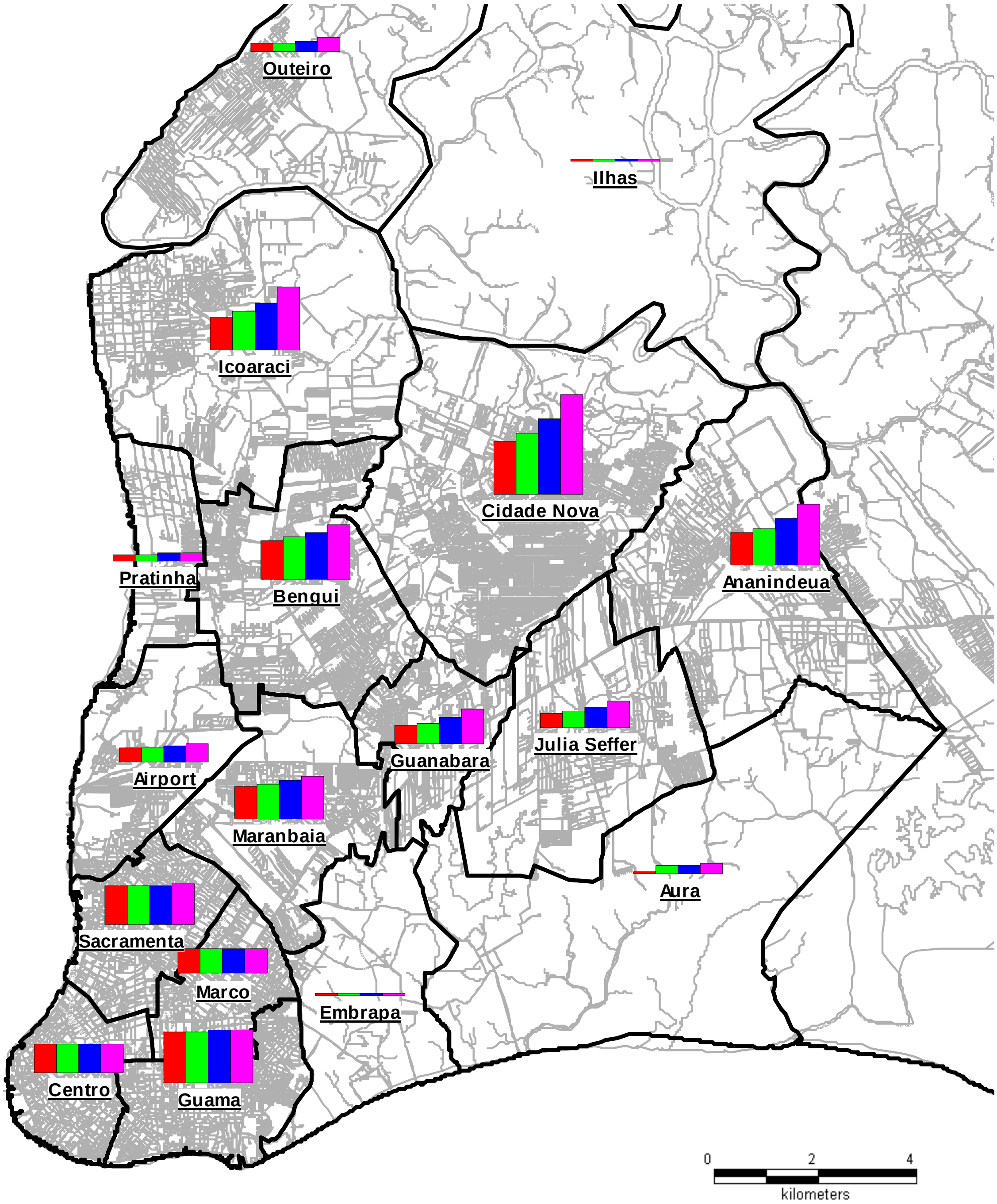


Figure 4.1-1 Trend of Future Population by Macro Zone

4.2. TRAVEL DEMAND FORECAST MODEL

4.2.1. TRAVEL DEMAND FORECAST MODEL

(1) Outline of the Model

The present Study uses a forecast model different from the one employed by the F/S Study. The decision is considered justifiable because of the need to reflect a significant socio-economic change that took place after 2003. That is to say, the new model must forecast the modal split between public transport and private means of travel. The present Study carried out the survey of stated preferences to understand passenger behaviors better and incorporated the findings into the model building.

The modal choice varies by the trip purpose. It is thus necessary to forecast the demand by purpose. This requires the appropriate revision of the model used in the F/S Study. The new model building starts from the estimation of trip generation and attraction, utilizing the database of the person trip survey conducted during the PDTU2001.

1) Trip Purposes

The following four purposes are considered in the model building.

1) To work
2) To school
3) Private and other purposes
4) To home

2) Modal Split

The following three modes are considered.

1) Passenger car
2) Public transport (conventional bus)
3) Public transport (trunk bus)

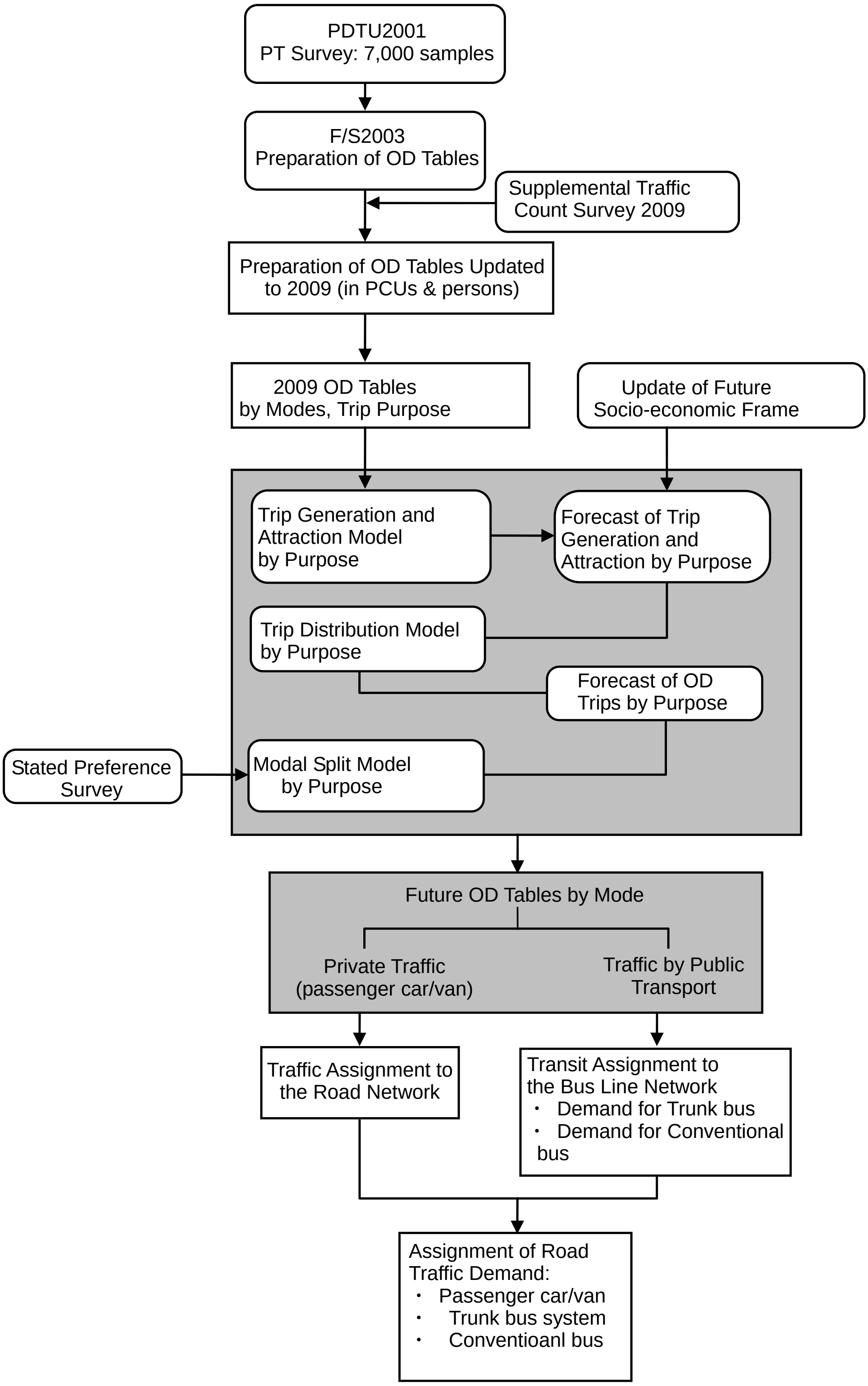


Figure 4.2-1 Flow Chart of Traffic Demand Forecast and Assignment

(2) Model for Trip Generation and Attraction

The model forecasts the total trips generated in the study area. The number of trips per person significantly differs between those who own the cars and those who do not. The former category of motorized people takes trips more frequently per person. Two important factors influence the trend of household motorization, namely, population and GDP growth, or per capita GDP growth. The higher the per capita economic growth, the larger the increase of car ownerships, and smaller gets the percentage of non-motorized households. This relationship crucially influences the future modal split in the demand forecast. When the car ownerships increase due to economic growth, the cars will expand their share in the total traffic, by slowing down the growth of passengers on public transport means. The model forecasts the total trip generation by taking into account this relationship of influence. The forecast is done in the following two steps.

1) The increase of car ownerships is forecast and the result is then used to forecast the motorized and the non-motorized households and the respective population thereof.

2) Forecast of trip generation

1) Forecast of Motorized and Non-motorized Households

The monthly household income is estimated by applying the growth rate of per capita GDP (one of the basic socio-economic frame values) and then used to estimate the motorized and the non-motorized households and the respective population thereof. The results are shown in Table 4.2-1.

It is estimated that the percentage of motorized households rises to 23.5% from 19.9% in 2009. The motorized population increases 1.48 times over the period. The rate of this population increase is very close to that of the average monthly household income. In contrast, the population increase of the non-motorized households is lower than the growth rate of total population.

Table 4.2-1 Forecast of Household Motorization and Trip Production

Items		2009	2013	2018	2025	2013/2009	2018/2009
Population		2,153,280	2,381,689	2,697,293	3,210,617	1.11	1.25
Monthly Household Income (R$)		1,130	1,337	1,656	2,233	1.18	1.47
Population by Car Ownership							
	Non-motorized Households	1,723,775	1,862,741	2,063,612	2,362,847	1.08	1.20
	Motorized Households	429,505	518,948	633,681	847,770	1.21	1.48
	Total	2,153,280	2,381,689	2,697,293	3,210,617	1.11	1.25
Percentage Share							
	Non-motorized Households	80.10%	78.20%	76.50%	73.60%	0.98	0.96
	Motorized Households	19.90%	21.80%	23.50%	26.40%	1.10	1.18
Trips per person by Car Ownership							
	Non-motorized Households	1.72					
	Motorized Households	2.03					
Total Generated Trips		3,836,788	4,257,379	4,835,785	5,785,070	1.11	1.26
Trips per person		1.78	1.79	1.79	1.80	1.00	1.01

2) Forecast of Trip Generation

The trip generation is obtained by multiplying the motorized and the non-motorized population by the respective base units of trips per person. The base units are derived from the person trip survey carried out in 2000. The results are shown in Table 4.2-1. The total generated trips thus estimated include walking and bicycling trips. The trip data usable in OD tables are obtained after subtracting these trips.

As shown in Table 4.2-1, the total trip generation (excluding walk and bicycle) increases by 11% in 2013 and 26% in 2018. The estimates of the present Study grow more slowly than the trip forecasts of the F/S Study, in which the increase is 17% and 38% respectively over the same period. The lower trip estimates by the present Study are in close agreement to the growth rate of total population adopted for the socio-economic frame.

(3) Model of Trip Generation and Attraction

The model of trip generation and attraction is constructed by using socio-economic attributes as explanatory variables.

$$Gi = a + b1*Xi1 + b2*Xi2$$

$$Aj = a + b1*Xj1 + b2*Xj2$$

Where;

Gi: Generated trips from zone i
Aj: Attracted trips to zone j
Xin, Xjn: Socioeconomic attributes in zone i or j
a, b1, b2: model parameters

Table 4.2-2 summarizes the parameters obtained from running the model. Socio-economic attributes of OD zones are five as shown below. They were originally adopted in the PDTU2001 and then repeated in the 2003 F/S Study.

1) Population (night time population)
2) Total working population (home base)
3) Total working population (place of work)
4) Total pupils and students (home base)
5) Total pupils and students (place of enrolment)

Table 4.2-2 Model Parameters of Trip Generation and Attraction

Purpose of Trip	Generation and Attraction	Population	Working Population	Tertiary Sector	Students	Average Household Income	Multiplier	R2
To Work	Generation		0.9070			3.6310	-4,129.5	0.887
	Attraction			1.1217			-1,086.0	0.911
To School	Generation	0.0977			0.0837		-139.4	0.850
	Attraction				0.5322		-1,135.5	0.804
Other Trips	Generation	0.0980	0.0888	0.3790			-47.3	0.909
	Attraction			0.8727			-630.9	0.855

(4) Model of Trip Distribution

The F/S Study used the OD model for all trip purposes. The present Study builds a model for each trip purpose. The PDTU2001 assumed that the pattern of land use in the metropolitan area of Belem would not change much from the present situation. Following this assumption, the model of trip distribution in the present Study employs the present pattern method. However, the gravity model is used to forecast the trips to work under the presumption that the places of work would become more widely distributed apace with population increase. The model equation is as follows. The gravity model parameters are shown in Table 4.2-3.

$$Tij = Gi \frac{Aj * Dij^{a}}{\sum_{j=1}^{n} (Aj * Dij^{a})}$$

Where,

Tij:	OD trips between zone i and j
Gi:	Generated trips from zone i
Aj:	Attracted trips to zone j
Dij:	Travel time distance between zone i and zone j (hr)
a:	Parameter

Table 4.2-3 Gravity Model Parameters

	Parameter	R2:Correlation Factor
To work	0.2787	0.68

(5) Modal Split Model

Based on the findings from the stated preference survey, the disaggregate logit model is built for each trip purpose. The interviewees of the SP survey were asked if they would choose the trunk bus service when it could be introduced. The utility function uses travel time and cost as explanatory variables.

1) Outline of Stated Preference Survey

The stated preferences survey was conducted to build modal split models. The outline of the survey is as follows.

1) Total coverage: 500 samples, of which,

   a. Interviewed at home: 300 samples

   b. Interviewed at shopping centers: 300 samples

   c. Interviewed at business establishments: 100 samples

2) Topics surveyed

   a. Personal attributes

   b. Data on the trips actually taken: places of origin and destination, travel time, means of transport, etc.

   c. Conditions for choosing trunk bus service over other modes: fare, total travel time (including walk and wait time), frequency of transfers and any combination thereof

The findings of the survey are incorporated into the model building.

2) Trips to Work

The utility functions are:

$$V_{Cars} = \beta_3 T_C + \beta_4 C_C / I * 100$$
$$V_{Bus} = \beta_1 + \beta_3 T_B + \beta_4 C_B / I * 100$$
$$V_{TBus} = \beta_2 + \beta_3 T_T + \beta_4 C_T / I * 100$$

Where,
β_k : parameter
T_i : total travel time of mode i
C_i : total travel cost of mode i
I : household income
(C : passenger car, B : ordinary bus, T : trunk bus)

Table 4.2-4 Model Parameters for Trips to Work

Parameters	Estimates
BCONST (β1)	0.2485
TCONST (β2)	-0.3858
TIME (β3)	-1.4504
COST/INCOME (β4)	-1.6216

3) *Trips to School*

The utility functions are:

$$V_{Cars} = \beta_3 T_C + \beta_4 C_C$$
$$V_{Bus} = \beta_1 + \beta_3 T_B + \beta_4 C_B$$
$$V_{TBus} = \beta_2 + \beta_3 T_T + \beta_4 C_T$$

Where,
β_k : parameter
T_i : total travel time of mode i
C_i : total travel cost of mode i
(C : passenger car, B : ordinary bus, T : trunk bus)

Table 4.2-5 Model Parameters for Trips to School

Parameters	Estimates
BCONST (β1)	2.8717
TCONST (β2)	1.5587
TIME (β3)	-8.7490
COST (β4)	-0.5535

4) *Other Trips*

The utility functions are:

$$V_{Cars} = \beta_3 T_C + \beta_4 C_C / I * 100$$
$$V_{Bus} = \beta_1 + \beta_3 T_B + \beta_4 C_B / I * 100$$
$$V_{TBus} = \beta_2 + \beta_3 T_T + \beta_4 C_T / I * 100$$

Where,
β_k : parameter
T_i : total travel time of mode i
C_i : total travel cost of mode i
I : household income

(C : passenger car, B : ordinary bus, T : trunk bus)

Table 4.2-6 Model Parameters for Trips with Other Purpose

Parameters	Estimates
BCONST (β1)	2.3665
TCONST (β2)	1.0497
TIME (β3)	-8.8793
COST/INCOME (β4)	-4.4579

(6) Method of Traffic Assignment

The traffic assignment consists of two steps: (i) trips by private means of transport are assigned by minimum route search to the road network and (ii) trips by public transport are assigned to the bus lines. Trips by trunk bus are assigned to the exclusive busways and lanes without any drop in the operating speed. Trips by ordinary bus are assigned to the roads to run side by side with other motorized vehicles and therefore they are subjected to the slowdowns in speed due to congestion.

The sequence of assignment is first to forecast the public transport demand and preload it to bus lines and then to assign the traffic by private passenger car to the road network.

4.3. TRAVEL DEMAND FORECAST

4.3.1. TRIP GENERATION AND ATTRACTION

Figure 4.3-1 compares the trip generation in 2009 and 2018, while Figure 4.3-2 shows the trip attraction in the same years. Trips are for all purposes.

As seen in the said figures, the increase of both generation and attraction is notably substantial in Icoaraci, Cidade Nova and Ananindeua and elsewhere in the suburbs.

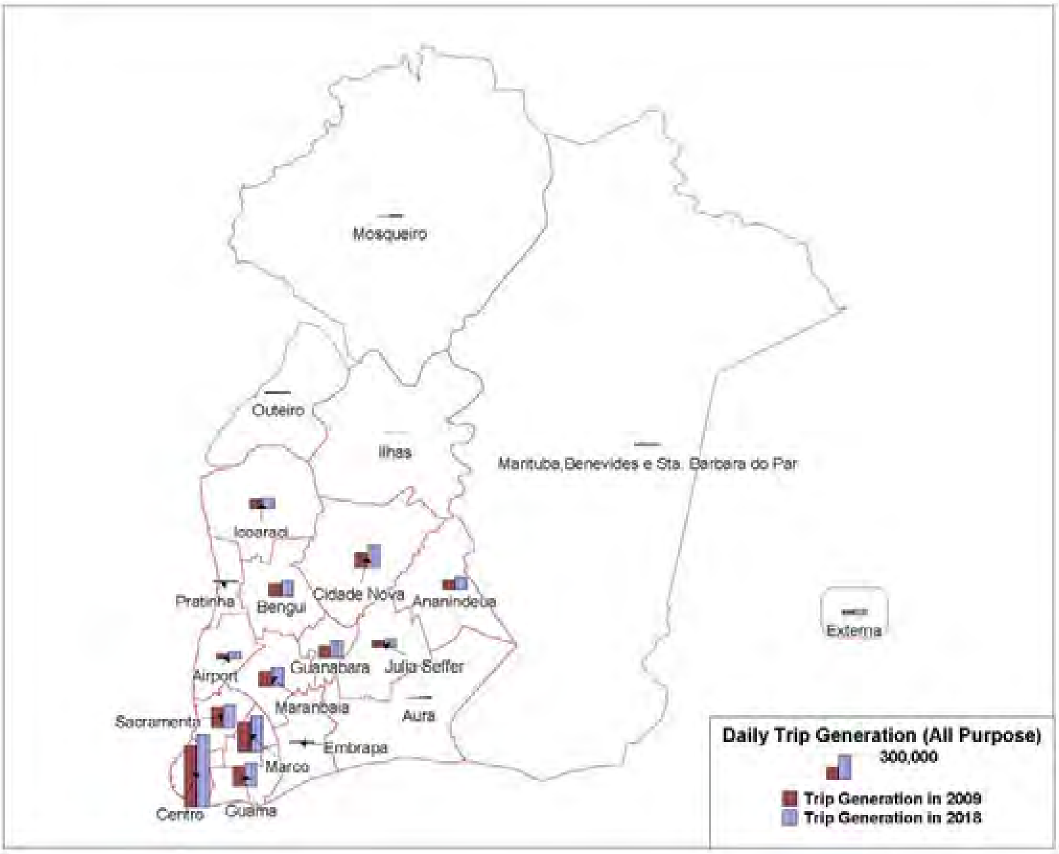


Figure 4.3-1 Generated Trips of All Purposes in 2009 and 2018

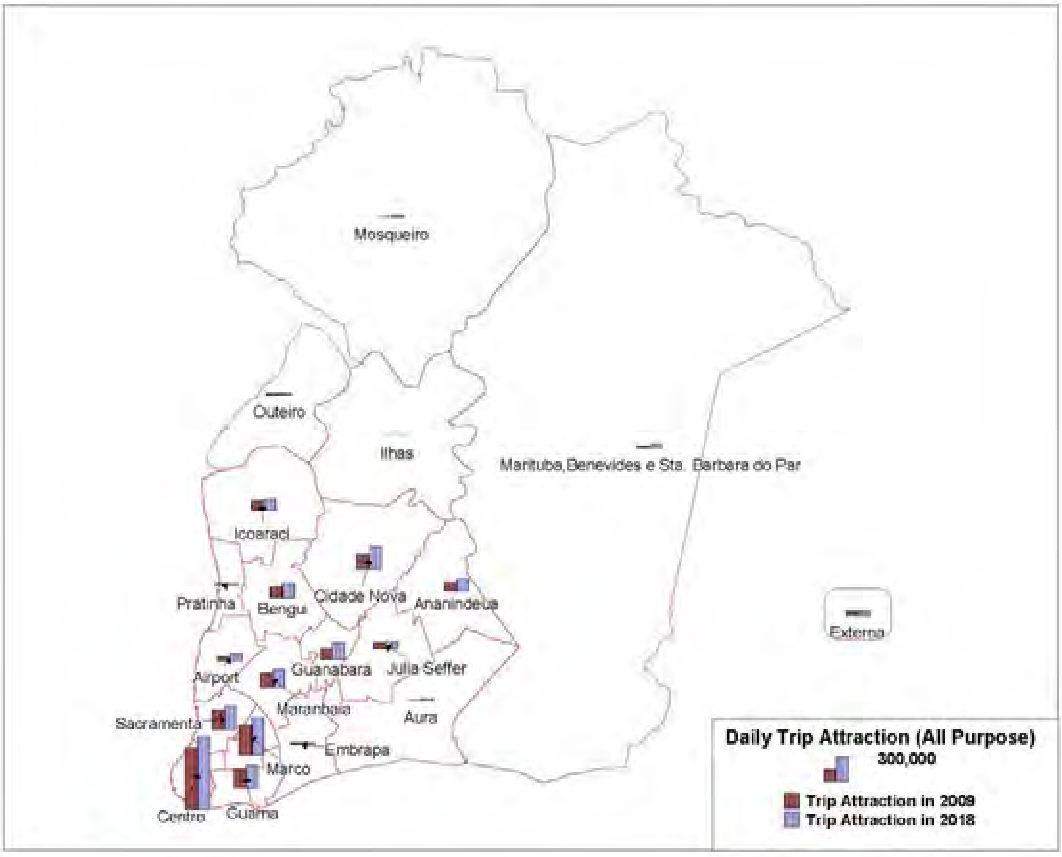


Figure 4.3-2 Attracted Trips of All Purposes in 2009 and 2018

4.3.2. DISTRIBUTION OF OD TRIPS

Figure 4.3-3 compares the desired lines of OD trips for 2009 and 2018. The increase of OD trips is pronounced in the suburbs and exurbs of Belem. By 2018, OD trips expand widely into the outlying areas of Belem City.

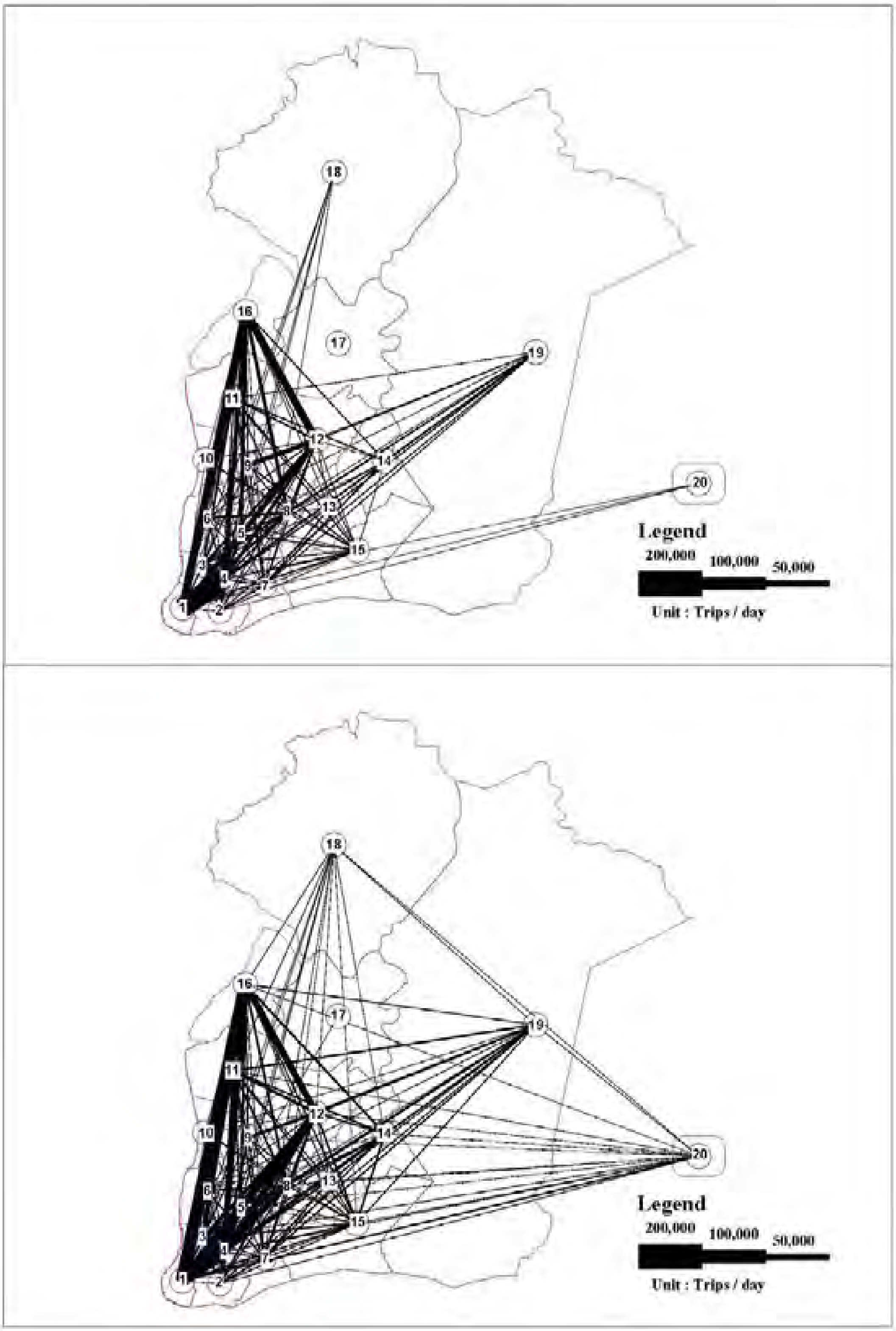


Figure 4.3-3 Desired Lines of OD Trips for 2009 and 2018 (all purposes)

4.3.3. MODAL SPLIT

The future mode shares are derived from the OD tables by trip purpose. The model forecasts the modal split per trip purpose. The results are shown in Table 4.3-1. The totals of the two modes use the total generated trips as control total.

As seen in the table, the growth of private trips matches that of motorized population, while the increase of trips by public transport corresponds to that of non-motorized population. Table 4.3-2 shows the ratios of modal split. The share of public transport decreases from 62% in 2009 to 57% in 2018.

Table 4.3-1 Traffic Demand Forecast by Mode (daily trips)

Year	Private	Public	Total	Private	Public	Total
2009	1,043,252	1,724,093	2,767,345	-	-	-
2013	1,225,666	1,859,999	3,085,665	1.17	1.08	1.12
2018	1,504,806	2,006,348	3,511,154	1.44	1.16	1.27
2025	1,969,663	2,238,954	4,208,617	1.89	1.30	1.52

Table 4.3-2 Ratios of Modal Split (daily trips)

Year	Private	Public	Total
2009	0.38	0.62	1.00
2013	0.40	0.60	1.00
2018	0.43	0.57	1.00
2025	0.47	0.53	1.00

4.4. ROUTING OF TRUNK BUS SERVICES

4.4.1. TWO TARGET YEARS FOR TRUNK BUS SERVICES

As discussed in 5.2.4 (2) of Chapter 5, the trunk bus system is assumed to operate two routing systems, as follows.

1) Routing System A: Routes that service between the respective trunk bus terminals in the outlying area and the bus stop at Sao Braz (the bus services bound for Sao Braz)

2) Routing System B: Routes that service inside the city center of Belem after travelling from the respective outlying terminals to Sao Braz (the bus services bound for the city center of Belem)

The two routing systems are proposed to correspond to two target years of trunk bus operation. Figure 4.4-1 shows how the trunk bus system will extend its services by 2013 and 2018. Trunk bus services will be provided on (i) the routes that originate in each of the seven outlying terminals and continue to service inside the city center after the bus stop at Sao Braz and (ii) the others that end at Sao Braz. The express services are operated only on BR-316, Av. Augusto Montenegro and Av. Almirante Barroso, where bus stops are provided with enough room for passing. In sum, a total of 33 trunk bus routes are proposed, including seven where express services are operated. Supposing that trunk bus services would be introduced after 2018 to Av. Independencia now under construction, 15 routes are assumed to be in operation on the avenue in 2013. Table 4.4-1 lists 33 routes proposed for the trunk bus system. Figures 4.4-2 through 4.4-7 show the respective routes. The express bus stops at each bus station and Entrocamento. These stations are underlined in red in the figures.

Figure 4.4-1 Starting Years of Trunk Bus Operation

Table 4.4-1 List of Trunk Bus Routes

Routing System (A or B)	Route Name	Origin	By way of:	Destination	Route Length (km)	Year of Starting Operation
B	R2104	Icoaraci	Almirante Barroso	Centro	56.3	2013
B	R2108		Independencia	Centro	51.3	2018
A	R2112		Almirante Barroso	Sao Braz	46.4	2013
A	R2113		Independencia	Visconde Souza Franco	46.6	2018
A	E2112		Almirante Barroso	Sao Braz	46.4	2013
B	R2202	Tapana	Almirante Barroso	Centro	36.3	2013
B	R2204		Independencia	Centro	31.3	2018
A	R2212		Almirante Barroso	Sao Braz	26.4	2013
A	R2213		Independencia	Visconde Souza Franco	26.7	2018
A	E2212		Almirante Barroso	Sao Braz	26.4	2013
B	R2302	Mangueirao	Almirante Barroso	Centro	26.7	2013
B	R2304		Independencia	Centro	29.1	2018
A	R2312		Almirante Barroso	Sao Braz	16.8	2013
A	R2313		Independencia	Visconde Souza Franco	24.4	2018
A	E2312		Almirante Barroso	Sao Braz	16.8	2013
B	R2402	Coqueiro	Almirante Barroso	Centro	32.2	2018
B	R2404		Independencia	Centro	35.5	2018
A	R2412		Almirante Barroso	Sao Braz	22.3	2018
A	R2413		Independencia	Visconde Souza Franco	30.9	2018
A	E2412		Almirante Barroso	Sao Braz	22.3	2018
B	R2502	Aguas Lindas	Almirante Barroso	Centro	33.0	2013
B	R2504		Independencia	Centro	41.4	2018
A	R2512		Almirante Barroso	Sao Braz	23.1	2013
A	R2513		Independencia	Visconde Souza Franco	36.8	2018
A	E2512		Almirante Barroso	Sao Braz	23.1	2013
B	R2602	Marituba	Almirante Barroso	Centro	44.7	2013
A	R2612		Almirante Barroso	Sao Braz	34.8	2013
A	E2612		Almirante Barroso	Sao Braz	34.8	2013
B	R2704	Cidade Nova	Almirante Barroso	Centro	40.0	2018
B	R2706		Independencia	Centro	35.1	2018
A	R2712		Almirante Barroso	Sao Braz	30.1	2018
A	R2713		Independencia	Visconde Souza Franco	30.4	2018
A	E2712		Almirante Barroso	Sao Braz	30.1	2018

Note: Blue-shaded rows indicate express services.

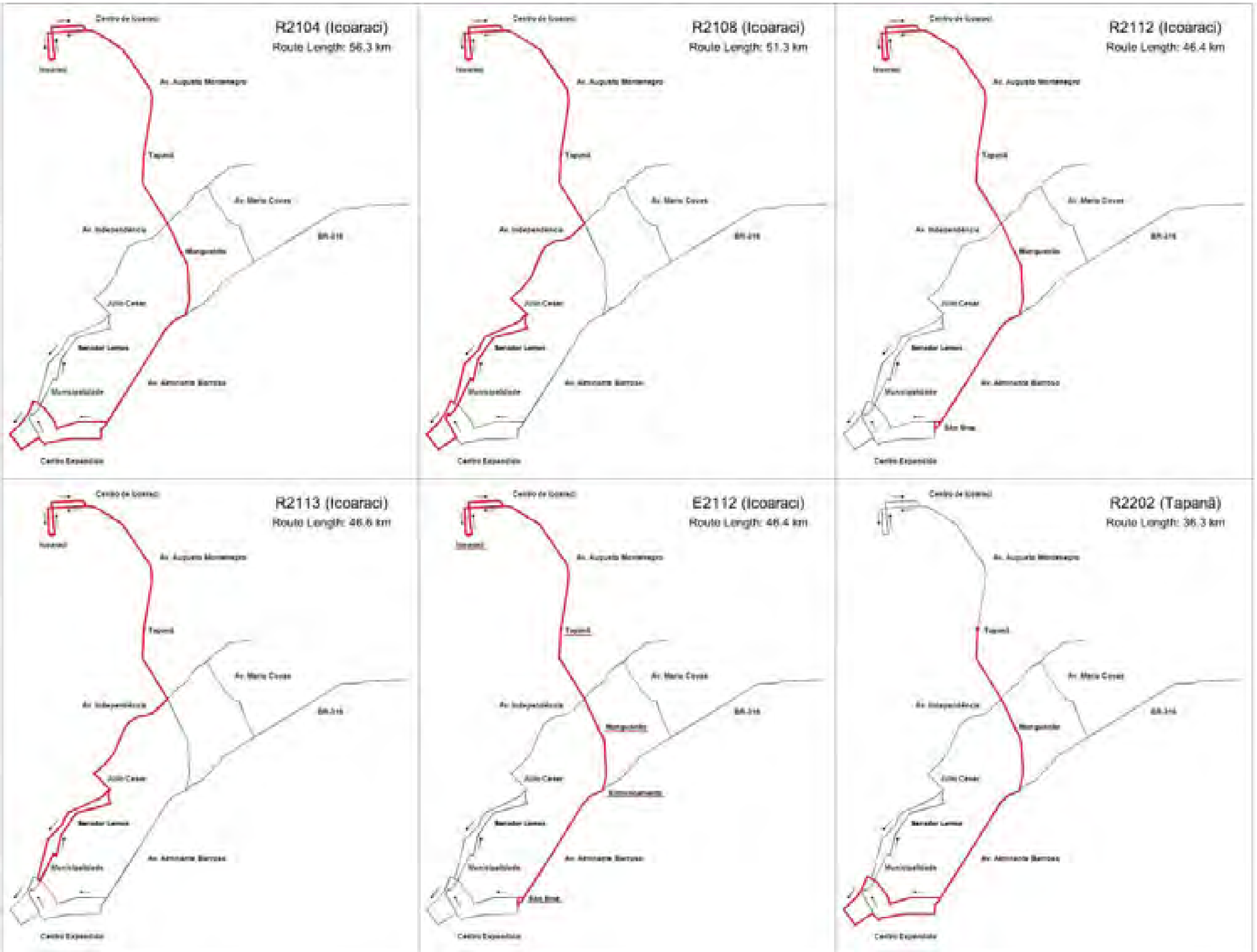


Figure 4.4-2 Trunk Bus Routes (1)

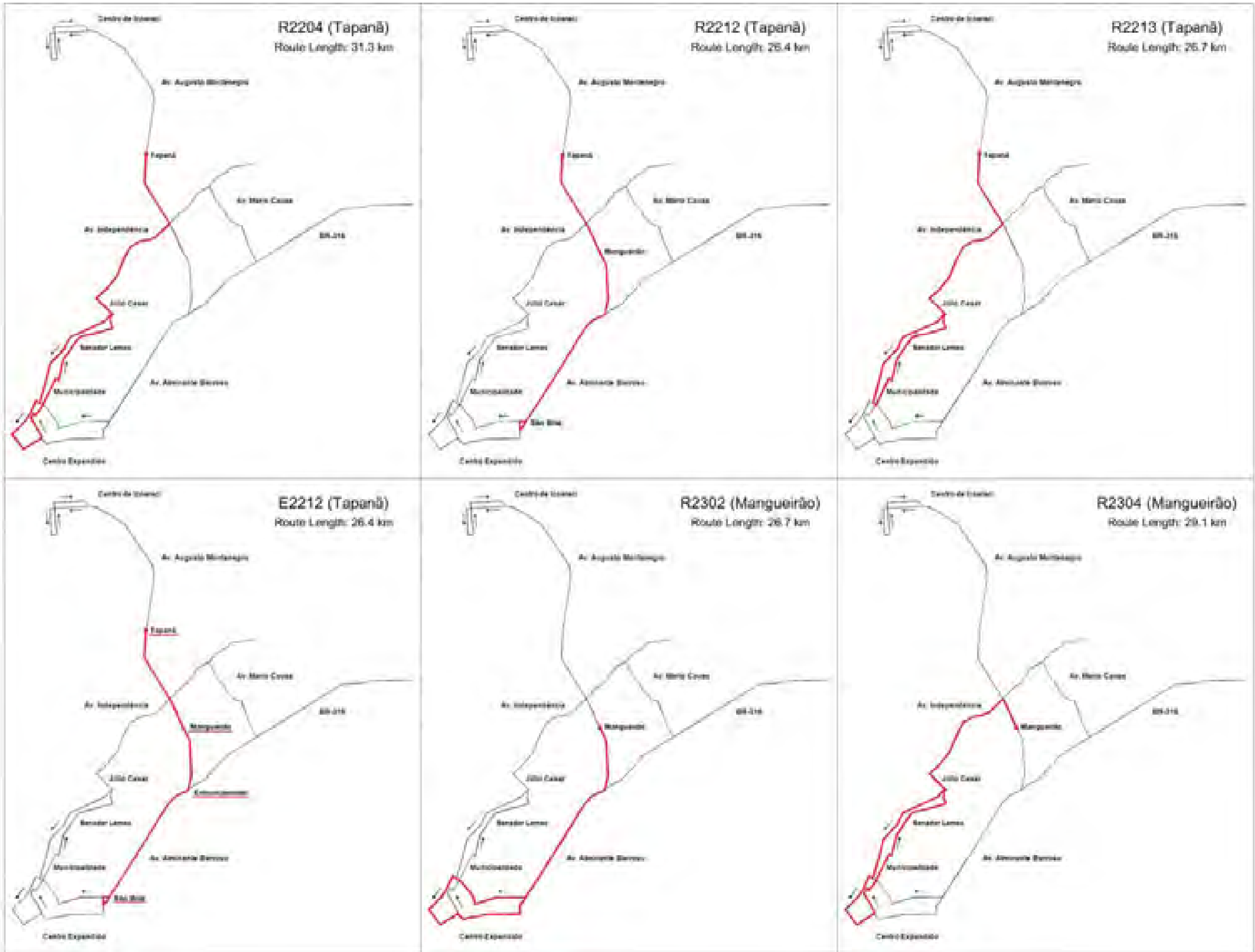


Figure 4.4-3 Trunk Bus Routes (2)

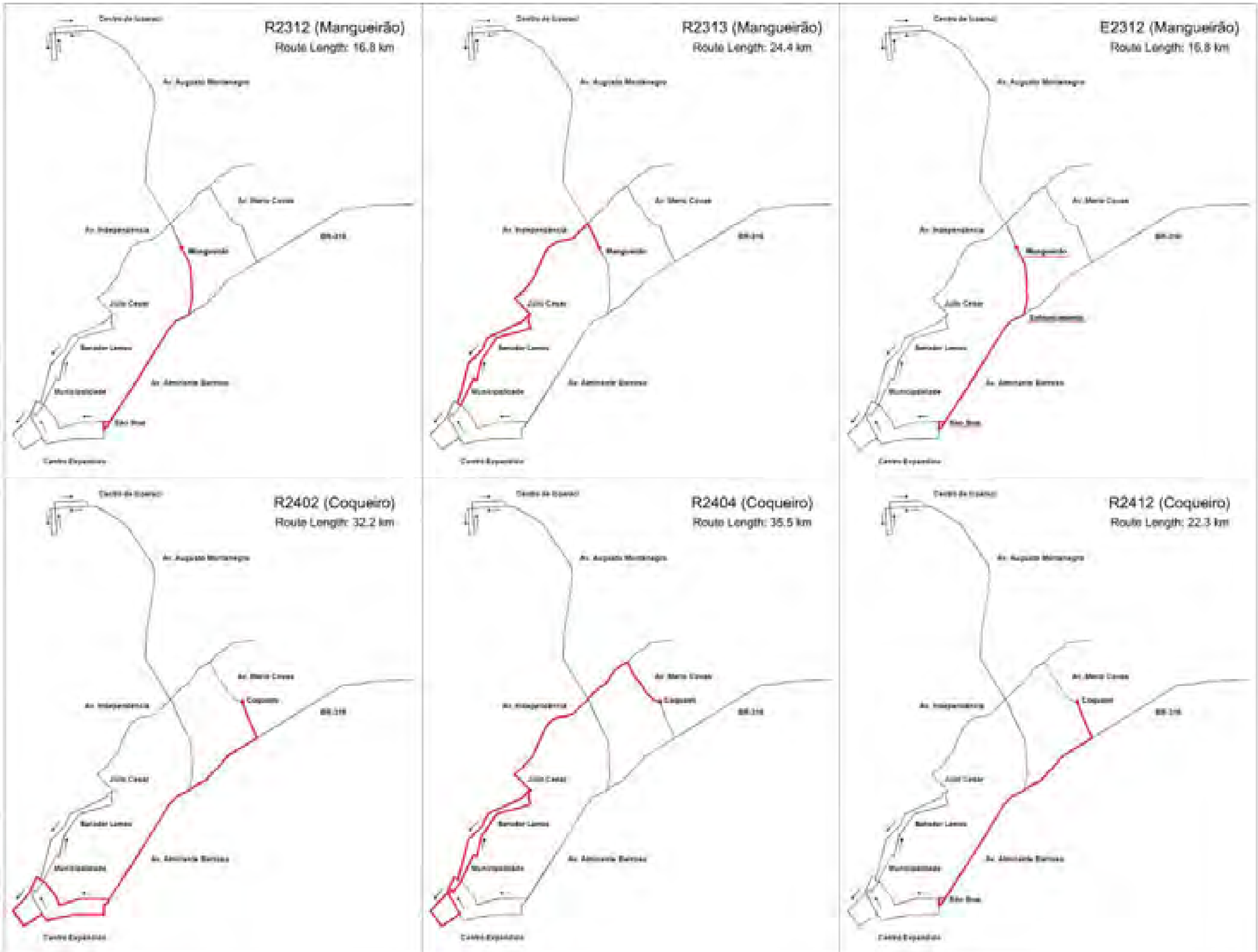


Figure 4.4-4 Trunk Bus Routes (3)

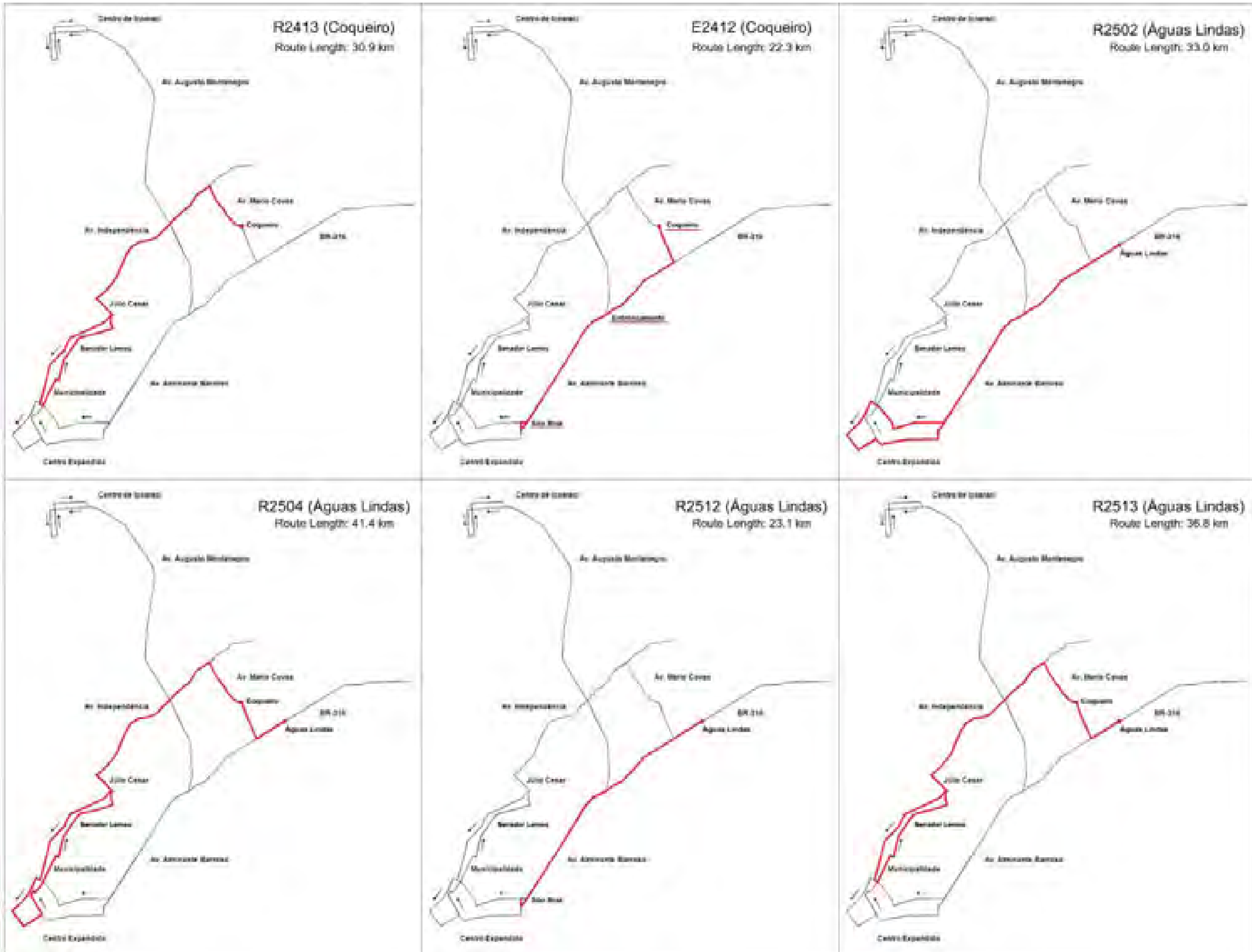


Figure 4.4-5 Trunk Bus Routes (4)

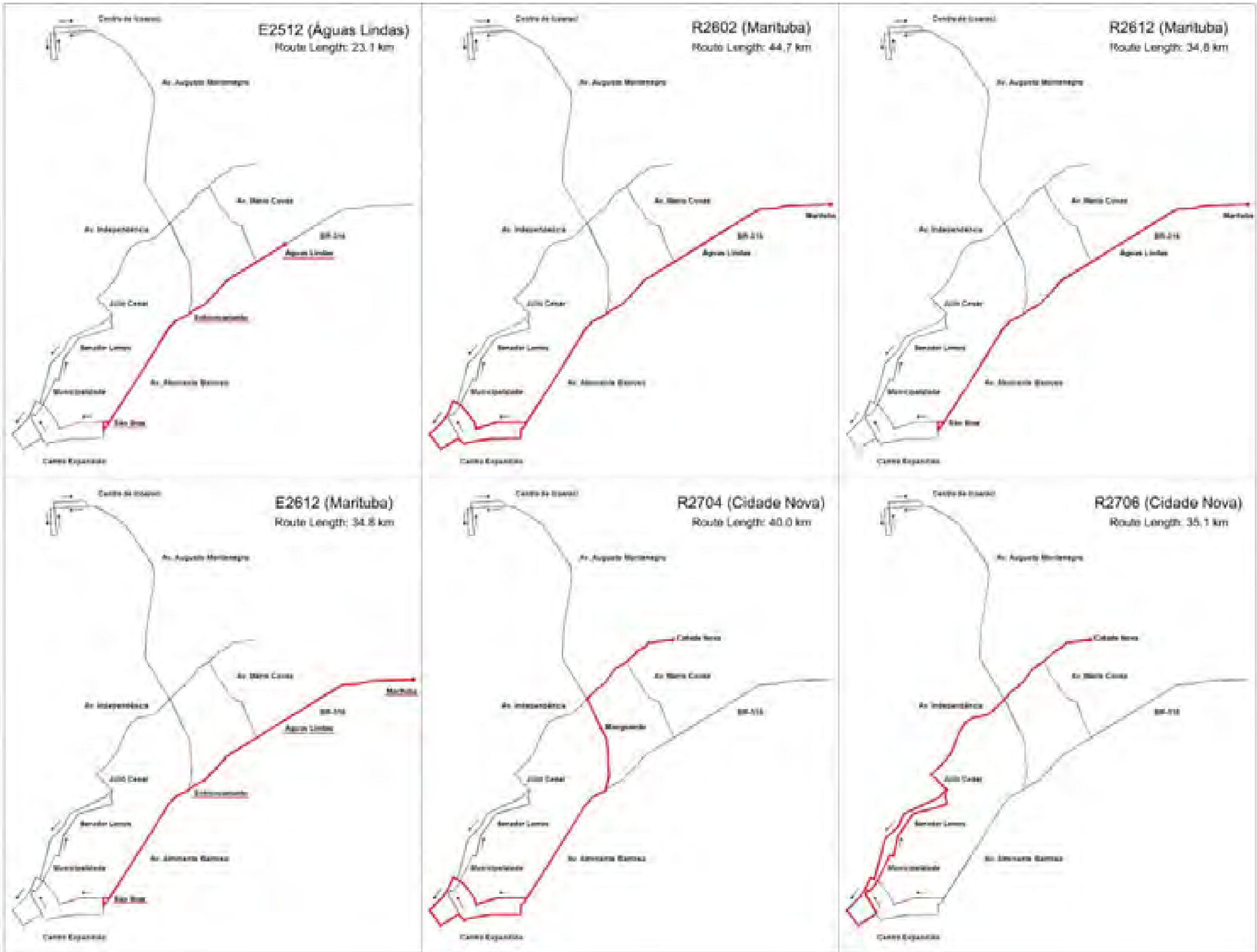


Figure 4.4-6 Trunk Bus Routes (5)

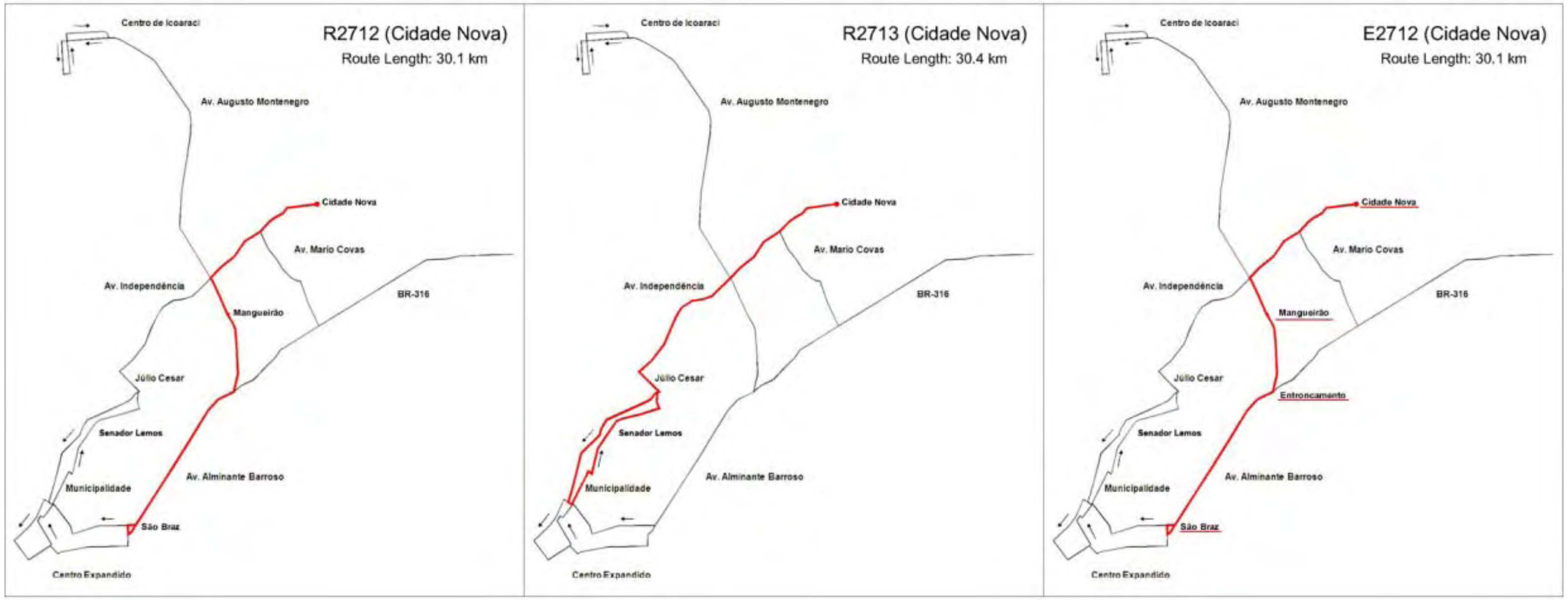


Figure 4.4-7 Trunk Bus Routes (6)

4.4.2. ROUTING FOR EXISTING BUS SERVICES

(1) Existing Bus Lines

The ordinary bus lines have been discontinued, merged or added over the period of 2002 – 2009. The total number of operating bus lines did not change much, from 165 in 2002 to 168 in 2009.

(2) Merging and Discontinuance of Existing Bus Lines

Ideally speaking, the existing ordinary bus lines that would compete with trunk bus on the same routes should be discontinued, because the removal of competitors will ensure the efficient operation of the latter. It must be noted, however, that there is no easy straight answer to the question as to which lines should be discontinued and why. The solution must be sought by carefully judging a variety of factors. There is no set way to address the issue, as exemplified by the experiences of the cities that introduced a similar trunk bus system. They dealt with the issue step by step in their own way, but most of their decisions involved the eventual discontinuation of competing bus lines. The trunk bus system proposed for the metropolitan area of Belem will necessitate the discontinuance of some existing bus lines in accordance with the expected shift in passenger demand. The basic stance of the present Study over the issue is summarized as follows.

- To minimize unnecessary confusion among bus passengers, it is necessary to avoid discontinuing too many bus lines in too hasty a decision.
- The issue naturally poses a threat to the bus operating companies. It must be repeated not to discontinue too many bus lines.
- If the percentage of discontinued lines should be too high, the trunk bus system would have to handle the excessive operating load.
- If the percentage of discontinued lines should be kept low, the trunk bus system would face a reduced passenger demand and suffer the lowered investment efficiency.

The discontinuance and merging of existing bus lines are customarily done by setting a certain cut expressed in the ratio, or percentage, of the competing distance in the total length of a given bus line. Naturally, the number of bus lines to be discontinued increases or decreases depending on how low or high the cut ratio is set.

Table 4.4-2 shows how the total number of bus lines to be discontinued by 2013 varies by the different cut ratios. Table 4.4-3 shows the same variation regarding 2018. If the ratio of 0.5 is chosen for the cut, for example, 84 bus lines, or 50% of the total, will have to be discontinued by 2013. If the cut is raised to 0.7, the number will be reduced to 34 lines, or 20% of the total bus lines. The situation would be basically the same for the target year of 2018.

Table 4.4-2 Existing Bus Lines to be Discontinued by 2013 by Different Cut Ratio

	Cut Ratio of Competing Distance with Trunk Bus Lines	Total Existing Bus Lines	Total Discontinued Lines	Share of Discontinued Lines	Total Retained Lines	Share of Retained Lines	Total Extension of Retained Lines (km)
2013		168					6,797.7
1	0.0	168	168	100.0%	0	0.0%	0.0
2	0.1	168	154	91.7%	14	8.3%	414.0
3	0.2	168	137	81.5%	31	18.5%	1,075.8
4	0.3	168	113	67.3%	55	32.7%	1,940.7
5	0.4	168	100	59.5%	68	40.5%	2,435.8
6	0.5	168	84	50.0%	84	50.0%	3,193.1
7	0.6	168	55	32.7%	113	67.3%	4,542.8
8	0.7	168	34	20.2%	134	79.8%	5,471.4
9	0.8	168	18	10.7%	150	89.3%	6,113.7
10	0.9	168	6	3.6%	162	96.4%	6,578.2
11	1.0	168	2	1.2%	166	98.8%	6,734.6

Table 4.4-3 Existing Bus Lines to be Discontinued by 2018 by Different Cut Ratio

	Cut Ratio of Competing Distance with Trunk Bus Lines	Total Existing Bus Lines	Total Discontinued Lines	Share of Discontinued Lines	Total Retained Lines	Share of Retained Lines	Total Extension of Retained Lines (km)
2013		168					6,797.7
1	0.0	168	168	100.0%	0	0.0%	0.0
2	0.1	168	156	92.9%	12	7.1%	383.1
3	0.2	168	139	82.7%	29	17.3%	1,024.5
4	0.3	168	118	70.2%	50	29.8%	1,789.1
5	0.4	168	100	59.5%	68	40.5%	2,435.8
6	0.5	168	87	51.8%	81	48.2%	3,085.6
7	0.6	168	58	34.5%	110	65.5%	4,399.0
8	0.7	168	38	22.6%	130	77.4%	5,326.4
9	0.8	168	20	11.9%	148	88.1%	6,045.0
10	0.9	168	6	3.6%	162	96.4%	6,578.2
11	1.0	168	2	1.2%	166	98.8%	6,734.6

(3) Experiences in Other Cities

1) Curitiba

Curitiba did not discontinue competing bus lines but moved them to the roads that ran parallel to the trunk busways. However, many of them went out of business after losing passengers to the trunk bus system.

2) Recife

The trunk bus system is yet to go into operation. Thus, no action has been taken either way.

3) Santiago

Santiago did not discontinue the existing bus lines when the trunk bus system was introduced. Subsequently, the city began to discontinue one by one.

4) Lima

The city has a plan to reroute the existing bus lines by the time the trunk bus system is to go into operation. The plan is yet to be implemented.

4.4.3. ALTERNATIVE CASES FOR DEMAND ASSIGNMENT

(1) Identification of Alternative Cases

The passenger demand on the trunk bus system is forecast for three target years of 2013, 2018 and 2025. Alternative cases are identified by considering the assumptions about the trunk bus routing systems and the variable decision over the discontinuance of the existing bus lines.

As shown in Table 4.4-4, the alternative cases are based on the network of trunk bus lines to be opened by each target year and then varied by the different percentages of discontinued ordinary bus lines. The passenger demand assignment is done on each alternative case “with” and “without” the trunk bus project. Of three alternative cut ratios for bus line discontinuance, the variant of 100% is considered necessary in case the planned discontinuance should fall through.

Table 4.4-4 Alternative Cases for Demand Assignment

Case	Target Year	Trunk Bus Lines	Existing Bus Lines
Case-1-1	2013	Network developed by 2013	100% of bus lines in 2009 to be retained
Case-1-2			20% of bus lines in 2009 to be discontinued (cut at 70%)
Case-2-1	2018	Network developed by 2018	100% of bus lines in 2009 to be retained
Case-2-2			23% of bus lines in 2009 to be discontinued (cut at 70%)
Case-2-3			52% of bus lines in 2009 to be discontinued (cut at 50%)
Case-3-1	2025	Network developed by 2018	23% of bus lines in 2009 to be discontinued (cut at 70%)

(2) Fare

The demand forecast assumes the following conditions for the fare system.

- The integrated system of fixed fare: Passengers pay no extra charge for transfers from a trunk bus to another or between a trunk and a feeder bus. When transferring from a trunk bus to an ordinary bus, the passenger pays the additional fare charged by the latter.
- Trunk bus fare: fixed fare of R$1.7
- Conventional bus fare: fixed fare of R$1.7 (same as the present fare)
- An increase or a decrease of the fare and its possible impact on the passenger demand are examined in the economic and financial analysis of the project.

(3) Results of Demand Forecast on Trunk Bus System

The details of the forecast are given in Chapter 5.

CHAPTER 5
Basic Planning For Trunk Bus Project

5. BASIC PLANNING FOR TRUNK BUS PROJECT

5.1. TRANSPORT MODE TO BE INTRODUCED IN THE STUDY AREA

5.1.1. CONSTRUCTION COST AND TRANSPORT CAPACITY OF EACH TRANSPORT MODE

The construction cost and transport capacity of each transport mode are shown in Table 5.1-1. Generally, the transport capacity of the Light Rail Transit (LRT) and Mono Rail is estimated at about 5,000 to 6,000 persons per hour per direction. The transport capacity of Heavy Rail Transit is estimated at about 30,000 to 50,000 persons per hour per direction.

On the other hand, the transport capacity of conventional bus system (single bus) and articulated bus system is estimated at about 5,000 to 6,000 persons per hour per direction and 10,000 persons per hour per direction depend on the different bus operation system. However, the transport capacity of bi-articulated bus in the Curitiba City is observed at 20,000 persons per hour per direction, and the minimum operation head way is observed at about 45 seconds. In case of preparation of passing lane for buses at a bus stop, the line capacity of bus will become twice from the view point of structure.

The construction cost of LRT and Monorail is adopted at about US$ 30 million per kilometer based on the past experience, and the construction cost of trunk bus system is adopted at about US$ 5Million per kilometer. The construction cost of the trunk bus system is very cheap compared with LRT and Monorail.

For reference, the transport capacity of Bogota Tranmilenio trunk bus system operated in Bogota City was observed at about 44,000 persons per peak hour per 2-lane per direction according to the [Report of Bogota Transmilenio] published in 2007.

Table 5.1-1 Comparison of Transport Modes

Transport Mode	Capacity per Vehicle	Combination Of Train Cars	Capacity of Train Cars	Minimum Operation Head	Transport Capacity /hour/direction	Const.Cost (US$ mill/km)
LRT	100	3	300	5.0	3,600	25～37
	100	5	500	5.0	6,000	
Monorail	100	4	400	5.0	4,800	35 ～50
	100	5	500	5.0	6,000	
	100	6	600	5.0	7,200	
Heavy Rail	400	7	2,800	5.0	33,600	50～70
	400	8	3,200	5.0	38,400	
	400	10	4,000	5.0	48,000	
Bus (1-Lnae)	100	1	100	0.5	3,000	
(2-Lnae)	100	1	100	0.25	6,000	
Trunk bus(1-Lane)	80	2	160	1.0	9,600	4 ～5
(2-Lnae)	80	2	160	0.5	19,200	
(1- Lane)	80	3	240	1.0	14,400	
(2- -Lane)	80	3	240	0.5	28,800	

5.1.2. TRANSPORT MODE TO BE INTRODUCED IN THE STUDY AREA

Based on the bus passenger demand volume, the characteristics of bus passenger trips, the comparison with other transport modes and the results of discussion with counterparts, the trunk bus system (articulated bus) will be introduced in the study area. The major reasons are described below.

(1) From Viewpoint of Capacity and Bus Passenger Demand Volume

Bus passengers are concentrated on the Av. Almirante Barros and about 39,000 passengers per hour per direction were observed in 2009 traffic survey conducted by the JICA team. Considering the characteristics of bus passenger trips, about 65% (25,000 passengers) of the total numbers of passengers may use a new transport mode.

From the viewpoint of bus passenger demand volume, a new transport mode should ensure the transport capacity over 20,000 passengers per hour per direction. The transport capacity of LRT (about 6,0000 persons/hour/direction), and Monorail (7,000 persons/hour/direction), and the conventional buses (6,000 persons/hour/direction) cannot handle all the bus passenger demand. Therefore, the trunk bus system will be recommended for introduction in the study area.

(2) From Viewpoint of Transport Flexibility

The operation system of bus transport is easy compared with the railway system and bus operation can be controlled at 60 seconds headway. In addition, the bus system and bus operation routes can be easily changed depending on the passenger demand. The bus system is a flexible transport system and can be operated at low construction cost. Therefore, bus transport is more advantageous in this respect.

(3) From Viewpoint of Operation and Maintenance

Compared to the railway system, the bus system enables easier operation and maintenance and is more advantageous.

(4) From Viewpoint of Construction Cost

As shown in Table 5.1-1, the construction of LRT and Monorail is very high at about US$ 30 to 50 million. But the trunk bus system only costs US$ 5 million. Therefore, bus transport is more advantageous in this respect.

(5) From Viewpoint of Existing Road Facility Conditions

The width of major existing roads in Belém city center is very narrow at about 15 m to 17 m width, and also one-way traffic controls are implemented. Large roadside trees (mango trees, diameter of tree is about 60 cm) are planted on both sides of the pedestrian way as a symbol of Belém City. These roadside trees cannot be cut down for widening of the existing roads. Since there is no room to construct the LRT including railway transport system on the same ground level of the existing road, bus transport is again advantageous.

(6) From Viewpoint of Operation Experience

The government of Para state and the local government have a lot of bus operation experience. It is easy for the trunk bus system to join in operation of existing companies. However, they have not experience to operate a railway system. Therefore, it is very easy to introduce the trunk bus system.

(7) From Viewpoint of Environmental Conservation

Considering the global warming aspect, the railway systems obviously have lots of advantages compared with the bus system. However, the trunk bus system will contribute to reducing air pollution by largely reducing the number of buses in operation and mitigating traffic congestion.

5.2. BASIC PLAN OF TRUNK BUS SYSTEM

The trunk bus system study is conducted based on the results of the F/S conducted by JICA in 2003, and the results of full discussion with counterparts of the study. The Para State Government should realize the trunk bus system in accordance with the recommendations of this study.

5.2.1. PURPOSE OF INTRODUCTION OF TRUNK BUS SYSTEM

The major objective of the introduction of the trunk bus system is to improve the existing bus operation system, and to improve the traffic congestion in the study area. By introducing the trunk bus system, efficient bus operations and sound urban transport functions will be secured. From these viewpoints, the trunk bus system study will be conducted considering the following points, i) bus passengers ,ii) bus operating company, iii) citizens, and iv) environmental aspects.

Generally, the trunk bus system should ensure the following matters.

1) In general, the conventional bus system is a supplemental transport system to the railway system, however, the trunk bus system is a public transport mode that secures medium transport volume in place of railways. There are many trunk bus systems in the cities of Brazil.

2) The trunk bus system should be flexible enough to respond to future changes in bus passenger demand.

3) The trunk bus system should be a fast and pleasant transit system so as to encourage private transport passengers to switch to it.

4) Two large-carriage articulated buses should be introduced in order to increase the transport capacity.

5) Bus lanes shall be separated from ordinary traffic lanes as much as possible from a view point to securing functional and effective services and safety.

6) The intersections between the trunk bus roads and other roads will be planned as the same grade type generally. However, separate-grade intersections shall be considered between arterial roads.

5.2.2. BUS SYSTEM IN STUDY AREA

As can be seen in Figure 5.2-1, the bus system in the study area will be formed by three systems, i.e. i) trunk bus system, ii) feeder bus system, and iii) conventional bus system.

In F/S report conducted by JICA in 2003, the trunk bus system was classified into three categories, i.e. i) trunk bus exclusive road, ii) trunk bus exclusive lane, and iii) trunk bus priority lane. These trunk busways are applied on major trunk roads. However, since the bike way on Av. Almirante Barrosois was constructed in the middle of the cross section, the trunk bus exclusive lane is proposed due to insufficient width of right of way, in spite of recommendation of trunk bus exclusive road in F/S in 2003.

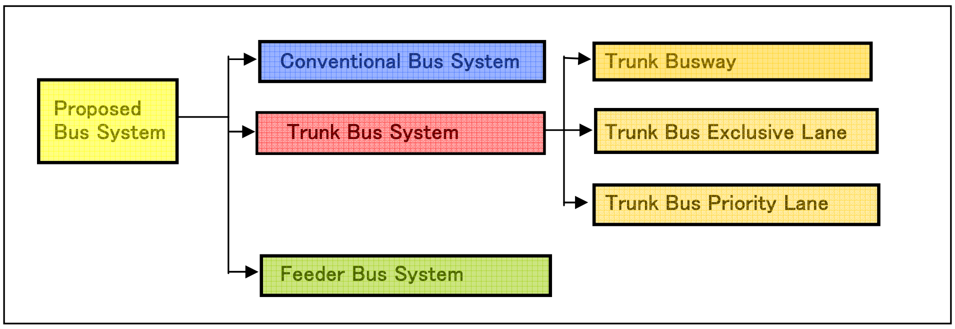


Figure 5.2-1 Bus system in the study area

(1) Outline of Trunk Bus System

The trunk bus system is classified into three types, i.e. i) trunk bus exclusive road, ii) trunk bus exclusive lane, iii) trunk bus priority lane in accordance with the recommendation of F/S Report conducted by JICA in 2003.

1) Trunk Bus Exclusive Road and Exclusive Lane

The trunk bus roads and lanes will be introduced under the following existing road conditions.

a) On the primary arterial and secondary roads with estimated demand volume of 8,000 to 10,000 passengers.

b) On the primary arterial and secondary roads which have enough right of way (ROW) width for introduction of the trunk bus system.

c) On the primary arterial and secondary roads which are maintained as 3-lane dual carriageways.

The facility conditions of trunk bus exclusive road are as follows, and the typical cross section of the trunk bus exclusive road is shown in Figure 5.2-2.

a) The trunk bus exclusive road is separated from other vehicle lanes with a separator of concrete structure so that other vehicles cannot enter the bus road.

b) The trunk bus exclusive road will be constructed in the center of the existing road with 2-lane bus exclusive road. In case of trouble of a bus on trunk bus exclusive road, a following bus can overtake with running on a lane in opposite direction.

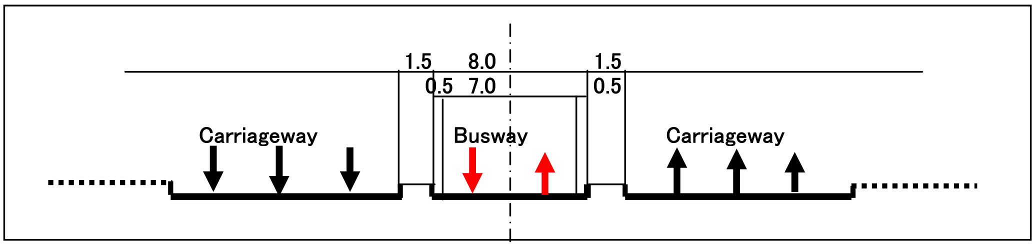


Figure 5.2-2 Typical Cross Section of Trunk Bus Exclusive Road

The road facility conditions of trunk bus exclusive lane are as follows, and the typical cross section of the trunk bus exclusive lane is shown in Figure 5.2-3.

a) The trunk bus exclusive lane is partially separated from the general vehicle traffic lanes by separator, and general vehicles are excluded from the trunk bus exclusive lane for all day long.

b) The trunk bus exclusive lanes are planned at the center side of the existing road, and in-bound and out-bound trunk bus exclusive lane are separated by the central reservation.

c) Taxis, private cars, bicycles, motorcycles and pedestrians, etc. are excluded from the trunk bus exclusive lane for all day long.

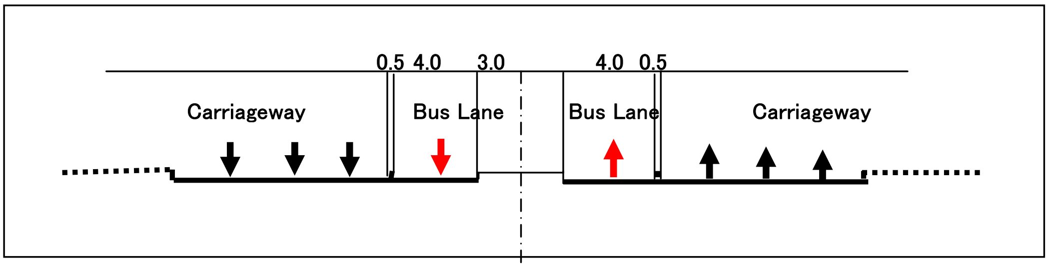


Figure 5.2-3 Typical Cross Section of Trunk Bus Exclusive Lane

2) *Trunk Bus Priority Lane*

The trunk bus priority lanes will be introduced on the following existing roads.

a) The trunk bus priority lane is introduced on the existing roads which have comparatively low bus passenger volume (8,000 to less than 10,000 passengers).

b) The trunk bus priority lane is introduced on the existing secondary arterial roads with 2-lane dual carriageway.

c) The trunk bus priority lane is introduced on the existing roads which experience traffic congestion.

d) The trunk bus priority lane is introduced on the roads which cannot be widened.

The road facility conditions of trunk bus priority lane are as follows, and the typical cross section of the trunk bus priority lane is shown in Figure 5.2-4.

a) The trunk buses can use the priority lane in peak hours. In off-peak hours, general vehicle traffic can be used on the priority lane.

b) However, general vehicle traffic can use the priority lane in peak hours if it doesn't hinder trunk bus operation.

c) The trunk bus priority lane is introduced at the same level as the existing road surface.

d) The trunk bus priority lane is introduced at the same level of the existing road surface without any separators.

e) The trunk bus priority lane is introduced to the left side of the existing road. Conventional buses will use the right side traffic lane of the existing road (as they do now).

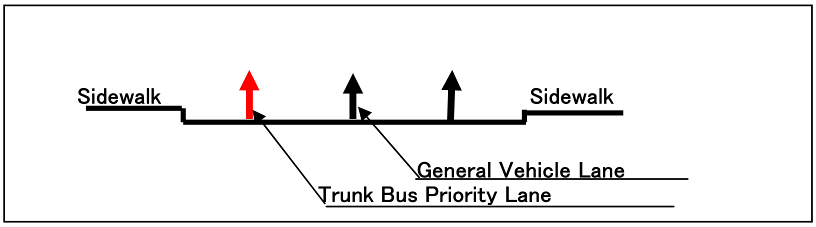


Figure 5.2-4 Typical Cross Section of Trunk Bus Priority Lane

(2) Conventional Bus System

At present, the conventional bus with transport capacity of 60 to 100 passengers is operating on the right side traffic lane of existing road. After introduction of the trunk bus system, the operation condition of the conventional buses will not change, however, the bus routes of the conventional buses will need to be re-routed.

(3) Feeder Bus System

The feeder buses are operated in the areas from trunk bus terminals and bus stations to local areas. The feeder bus system requires the following functions or characteristics.

a) Small buses with about 50 to 70 transport capacity will be adopted due to the narrow operation routes in the service areas.

b) Feeder buses are connected directly to the trunk bus terminals and trunk bus stations introduced by integrated system.

(4) Summary of Bus System in Study Area

The outline of bus system comprising i) trunk bus exclusive road, ii) trunk bus exclusive lane, iii) trunk bus priority lane , iv) conventional bus system, and v) feeder bus system in the study area is shown in Table 5.2-1.

Table 5.2-1 Outline of Bus System

Bus System	Separation Of Road	Control Hour	Operated Bus System	Existing Road Introduced			Bus		Passenger Demand
				No of Lane	ROW	Road Class	Type	Capacity (person)	
Exclusive Road	Full Separation	All Day	Trunk Bus	>6-Lane	>45m	Arterial	Articulated	200	>10,000
Exclusive Lane	Partial Separation	All Day	Trunk Bus	>6-Lane	>30m	Arterial	Articulated	200	>10,000
Priority Lane	No Separation	Peak Hours	Trunk Bus Conventional Car	4-lane	>25m	Second Arterial	Articulated	200	<10,000
Conventional Bus	No Separation	Non	Conventional Car	————	————	Road	Single	60 100	————
Feeder Bus	No Separation	Non	Feeder Bus Conventional Car	————	————	Local Road	Single	50 70	————

5.2.3. TRUNK BUS SYSTEM ROUTE PLAN

(1) Selected Criteria for Trunk Bus System Route Introduction

Considering the functions and characteristics of the each bus system, the existing roads to be selected for each bus system are identified as shown in Table 5.2-2.

Table 5.2-2 Selection Criteria

Bus System	Bus Road or Lane	Criteria
Trunk Bus System	Trunk Bus Exclusive Road & Lane	1) Many bus passengers are collected 2) At least a 3-lane dual carriageway (6 lanes in total) 3) Primary arterial 4) Many bus routes are concentrated 5) Traffic congestion by bus traffic

	Trunk Bus Priority Lane	1) Many bus passenger are collected 2) At least a 2-lane dual carriageway (4 lanes in total) 3) Major streets in urban areas 4) Difficult to widen 5) Traffic congestion by bus traffic
Feeder Bus System	Feeder Bus	1) Many bus passenger are collected in local area 2) At least a 2-lane dual carriageway (4 lanes in total) 3) Major street in local area 4) Traffic congestion by bus traffic
Conventional Bus System	Existing Road	Adopted existing conventional bus route

(2) Comparison to Locations of Trunk Bus System Recommended by F/S in 2003 and the Study

Table 5.2-3 shows the comparison to locations of trunk bus system in both studies: JICA Study in 2003 and this Study. The locations of trunk busway are shown in Figure 5.2-5 in F/S in 2003 and Figure 5.2-6 in the Study.

Table 5.2-3 Comparison to Locations of Trunk Bus System Proposed by F/S in 2003 and the Study

Locations of trunk bus system recommended in F/S in 2003		Locations recommended in the Study	
Type of Trunk Busway	Criteria of Selection	Type of Trunk Busway	Criteria of Selection
Trunk Bus Exclusive Road		*Trunk Bus Exclusive Road*	
Av. Alimirante Barroso	- High bus passenger demand - 6 lane road	BR-316	- High bus passenger demand - 6 lane road
BR-316	- High bus passenger demand - 6 lane road	Av. August Montenegro	- High bus passenger demand - 6 lane road
Av. August Montenegro	- High bus passenger demand - 6 lane road		
Trunk Bus Exclusive Lane		*Trunk Bus Exclusive Lane*	-
Av. Independencia	- High bus passenger demand - Insufficiency of 6 lane	Av. Alimirante Barroso	- High bus passenger demand Insufficiency of 6 lane
Trunk Bus Priority Lane		*Trunk Bus Priority Lane*	-
Av. Mario Covas	Somewhat high bus passenger demand	Av. Independencia	- High bus passenger demand - 4 lane road
Gov. Jose Malcher	Somewhat high bus passenger demand	Av. Mario Covas	Somewhat high bus passenger demand
Av. Visconde Souze Franco	Somewhat high bus passenger demand	Gov. Jose Malcher	Somewhat high bus passenger demand
Av. Marcechal Hermes	Somewhat high bus passenger demand	Av. Visconde Souze Franco	Somewhat high bus passenger demand
Bourevardo Castilhos	Somewhat high bus passenger demand	Av. Marcechal Hermes	Somewhat high bus passenger demand
Av. Portugal	Somewhat high bus passenger demand	Bourevardo Castilhos	Somewhat high bus passenger demand
Av. 16 de Novembro	Somewhat high bus passenger demand	Av. Portugal	Somewhat high bus passenger demand
Av. Aliminante Tamandare	Somewhat high bus passenger demand	Av. 16 de Novembro	Somewhat high bus passenger demand
Rua. Gama Abreu	Somewhat high bus passenger demand	Av. Aliminante	Somewhat high bus passenger demand

		Tamandare	
Av. Serzedelo Correa	Somewhat high bus passenger demand	Rua. Gama Abreu	Somewhat high bus passenger demand
Av. Gentil Binifacio	Somewhat high bus passenger demand	Av. Serzedelo Correa	Somewhat high bus passenger demand
Av. Pedro Alvares Cabral	Somewhat high bus passenger demand	Av. Gentil Binifacio	Somewhat high bus passenger demand
Assis de Vasconcelos	Somewhat high bus passenger demand	Av. Pedro Alvares Cabral	Somewhat high bus passenger demand
Bouevard Castilhos Franca	Somewhat high bus passenger demand	Assis de Vasconcelos	Somewhat high bus passenger demand
Rua Municipaidade	Somewhat high bus passenger demand	Bouevard Castilhos Franca	Somewhat high bus passenger demand
Av. Senador Lemons	Somewhat high bus passenger demand	Rua Municipaidade	Somewhat high bus passenger demand
Djalma Dutra	Somewhat high bus passenger demand	Av. Senador Lemons	Somewhat high bus passenger demand
Trav. Sao Roque	Somewhat high bus passenger demand	Djalma Dutra	Somewhat high bus passenger demand
Rua. Siqueira Mendos	Somewhat high bus passenger demand	Trav. Sao Roque	Somewhat high bus passenger demand
Rua. Manuel Barata	Somewhat high bus passenger demand	Rua. Siqueira Mendos	Somewhat high bus passenger demand
Trav. Cristovao Colombo	Somewhat high bus passenger demand	Rua. Manuel Barata	Somewhat high bus passenger demand
Soledade	Somewhat high bus passenger demand	Trav. Cristovao Colombo	Somewhat high bus passenger demand
		Soledade	Somewhat high bus passenger demand

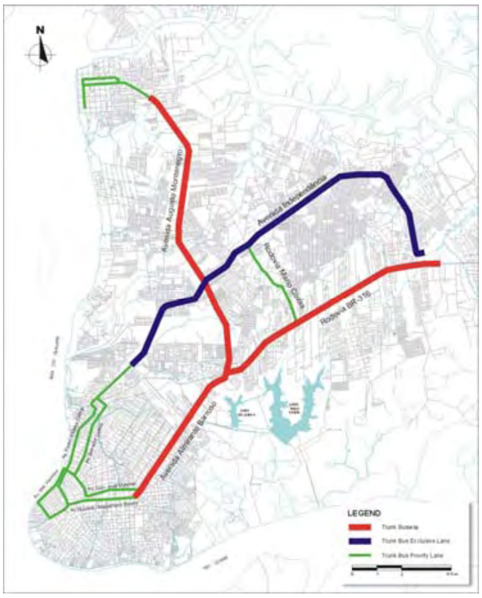


Figure 5.2-5 Location of Trunk Bus Road Recommended by F/S in 2003

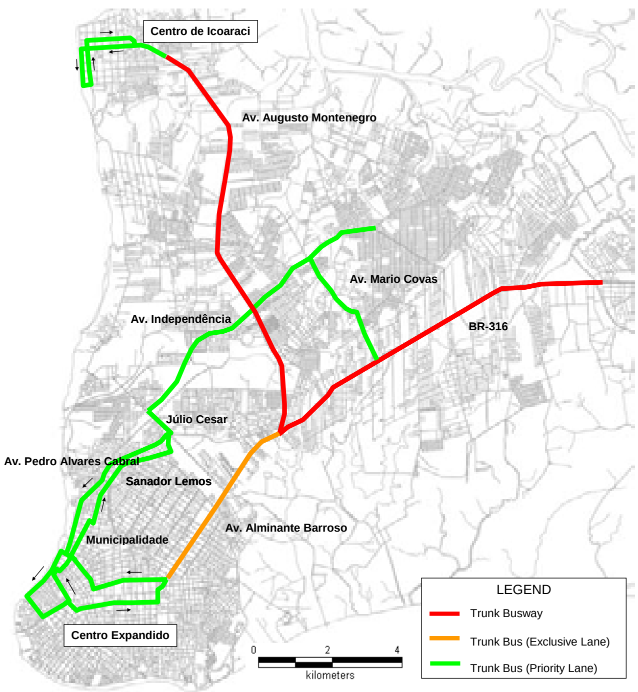


Figure 5.2-6 Location of Trunk Bus System Recommended by This Study

The comparison of location of trunk bus system recommended between F/S study conducted by JICA in 2003 and this study is shown in Table 5.2-4 in which shadow areas are different in the trunk busway system between both Studies.

Table 5.2-4 Comparison of Location of Trunk Bus System

Name of Road	Recommended by F/S Study	Recommended by This Study
BR-316	Trunk Bus Exclusive Road	Trunk Bus Exclusive Road
Av. Montenegro	Trunk Bus Exclusive Road	Trunk Bus Exclusive Road
Av. Alimirante Barroso	Trunk Bus Exclusive Road	Trunk Bus Exclusive Lane
Av. Independencia (East)	Trunk Bus Exclusive Lane	Trunk Bus Priority Lane
Av. Independencia (West)	Trunk Bus Exclusive Lane	Trunk Bus Priority Lane
Streets in Icoaraci Area	Trunk Bus Priority Lane	Trunk Bus Priority Lane
Streets in Binario Area	Trunk Bus Priority Lane	Trunk Bus Priority Lane
Streets in Belem Central Area	Trunk Bus Priority Lane	Trunk Bus Priority Lane

5.2.4. Trunk Bus System Operation Plan

When the trunk bus system operation plans are identified, the following matters should be examined.

a) Functions and characteristics of operation on the trunk bus exclusive roads and lanes

b) Functions and characteristics of operation on the trunk bus priority lanes

c) Functions and characteristics of operation on the feeder bus system

d) Functions and characteristics of operation on the conventional bus system

e) Functions and characteristics of operation at the trunk bus terminals

f) Functions and characteristics of operation at the trunk bus stations

g) Functions and characteristics of operation at the trunk bus stops

h) Functions and characteristics of operation at the existing conventional bus stops

(1) Trunk Bus Operation System

The general trunk bus system operation system is shown in Figure 5.2-7.

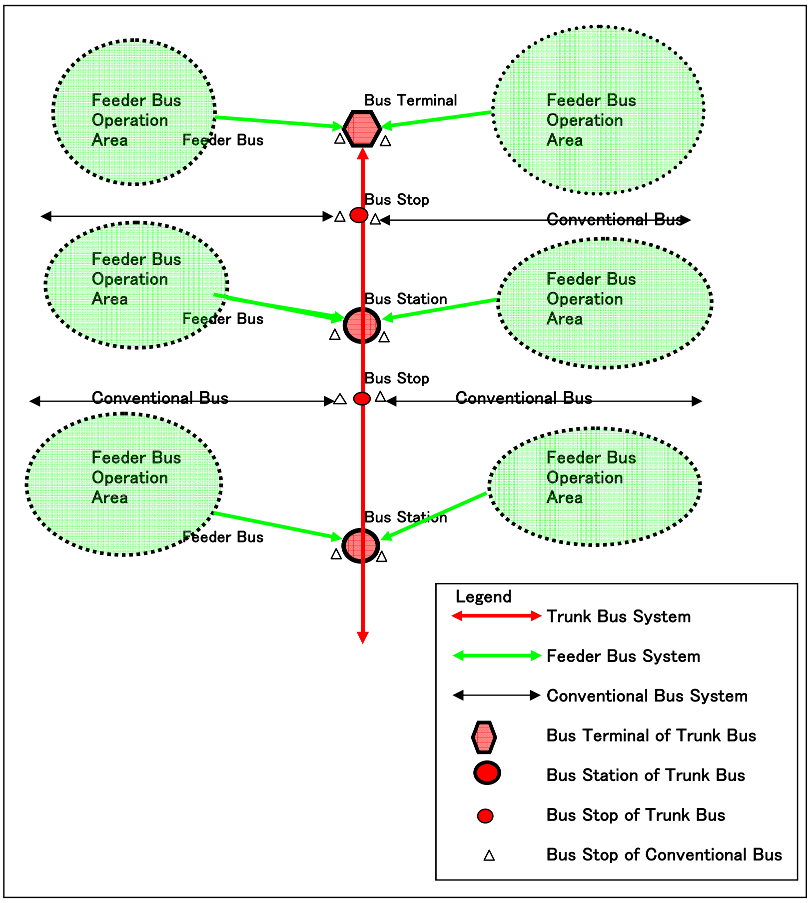


Figure 5.2-7 General Trunk Bus Operation System

1) Trunk Bus Exclusive Road Operation System

The trunk bus exclusive road operation system is identified as follows, and the typical cross section is shown in Figure 5.2-8.

a) The trunk bus exclusive roads are operated between the trunk bus terminals and trunk bus stops which are located along the trunk bus exclusive roads.

b) The trunk bus exclusive roads are constructed at the center of the existing roads as 2-lane bus roads. (See Figure 5.2-8)

c) Cars cannot enter the trunk bus exclusive roads.

d) The trunk buses will stop at the trunk bus stops and trunk bus stations.

e) The integrated system between trunk buses and feeder buses is introduced at the trunk bus terminals and trunk bus stations. At the trunk bus stops, the integrated system among trunk bus system and other bus system is not introduced.

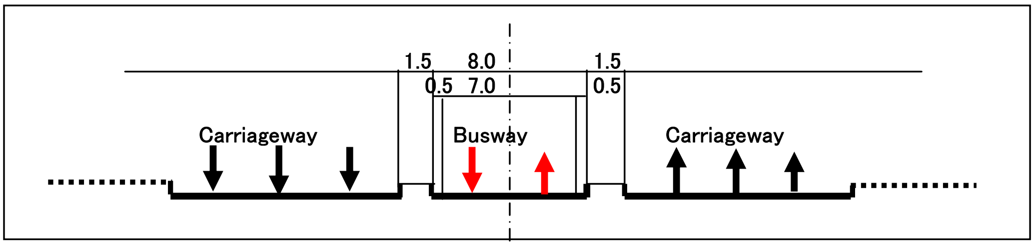


Figure 5.2-8 Typical Cross Section of Trunk Bus Exclusive Road

2) Trunk Bus Exclusive Lane Operation System

The trunk bus exclusive lane operation system is identified as follows, and the typical cross section is shown in Figure 5.2-9.

a) The trunk bus exclusive roads are operated between the trunk bus terminals and trunk bus stops which are located along the trunk bus exclusive roads.

b) The trunk bus exclusive roads are constructed at the center of the existing roads as 2-lane bus roads. (See Figure 5.2-9)

c) Cars cannot enter the trunk bus exclusive roads.

d) The trunk buses will stop at the trunk bus stops and trunk bus stations.

e) The integrated system between trunk buses and feeder buses is introduced at the trunk bus terminals and trunk bus stations.

f) At the trunk bus stops, the integrated system among trunk bus system and other bus system is not introduced.

In the 2003 F/S, the trunk bus exclusive road on Av. Almirante Barroso was planned on the median which is removed from it and constructed on the same space. However, after 2003, Belem municipality constructed bike way with 6km long on the median on Av. Almirante Barroso. The trunk bus exclusive road is planned on both sides of the median in the Study due to difficulty to remove the bike way as shown in Figure 5.2-9. The existing median is used for bus stop facility.

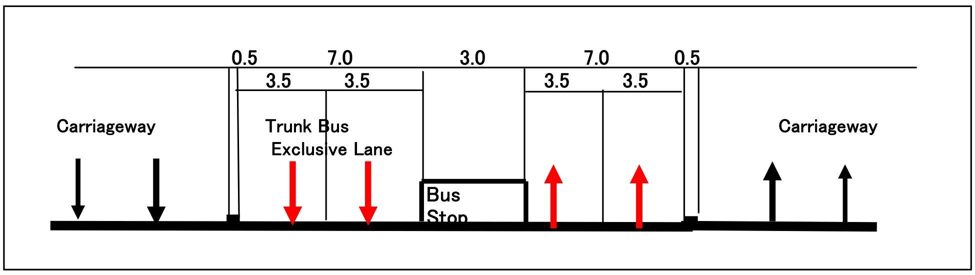


Figure 5.2-9 Typical Cross Section of Trunk Bus Exclusive Lane (Bus stop section)

3) Trunk Bus Priority Lane Operation System

The operation systems of trunk bus priority lanes are as follows,

a) The trunk bus priority lanes are located at the left side lane of the existing roads (see Figure 5.2-10).

b) When the trunk buses are not operated in the lane, cars can use the lane.

c) The priority hour in the trunk bus priority lane can be adopted under two systems such as during for the peak hour and for all-day. Prior to the priority system (only peak hour or all-day introduced) will be decided, the traffic characteristics and the traffic volume at that time should be examined.

d) The bus stops of the trunk bus priority lanes will be constructed at the left side of the trunk bus priority lanes.

e) The integrated bus fare system between the conventional buses and trunk buses at the bus stops is not introduced.

In 2003 JICA F/S, the trunk bus priority lane was planned on the right-lane on existing roads. However, the trunk bus fleets which have two doors on the right side of buses run on bus priority road and lane. The conventional buses run on right side lane of roads. Therefore, the trunk bus priority lanes are located at the left side lane of the existing roads (see Figure 5.2-10).

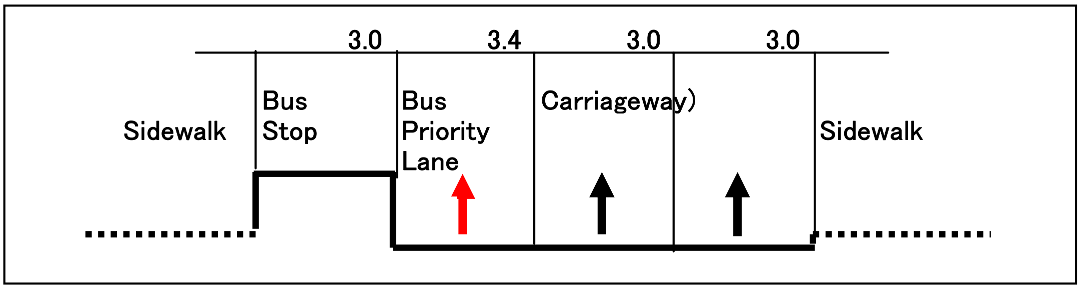


Figure 5.2-10 Typical Cross Section of Trunk Bus Priority Lane (Bus Stop Section)

4) Feeder Bus Operation System

The feeder bus operation system is as follows,

a) The feeder buses are operated in the areas between trunk bus terminals and local areas.

b) In the trunk bus terminals, the bus fare integrated system is adopted between the trunk buses and feeder buses.

c) Bus passengers should pay the bus fare in the feeder buses.

d) The feeder bus is not integrated at the trunk bus stops.

e) The transport capacity of feeder buses is about 50 to 70 persons.

f) Trunk bus system and feeder bus system will be operated to require at same bus company.

(2) Trunk Bus Operation Route System

The trunk bus operation route system is planned in consideration to bus passenger demand conditions. The general flow conditions in Belem are summarized below. 1) bus operates from suburb to Centro in the morning and the passengers are gradually increase to the inbound direction, 2) the passenger volumes is close to peak at the intersection between Av. Augusto Montenegro and

BR-316, 3) after that, the passengers are gradually decrease, 4) approximately 40% of the total passengers alight near Sao Braz terminal, and 5) the remained passengers arrive at Centro area

The trunk bus operation routes are identified based on the bus passenger volume and passenger trip characteristics. In this study, the following two (2) trunk bus operation routes are recommended as shown in Figure 5.2-11.

1) Operation route-A: The trunk buses will be operated on the route which is between each trunk bus terminal and San Braz area as a circulation system.

2) Operation route-B: The trunk buses will be operated on the route which is between each trunk bus terminal and Belem central area as a circulation system.

Each trunk bus operation route is operated based on the following functions and characteristics.

a) In the trunk bus terminal, the bus passengers from the feeder buses will be transferred to the two-carriage articulated buses (with capacity of 160).

b) And the average transport capacity of buses on the trunk bus exclusive way at terminal will be considered at 70% to 80%.

c) The maximum transport capacity of buses on the trunk bus exclusive way in peak hours will be 100% to 120 %.

d) And then, the passengers will alight at bus stop by stop until Sao Braz bus stop where majority of passengers alight.

e) The trunk bus operation route-B is served from each bus terminal or bus station to Sao Braz area as a circulation system.

f) The trunk bus operation route-A is served from each bus terminal or bus station to Belem central area as a circulation system.

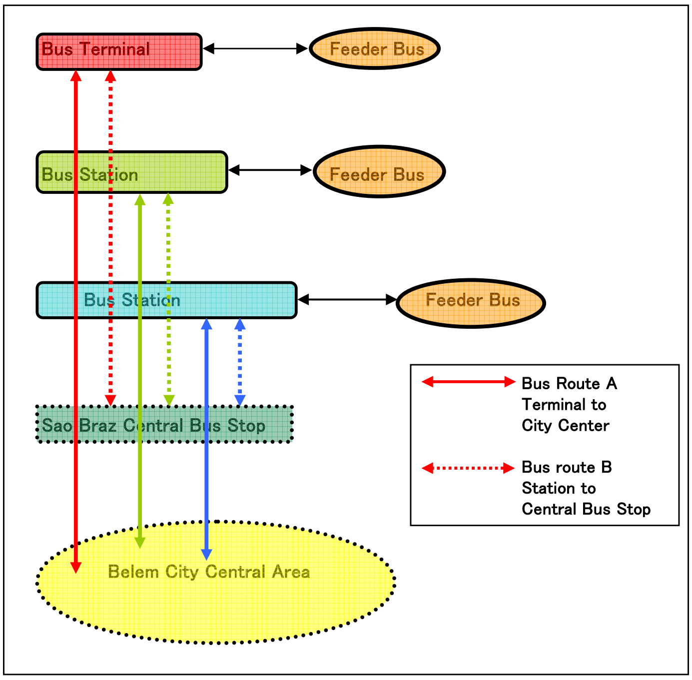


Figure 5.2-11 Concept of Bus Operation Route

(3) Express Bus and Normal Bus Operation System

For increasing the transport capacity of the trunk bus system, the following express bus and normal bus operation systems will be introduced.

1) ***Express Bus Operation System:*** the express bus will stop at the trunk bus terminals and trunk bus stations.

2) ***Normal Bus Operation System:*** the normal bus will stop at the trunk bus terminals, trunk bus stations, and each trunk bus stop.

(4) Bus Fare Payment System

The following fare system of the trunk bus is recommended as shown in Figure 5.2-12.

a) The bus fare of transfer from /to the trunk bus system is free of charge.

b) The bus fare of transfer from / to the trunk bus and the feeder bus is free of charge.

c) The bus fare of transfer from / to the trunk bus and the conventional bus is a separate charge.

d) The bus fare of transfer from / to the trunk bus and the conventional bus is a separate charge.

e) The bus fare of transfer from / to the feeder bus is a separate charge.

1) Bus Fare Payment System at Trunk Bus Terminal and Trunk Bus Station

Trunk bus fare systems in the trunk bus terminals and trunk bus stations are as follows,

a) The bus passengers should pay the trunk bus fare before entering the trunk bus terminal or trunk bus station, and the passengers can get on the trunk bus or feeder bus inside bus terminal or bus station.

b) The bus passengers who used the feeder bus should pay the bus fare inside the feeder bus, and they need not to pay the trunk bus fare inside the trunk bus terminal. They can get on the trunk bus inside the trunk bus system without additional bus fare.

c) Bus passengers who transfer the bus system from /to the conventional bus system and the trunk bus system should pay the bus fare additionally.

d) The passengers who get on the trunk bus cannot pay the bus fare inside the trunk bus.

2) Bus Fare Payment System at Trunk Bus Stops

Trunk bus fare system at the trunk bus stops is as follows:

a) Bus passengers should pay the bus fare before inter bus stop.

b) When bus passengers transfer to the other bus system, they should pay additional bus fare.

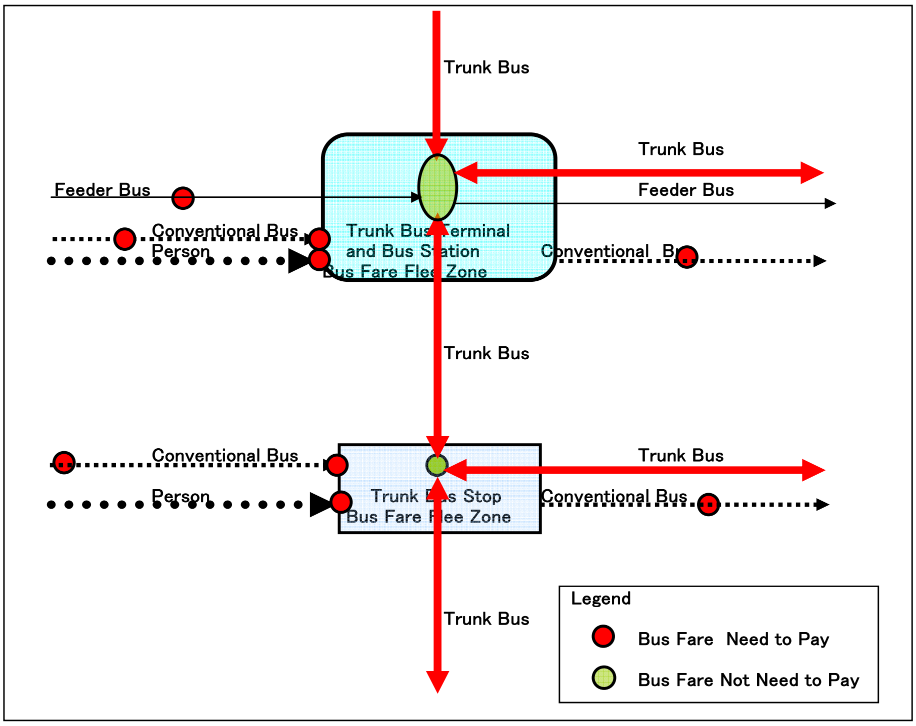


Figure 5.2-12 Bus Fare System of Trunk Bus System

5.2.5. TRUNK BUS TERMINAL SYSTEM

(1) Trunk Bus Terminal Operation System

As shown in Figure 5.2-13, the bus passengers who transfer from / to trunk bus and feeder bus need not pay the bus fare inside bus terminals. However, passengers who transfer from / to the conventional buses and trunk buses need to pay.

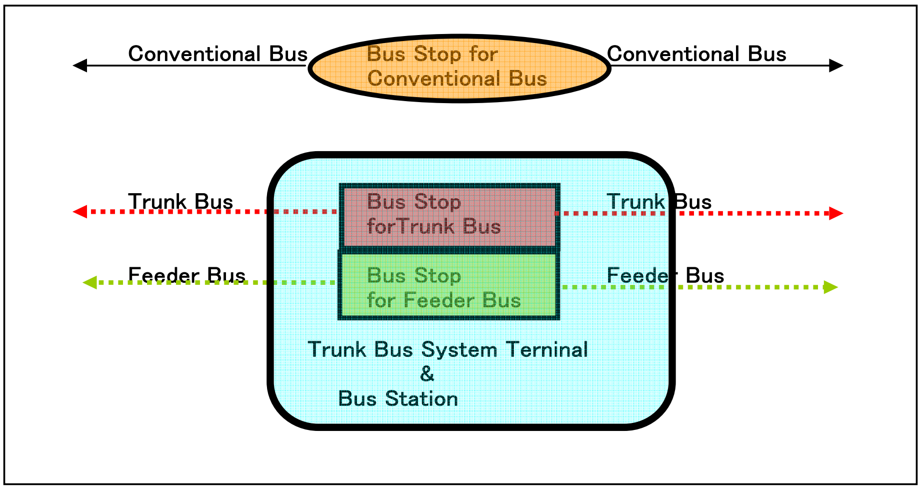


Figure 5.2-13 Trunk Bus Terminal System

(2) Functions and Characteristics of Trunk Bus Terminals

Considering the function and characteristics of the trunk bus terminals, the following facilities are required in the terminals.

a) Bus platforms and bus bays for the trunk bus system

b) Bus platforms and bus bays for the feeder bus system

c) Waiting room for bus passengers

d) Office building for management of bus terminal

e) Office building for bus operation

f) Bus waiting spaces

g) Space for bus maintenance

h) Space for bus drivers and conductors

i) Public space

In addition to the above, the following facilities are required.

a) Parking space for taxis

b) Parking space for cars

c) Parking space for bicycles

d) Open space

(3) Selection of Bus Terminal

Table 5.2-5 shows comparison of proposed plans to F/S in 2003 and the Study.

Table 5.2-5 Comparison of Proposed Plans to F/S in 2003 and the Study

Bus Terminals	Recommended in F/S in 2003	Recommended in the Study	Remarks
Icoaraci	Bus Terminal	Bus Terminal	Location of terminal is not changed due to the conditions are the same as that on F/S in 2003.
Tapana	Bus Terminal	Bus Station	This terminal should be changed to bus station due to difficulty to acquire the land for the construction of bus terminal.
Mangueirao	Bus Terminal	Bus Station	This terminal should be changed to bus station due to difficulty to acquire the land for the construction of bus terminal.
Independencia (I)	Bus Terminal	Bus Terminal	The terminal should be changed to Cidade Noba bus terminal due to difficulty to acquire the land for the construction of bus terminal.
Independencia (II)	Bus Terminal	Eliminated	The terminal is eliminated because the planned road has not been constructed yet.
Coqueiro	Bus Terminal	Bus Terminal	Location of terminal is not changed due to the conditions are the same as that on F/S in 2003.
Aguas Lindas	Bus Terminal	Bus Station	This terminal should be changed to bus station due to difficulty to acquire the land for the construction of bus terminal.
Marituba	Bus Terminal	Bus Terminal	Location of terminal is not changed due to the conditions are the same as that on F/S in 2003.

5.2.6. TRUNK BUS STATION AND BUS STOP SYSTEM

(1) Trunk Bus Station and Bus Stop Operation System

As shown in Figure 5.2-14, the bus station operation system is adopted as an integrated system between the trunk buses and feeder buses, however, the conventional buses are not integrated. The passengers who are transferred from the conventional buses to the trunk bus system in the bus stations should pay for the trunk bus fare.

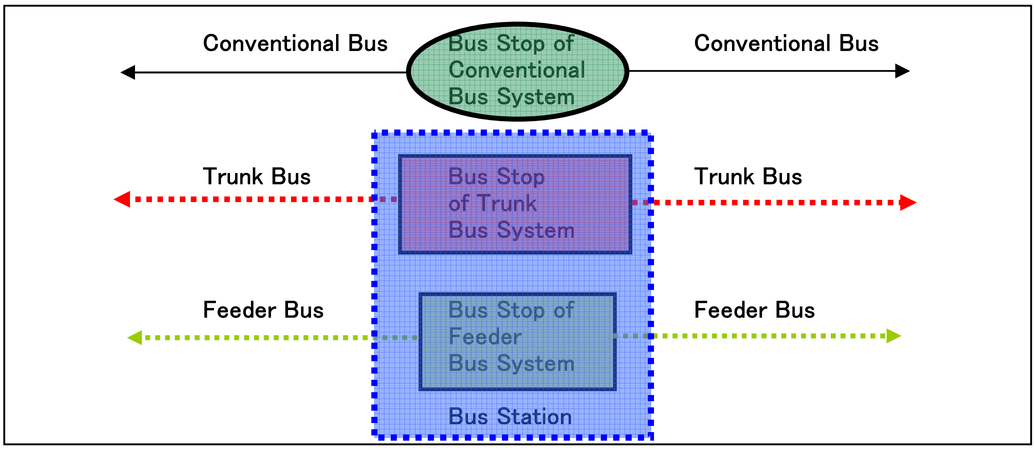


Figure 5.2-14 Trunk Bus Station and Bus Stop Operation System

(2) Trunk Bus Stations

1) *Characteristics and Functions of Trunk Bus Stations*

The characteristics and functions of the trunk bus stations are as follows, and a conceptual plan is shown in Figure 5.2-15.

a) The bus stations are planned at the center of the existing road spaces.

b) The trunk buses and feeder buses are directly connected.

c) The platform of the trunk bus is planned at the left side of trunk bus way or lane, and the feeder bus platform is planned at the right side of the feeder bus lane.

d) At the bus stop segment, two (2) bus lanes should be ensured for bus passing.

e) The bus stops for conventional buses should be ensured near trunk bus stations considering easy transfer.

f) The trunk bus fare should be paid before entrance of the trunk bus stations.

g) The many passengers transfer between trunk and feeder buses at the trunk bus stations in comparison to trunk bus stops. Pedestrian bridges should be provided for the bus passengers crossing.

h) Elevators will also be provided at the pedestrian bridges for passengers who use wheelchairs.

2) Location of Trunk Bus Stations

The following three (3) trunk bus stations are planned.

a) Avenida Augusto Montenegro in Tapana area

b) Avenida Augusto Montenegro in Mangueirao area

c) BR-316 in Aguas Lindas area

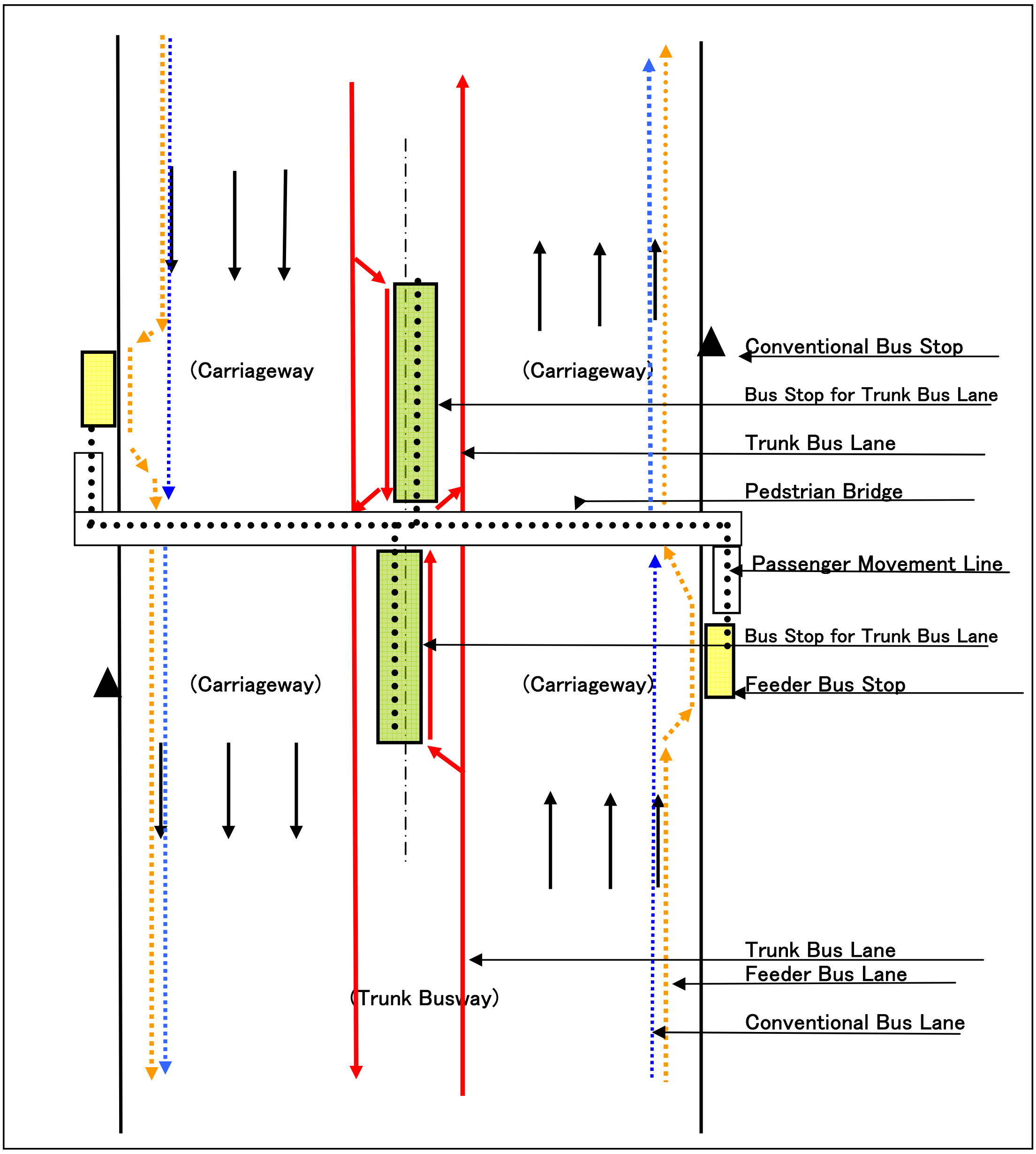


Figure 5.2-15 Conceptual Plan of Trunk Bus Station

(3) Trunk Bus Stop System

1) Bus Stop Operation System

The 2-lane bus lanes should be prepared at the bus stop sections due to increased transport capacity of the trunk bus system. The conventional buses are not directly connected to the trunk bus stops (no integrated system). The bus passengers should pay bus fare before entering the bus stops.

2) Cross Section of Bus Stop

There are two (2) types of bus stop, i.e. i) bus stop for the trunk bus exclusive road or lane (see Figure 5.2-16), and ii) bus stop for the trunk bus priority lane (see Figure 5.2-17). The characteristics of the trunk bus stop are as follows:

a) The width of platform is adopted at 3.0 m, and the platforms are separated according to in-bound and out-bound traffic flows.

b) The height of bus platform is adopted at 95 cm.

c) The width of bus bay lane is adopted at 3.5 m.

d) The width of passing lane is adopted at 3.5 m.

e) The bus passing lane and carriageway are divided by delineator, etc. occupying a width of 50 cm.

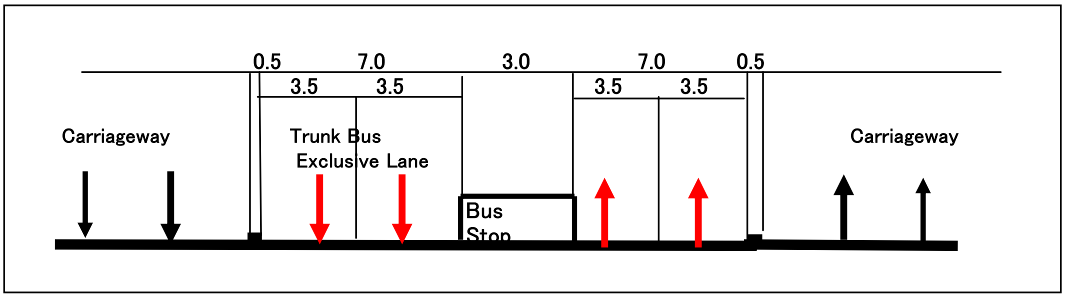


Figure 5.2-16 Bus Stop Section for Trunk Bus Exclusive Road and Lane

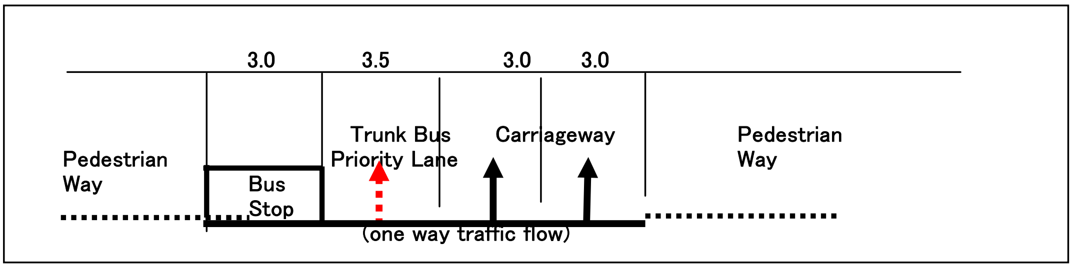


Figure 5.2-17 Bus Stop Section for Trunk Bus Priority Lane

3) Location of Bus Stops

Based on the following conditions, the bus stops are located.

a) Basically, bus stops are located at 800 m to 1,000 m intervals, and also in front of housing areas, as well as near the intersections.

b) Considering the condition of existing road facilities, the bus stops are not planned on the trunk bus priority lanes of Icoaraci city and Av. Morio Covas.

c) However, the bus stops are planned on the trunk bus priority lanes in the Belem central area. Based on the results of field survey, the locations of bus stops are identified.

4) *Conceptual Plan of Bus Stop*

The conceptual plan of bus stop for the trunk bus exclusive roads and lanes is shown in Figure 5.2-18, and for the trunk bus priority lanes is shown in Figure 5.2-19.

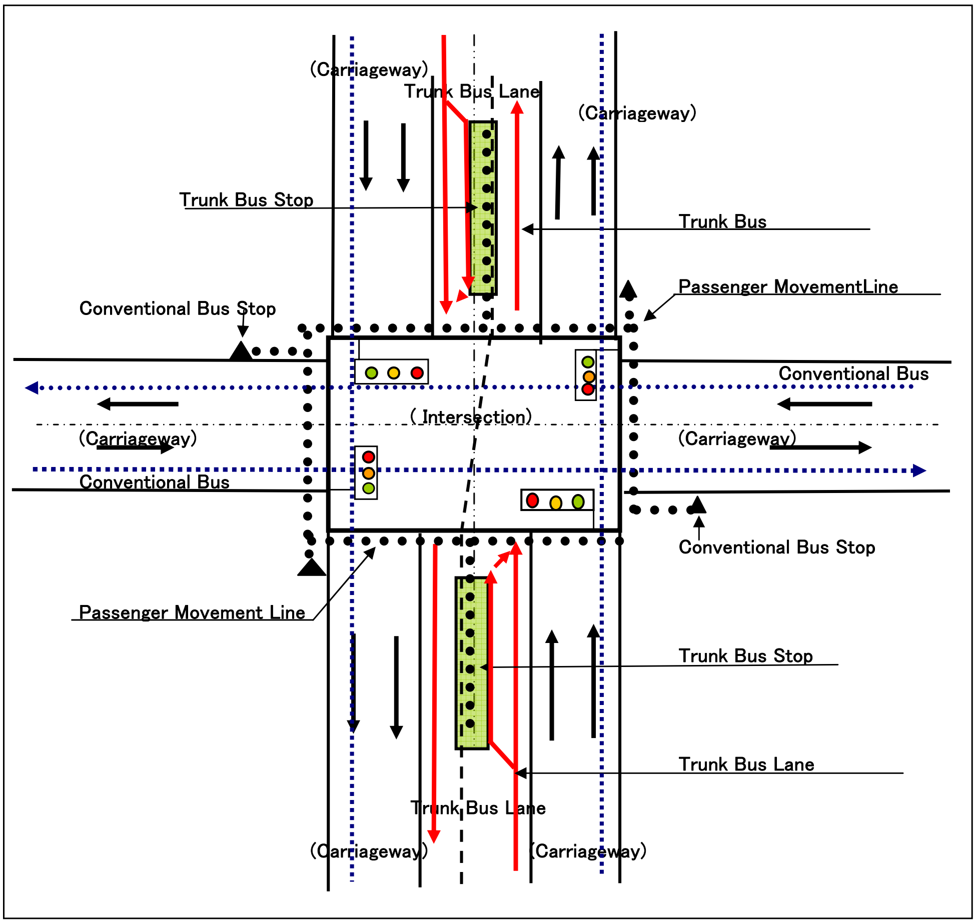


Figure 5.2-18 Conceptual Plan of Bus Stop on Trunk Bus Exclusive Road and Lane

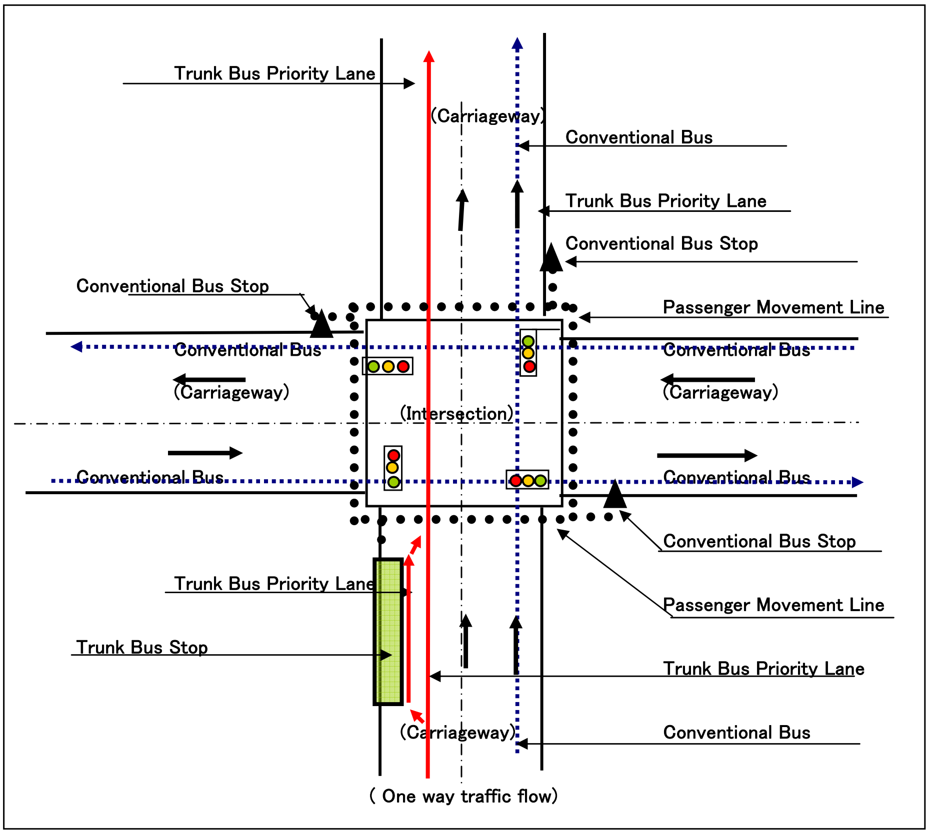


Figure 5.2-19 Conceptual Plan of Bus Stop on Trunk Bus Priority Lane

5.2.7. OPERATION AND MAINTENANCE FACILITIES (BUS DEPOTS) OF TRUNK BUS SYSTEM

In F/S in 2003, the eight (8) operation and maintenance facilities for trunk bus system which are located in the trunk bus terminals was planed. In the Study, three (3) trunk bus terminals out of eight (8) terminals which are planed in F/S in 2003 are reviewed and changed to the bus station. Those stations have function to transfer from the feeder to the trunk buses and its facilities are constructed on existing roads. The stations are insufficient in function of operation and maintenance for the trunk bus system due to shortage of land space. Therefore, in order to strengthen the function of the system, the operation and maintenance facilities are planned.

(1) Functions of Depots

The following functions should be prepared in the bus depots.

1) Bus operation control function

2) Bus operation inspection function

3) Collecting bus fares from bus terminals, bus stations, and bus stops.

4) Preparation and selling of bus tickets.

5) The following facilities should be prepared.

   a) Bus washing facilities

   b) Bus inspection facilities

c) Bus repair facilities

d) Fuel stand facilities

e) Bus parking facilities

f) Bus drivers and repair staff rest facilities

g) Management office

(2) Location of Depots

The depots of the trunk bus system are located near the trunk bus terminals to support those function each other. The following four (4) depots are selected considering the functions of depots and the trunk bus system. The site survey was carried out for selection of locations.

1) Icoaraci Depot

The Icoaraci depot is planned facing Av. Augusto Montenegro at the entrance of Icoaraci city, and the depot controls the operation of Icoaraci bus terminal and Tapana bus station.

2) Cidade Nova Depot

The Cidade Nova depot is planned in the central area of Cidade Nova city, and the depot controls the operation of Cidade Nova bus terminal and Mangueirao bus station.

3) Coqueiro Depot

The Coqueiro depot is planned beside Coqueiro bus terminal, and the depot controls the operation of Coqueiro bus terminal.

4) Marituba Depot

The Marituba depot is planned beside Marituba bus terminal, and the depot controls the operation of the Marituba bus terminal and Aguas Lindas bus station.

5.2.8. TRUNK BUS FLEETS

(1) Trunk Buses

The following trunk bus fleets are required to ensure the smooth operation of the trunk bus system. The general cross section and dimensions of trunk buses are presented in Figure 5.2-20. The proposed bus fleet is the same type as that in Bogota, Colombia.

1) Articulated buses with transport capacity of 160 passengers are adopted.

2) The floor height of buses is adopted at 95 cm from ground level.

3) Inside buses, space for wheelchairs should be installed.

4) Four (4) doors should be installed to decrease the time of getting on /off the buses.

5) Four (4) doors should be installed on the left side of the buses.

6) One door should be installed on the right side of buses for emergency exit.

7) The emergency exit is the step type.

(2) Feeder Buses

The following rolling stock conditions are required for the feeder buses.

1) The transport capacity is 50 to 70 passengers.

2) Two (2) doors are required on the right side of buses.

3) Exits are the step type.

4) The passengers get on the buses from front door and get off the bus at the rear door.

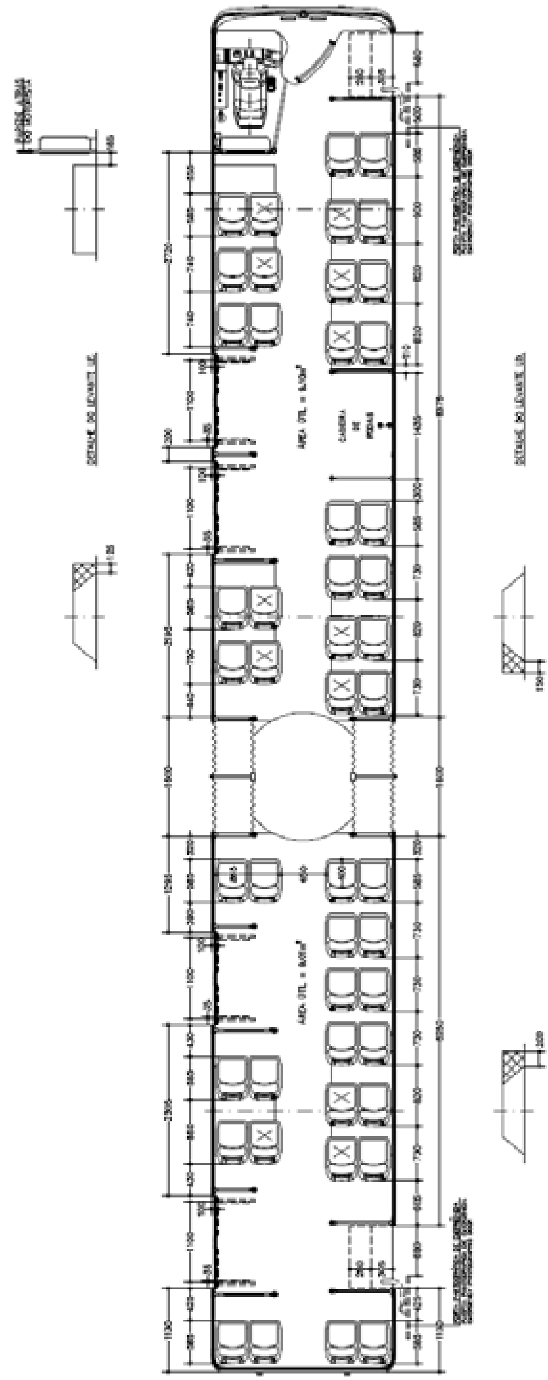


Figure 5.2-20 General Layout Plan of Articulated Bus

(3) Possibility for Introduction of Hybrid Buses

1) Results of Interview Survey of Bus Companies

The study team interviewed on April 2009 with METRA company which carry out trial operation of a hybrid bus fleet in Sao Paulo and ELTRA company develops the hybrid bus fleets in Brazil.

1) Interview Survey on ELTRA Company

The following comments are pointed out.

a) The hybrid engine by ELTRA company is mechanically to generate electric power by using diesel engines and to drive a motor by the electric power.

b) ELTRA company produced the generator of electric power and transmission to the motor. Chassis of bus fleet is produced by VOLVO and BENZ and body of bus is produced by MARCOPOLO.

c) The price of a hybrid bus (capacity is 90 persons) is about R/ 650,000, and diesel bus is about R/260,000. The price of hybrid articulated bus (capacity is 200 persons) is about R/1,000,000 to 1,200,000, and diesel articulated bus is about R/660,000. Therefore, the price of hybrid bus is about 2 times compared with the diesel bus.

d) In Brazil, at present approximately 40 of single body buses are produced in Brazil and only one (1) hybrid articulated bus is operated in Sao Paulo city.

e) If hybrid buses are operated, new repair factory, education of engineers, and education of bus drivers should be reinforced.

f) The hybrid buses are higher in price. Since the government does not develop a tax-incentive plan for low-emission vehicles, bus companies do not promote investment of bus purchases.

2) Interview Survey on Bus Operation Company

As a result of interview survey of bus operation companies in Brazil, the following comments are pointed out.

a) METRA operates 270 of bus fleets in Sao Paulo. At present, there is very little basic operation data on hybrid buses. . Therefore, prior to introduction of hybrid buses, the basic data should be collected from 3 hybrid buses.

b) Only ELTRA produces the hybrid bus fleets in Brazil. The price of hybrid buses is very expense compared with diesel buses.

c) The repair cost of hybrid buses is very expense compared with diesel buses.

d) Though the hybrid bus is higher in price (1.5 times to 2.5 times to diesel buses), the profit of the company is low due to difficulty of extra charge on bus fare. If hybrid buses are introduced, the benefits will not be profitable.

e) It is necessary to construct a repaired shop and to educate a service mechanic. Therefore, the operation and maintenance cost of hybrid buses is very expense.

f) The purchase of hybrid bus fleets will do not scheduled in near future due to the price and maintenance.

3) Environmental Comparison of Each Bus

The environmental comparison is shown in Table 5.2-6. As can be seen, the operation of hybrid bus fleets is possible to reduce the emission gases such as HC, CO, and NOX.

Table 5.2-6 Environmental Comparison

Item	Hybrid Bus	Trolley Bus
Minute Particles（PM）	90%	100%
Hydrocarbon（HC）	60%	100%
Carbon Monoxide（CO）	60%	100%
Nitrogen Oxide（NOX）	25%	100%
Noise（Dｂ）	65	60

(4) CNG (Compaction Natural Gas) Engine Buses

At present, the conditions of CNG in Brazil are as follows,

a) The CNG is produced only in Rio de Janeiro and Sao Paulo in Brazil.

b) In case of use of CNG, CNG must be transported from produced area by pipe-line and/or tank-lorry.

c) Belem is located about 3,700 km from Rio de Janeiro or San Paulo.

d) It is very difficult to transport of CNG from the production sites to Belem city.

(5) Conclusion of Possibility for Introduction of Hybrid Buses

The following issues and recommendations for the introduction of hybrid articulated buses to this project are summarized based on the results of interview survey mentioned above.

a) The price of hybrid articulated buses is very expensive at 1.5 times to 2.0 times compared with diesel buses (equivalent to R$1,200,000 to 1,500,000). Though the hybrid bus is higher in price (1.5 times to 2.5 times to diesel buses), the profit of the company is low due to difficulty of extra charge on bus fare. If hybrid buses are introduced, the benefits will not be profitable.

b) The experience of operation of hybrid buses is very limited in Brazil, and also the data and technology of operation by hybrid buses are very limited.

c) At present, the operation and maintenance system for hybrid articulated buses is not ensured in Brazil.

d) If hybrid buses are introduced in this project, the education of bus drives and engineers for repair will be required, as well as the construction of new repair factory. Education and training are needed for a long period.

e) From the above-mentioned point of view, the introduction of hybrid buses to the Project (the operation target year of this project is in year 2013) is still too early.

f) However, the price and technology of hybrid buses have been improving rapidly in recent years. Therefore, prior to operation of this project, the possibility of introduction of hybrid buses should be examined.

5.3. PASSENGER DEMAND ON THE TRUNK BUS SYSTEM

5.3.1. PASSENGER DEMAND AND OPERATING FREQUENCY ON THE TRUNK BUS SYSTEM

The study analyzes the following two cases for trunk bus passenger demand.

1) Analysis of effects of Introducing the study project: Phase I+II

2) Analysis of effects of Introducing the projects related to ODA loan, i.e., “Y” shape projects (Phase I)

(1) Demand Volume on the Trunk Bus System

1) Number of Passengers in Each Year

Table 5.3-1 and Figure 5.3-1 show the numbers of peak time trunk bus passengers in each year. In 2013, when the trunk bus system is introduced, the number of trunk bus passengers is 33,535 or 8.2% of the total number of bus passengers. In 2018, when only phase-I project is introduced, the number of trunk bus passengers is 37,091 or 8.5% of the total number of bus passengers, but when work is finished up to phase-II, the number is 57,078 or 12.9% of the total number of bus passengers. In this case, the increase in terms of number of passengers is 1.5 times or more, and this more or less corresponds to the expansion rate of the trunk bus route in phase-II. Although the trunk bus routes is not extended between 2018 and 2025, the number of trunk bus passengers is increasing due to the difference in the level of services (speed difference) with conventional buses.

Table 5.3-1 Number of Trunk Bus Passengers by Year (Persons/hour)

Years		2009		2013		2018 (Phase I)		202 (Phase I)		2018 (Phase I+II)		2025 (Phase I+II)	
		Passengers	Share	Passengers	Share	Passengers	Share	Passengers	Share	Passengers	Share	Passengers	Share
Trunk Bus	Ordinary			12,668	3.1%	13,969	3.2%	15,812	3.3%	34,321	7.7%	39,610	8.1%
	Express			20,867	5.1%	23,122	5.3%	26,745	5.6%	22,757	5.1%	26,397	5.4%
	Sub Total			33,535	8.2%	37,091	8.5%	42,557	8.9%	57,078	12.9%	66,007	13.4%
Conventional Bus		340,031	100.0%	373,005	91.8%	396,760	91.5%	436,805	91.1%	385,872	87.1%	425,240	86.6%
Total		340,031	100.0%	406,540	100.0%	433,851	100.0%	479,362	100.0%	442,950	100.0%	491,247	100.0%

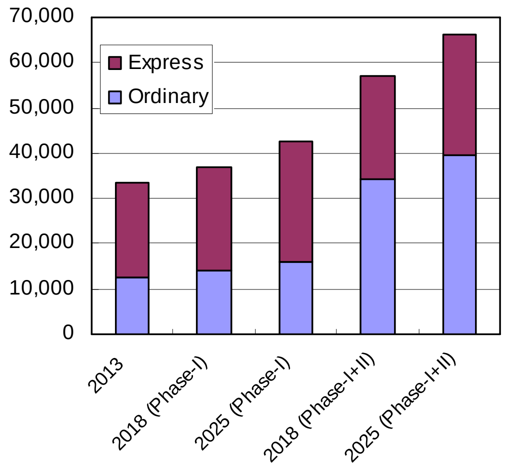


Figure 5.3-1 Transitions in the Number of Trunk Bus Passengers

2) Passenger-Kilometers per Year

Table 5.3-2 shows the total passenger-kilometers per year by conventional buses and trunk buses. The number of trunk bus passengers in 2013 (the year of introduction) is 8.2% of the total as mentioned previously, and the bus passenger-kilometers account for 18.3% of total bus passenger-kilometers. Therefore trunk bus system come to play an important role among public transportation in Belém metropolitan area. In the case where phase-II of the trunk bus system is introduced, the share of passenger-kilometers accounts for 25.6% in 2018 and 26.2% in 2025 respectively.

Table 5.3-2 Trunk Bus Passenger-Kilometers in Each Year (Passenger-Kilometers/Peak Hour)

Years		2009		2013		2018(Phase I)		202(Phase I)		2018(Phase I+II)		2025(Phase I+II)	
		Passengers	Share	Passengers	Share	Passengers	Share	Passengers	Share	Passengers	Share	Passengers	Share
Trunk Bus	Ordinary			134,356	6.3%	145,122	6.3%	160,251	6.3%	315,247	13.4%	355,180	13.5%
	Express			254,576	12.0%	283,784	12.4%	328,616	12.9%	286,082	12.2%	331,593	12.6%
	Sub Total			388,932	18.3%	428,906	18.7%	488,867	19.2%	601,329	25.6%	686,773	26.2%
Conventional Bus			100.0%	1,733,976	81.7%	1,859,016	81.3%	2,060,018	80.8%	1,748,127	74.4%	1,934,910	73.8%
Total			100.0%	2,122,908	100.0%	2,287,922	100.0%	2,548,885	100.0%	2,349,456	100.0%	2,621,683	100.0%

3) Number of Trunk Bus Passengers at Each Terminal (Station)

Table 5.3-3 shows the number of trunk bus passengers at each terminal (station). It is forecast that the number of passengers at peak time of each terminal becomes more than 5000 in the opening year 2013, and the highest number of passengers is at Aguas Lindas terminal. Also there is a lot of passengers at Cidade Nova terminal when the phase-II section is introduced, indicating the necessity of trunk bus system installation.

Table 5.3-3 Bus Passengers at Each Terminal (Station) (Persons / Peak hour)

Terminal Station	Phase-I	Phase-I Only		Phase-I + II	
	2013	2018	2025	2018	2025
Icoaraci	5,429	5,893	6,558	6,064	6,785
Tapana	5,890	6,556	7,627	7,336	8,363
Mangueirao	5,093	5,462	6,219	5,592	6,383
Coqueiro	-	-	-	2,092	2,496
Aguas Lindas	7,601	9,005	11,118	7,132	9,108
Marituba	4,775	5,165	5,774	5,352	6,020
Cidade Nova	-	-	-	5,384	5,829
Total	28,788	32,081	37,296	38,952	44,984

4) Number of Passengers on Major Roads

Table 5.3-4 shows the number of passengers on major roads. The number of trunk bus passengers reaches a maximum on Av. Almirante Barroso; specifically it is approximately 16,000 in 2013, approximately 19,000 (approximately 20,000) in 2018 and approximately 23,000 (approximately 25,000) in 2025. (In parentheses, the values at Phase-I +II are indicated, both are one-way traffic volume at peak hour). This is followed by Av. Augusto Montenegro and BR-316. On these three routes, between 30~60% of all bus passengers utilize trunk buses. On other roads, the number of passengers on Av. Independencia exceeds 10,000, indicating that this become an important bus route from 2018 onwards.

Table 5.3-4 Number of Bus Passengers on Major Roads

(One way Cross Section at Peak Time)

[Phase-I only]

№	Road	2009年			2013年			2018年			2025年		
		Conventional Bus	Trunk Bus	Total	Conventional Bus	Trunk Bus	Total	Conventional Bus	Trunk Bus	Total	Conventional Bus	Trunk Bus	Total
1	BR-316	-	-	-	6,946	4,391	11,337	7,715	4,501	12,216	9,652	4,744	14,396
		-	-	-	61.3%	38.7%	100.0%	63.2%	36.8%	100.0%	67.0%	33.0%	100.0%
2	BR-316	14,500	-	14,500	6,923	9,013	15,936	8,301	10,769	19,070	10,272	13,295	23,567
		100.0%	-	100.0%	43.4%	56.6%	100.0%	43.5%	56.5%	100.0%	43.6%	56.4%	100.0%
3	BR-316	-	-	-	28,227	9,140	37,367	32,050	10,907	42,957	37,826	13,484	51,310
		-	-	-	75.5%	24.5%	100.0%	74.6%	25.4%	100.0%	73.7%	26.3%	100.0%
4	Av. Augusto Montenegro	8,100	-	8,100	5,349	3,520	8,869	5,551	3,972	9,523	6,988	4,649	11,637
		100.0%	-	100.0%	60.3%	39.7%	100.0%	58.3%	41.7%	100.0%	60.0%	40.0%	100.0%
5	Av. Augusto Montenegro	-	-	-	6,311	8,352	14,663	7,450	9,461	16,911	9,018	11,110	20,128
		-	-	-	43.0%	57.0%	100.0%	44.1%	55.9%	100.0%	44.8%	55.2%	100.0%
6	Av. Augusto Montenegro	-	-	-	13,667	8,352	22,019	15,343	9,461	24,804	17,715	11,110	28,825
		-	-	-	62.1%	37.9%	100.0%	61.9%	38.1%	100.0%	61.5%	38.5%	100.0%
7	Av. Augusto Montenegro	-	-	-	22,629	11,901	34,530	24,466	13,250	37,716	27,166	15,424	42,590
		-	-	-	65.5%	34.5%	100.0%	64.9%	35.1%	100.0%	63.8%	36.2%	100.0%
8	Av. Almirante Barroso	39,800	-	39,800	28,740	17,379	46,119	32,493	20,076	52,569	38,318	24,296	62,614
		100.0%	-	100.0%	62.3%	37.7%	100.0%	61.8%	38.2%	100.0%	61.2%	38.8%	100.0%
12	Av. Mario Covas	-	-	-	16,704	-	16,704	18,454	-	18,454	21,293	-	21,293
		-	-	-	100.0%	-	100.0%	100.0%	-	100.0%	100.0%	-	100.0%
13	Av. Governador Jose Malcher	-	-	-	34,878	1,045	35,923	36,985	1,239	38,224	40,513	1,490	42,003
		-	-	-	97.1%	2.9%	100.0%	96.8%	3.2%	100.0%	96.5%	3.5%	100.0%
14	Gentil Bittencourt	-	-	-	7,052	1,195	8,247	7,245	1,143	8,388	7,739	1,086	8,825
		-	-	-	85.5%	14.5%	100.0%	86.4%	13.6%	100.0%	87.7%	12.3%	100.0%
15	Av. Pedro Alvares Cabral	-	-	-	20,145	-	20,145	21,782	-	21,782	24,338	-	24,338
		-	-	-	100.0%	-	100.0%	100.0%	-	100.0%	100.0%	-	100.0%
16	Municipalidade	-	-	-	5,201	-	5,201	4,944	-	4,944	4,688	-	4,688
		-	-	-	100.0%	-	100.0%	100.0%	-	100.0%	100.0%	-	100.0%

[Phase-I + II]

№	Road	2009年			2013年			2018年			2025年		
		Conventional Bus	Trunk Bus	Total	Conventional Bus	Trunk Bus	Total	Conventional Bus	Trunk Bus	Total	Conventional Bus	Trunk Bus	Total
1	BR-316	-	-	-	6,946	4,391	11,337	7,831	4,589	12,420	9,899	4,864	14,763
		-	-	-	61.3%	38.7%	100.0%	63.1%	36.9%	100.0%	67.1%	32.9%	100.0%
2	BR-316	14,500	-	14,500	6,923	9,013	15,936	9,081	9,383	18,464	11,159	11,669	22,828
		100.0%	-	100.0%	43.4%	56.6%	100.0%	49.2%	50.8%	100.0%	48.9%	51.1%	100.0%
3	BR-316	-	-	-	28,227	9,140	37,367	23,369	11,725	35,094	27,750	14,670	42,420
		-	-	-	75.5%	24.5%	100.0%	66.6%	33.4%	100.0%	65.4%	34.6%	100.0%
4	Av. Augusto Montenegro	8,100	-	8,100	5,349	3,520	8,869	5,965	4,052	10,017	6,961	4,758	11,719
		100.0%	-	100.0%	60.3%	39.7%	100.0%	59.5%	40.5%	100.0%	59.4%	40.6%	100.0%
5	Av. Augusto Montenegro	-	-	-	6,311	8,352	14,663	8,291	10,355	18,646	10,096	12,009	22,105
		-	-	-	43.0%	57.0%	100.0%	44.5%	55.5%	100.0%	45.7%	54.3%	100.0%
6	Av. Augusto Montenegro	-	-	-	13,667	8,352	22,019	14,970	9,660	24,630	17,246	11,367	28,613
		-	-	-	62.1%	37.9%	100.0%	60.8%	39.2%	100.0%	60.3%	39.7%	100.0%
7	Av. Augusto Montenegro	-	-	-	22,629	11,901	34,530	24,933	12,893	37,826	27,750	15,030	42,780
		-	-	-	65.5%	34.5%	100.0%	65.9%	34.1%	100.0%	64.9%	35.1%	100.0%
8	Av. Almirante Barroso	39,800	-	39,800	28,740	17,379	46,119	26,724	21,533	48,257	31,333	26,305	57,638
		100.0%	-	100.0%	62.3%	37.7%	100.0%	55.4%	44.6%	100.0%	54.4%	45.6%	100.0%
9	Avenida Independencia	-	-	-	-	-	-	-	4,437	4,437	-	4,947	4,947
		-	-	-	-	-	-	-	100.0%	100.0%	-	100.0%	100.0%
10	Avenida Independencia	-	-	-	-	-	-	-	5,974	5,974	-	6,793	6,793
		-	-	-	-	-	-	-	100.0%	100.0%	-	100.0%	100.0%
11	Avenida Independencia	-	-	-	-	-	-	-	8,209	8,209	-	10,034	10,034
		-	-	-	-	-	-	-	100.0%	100.0%	-	100.0%	100.0%
12	Av. Mario Covas	-	-	-	16,704	-	16,704	14,172	2,901	17,073	16,814	3,391	20,205
		-	-	-	100.0%	-	100.0%	83.0%	17.0%	100.0%	83.2%	16.8%	100.0%
13	Av. Governador Jose Malcher	-	-	-	34,878	1,045	35,923	32,479	1,281	33,760	35,554	1,570	37,124
		-	-	-	97.1%	2.9%	100.0%	96.2%	3.8%	100.0%	95.8%	4.2%	100.0%
14	Gentil Bittencourt	-	-	-	7,052	1,195	8,247	6,838	1,249	8,087	7,337	1,177	8,514
		-	-	-	85.5%	14.5%	100.0%	84.6%	15.4%	100.0%	86.2%	13.8%	100.0%
15	Av. Pedro Alvares Cabral	-	-	-	20,145	-	20,145	18,842	8,082	26,924	21,221	9,232	30,453
		-	-	-	100.0%	-	100.0%	70.0%	30.0%	100.0%	69.7%	30.3%	100.0%
16	Municipalidade	-	-	-	5,201	-	5,201	5,005	1,248	6,253	4,779	1,126	5,905
		-	-	-	100.0%	-	100.0%	80.0%	20.0%	100.0%	80.9%	19.1%	100.0%

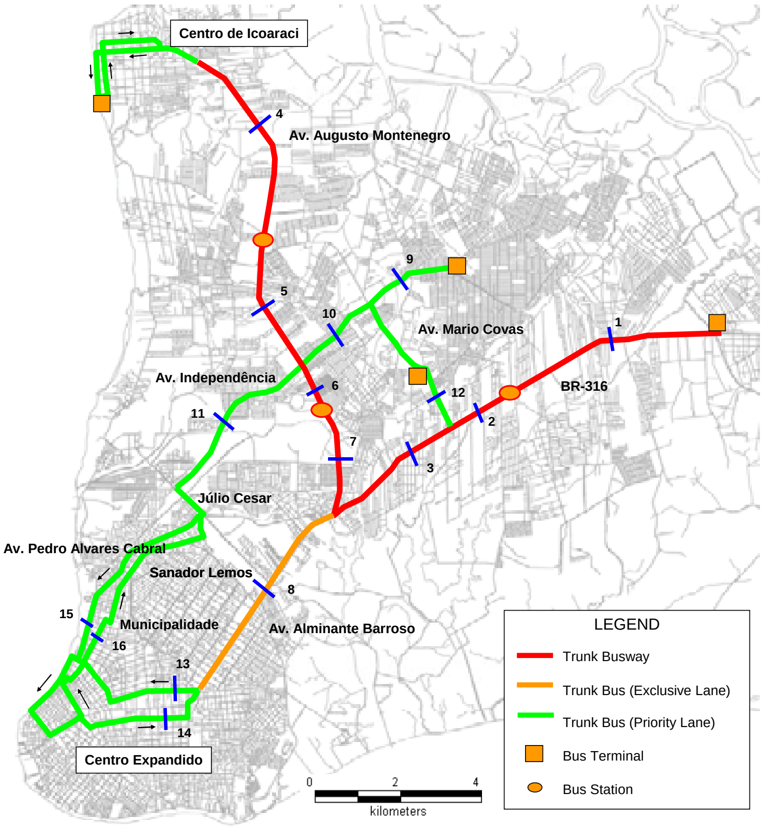


Figure 5.3-2 Major Cross Section Locations

5) *Required Operating Service Frequency*

Based on the maximum bus volumes per direction at peak hour on each bus route, the service frequency on each route is calculated and totaled according to each main road section and bus terminal (station). The service frequency is calculated so that the level of congestion is 120% with respect to the maximum bus volume per direction at peak hour. The capacity of trunk buses was assumed to be 160 passengers per bus (200 passengers per bus when a congestion level of 120% is taken into account).

a) Service Frequency on Each Main Road Section

Figure 5.3-3 shows the service frequency on each main road section. The highest frequency operation in 2013 when services begin is 126 buses per peak hour on Av. Almirante Barroso. This means that one bus arrives every 29 seconds on average, and since two bus berths are constructed on this route, the frequency per berth is one bus every 58 seconds, which can be comfortably handled. On other roads, the number of buses per peak hour is 68 (one every 53 seconds) on Av. Augusto Montenegro, 58 (one every 62 seconds) on BR-316 and 27 (one every 133 seconds) in Centro. In 2018 too, the number of operating buses is 140 (one every 51 seconds) on Av. Almirante Barroso, 75 (one every 48 seconds) on Av. Augusto Montenegro, 65 (one every 55 seconds) on BR-316, and 28 (one every 129 seconds) in Centro. However, by 2025, since the number of buses become excessively high at 168 (one bus every 43 seconds) on Av. Almirante Barroso, 85 (one every 42 seconds) on Av. Augusto Montenegro and 90 (one every 40 seconds) on BR-316, it become necessary to either introduce larger buses or expand the size of bus stop as appropriate. For example, through introducing the by-articulated buses with capacity of 240~270 passengers that are operated in Curitiba, transportation capacity can be increased by approximately 30%.

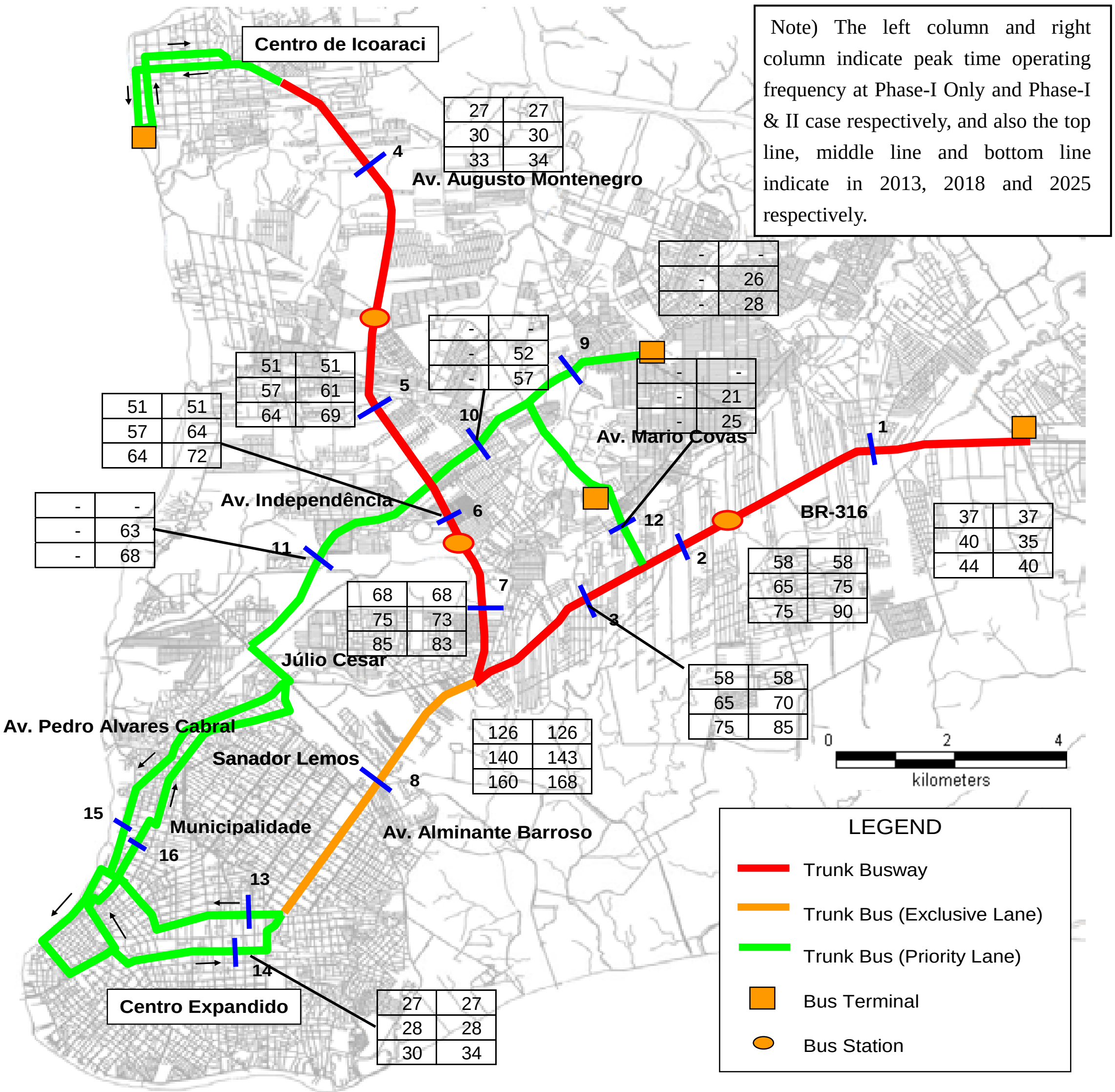


Figure 5.3-3 Trunk Bus Service Frequency at Major Cross Sections (per Direction at Peak Time)

b) Service Frequency by Bus Terminal and Bus Station

Table 5.3-5 shows the service frequency for each bus terminal and bus station. The highest frequency of 85 buses per hour happens at Mangueiran, and followed in order by Agua Lindas and Tapana when the only phase-I is introduced. Meanwhile, by the time of phase-II, the highest frequency of 90 buses per hour happens at Aguas Lindas, and this is followed in order by Mangueirao and Tapana.

Table 5.3-5 Operating Frequency (Peak Hour) by Bus Terminal (Bus Station)

	Phase-I	Phase-I Only		Phase I + II	
	2013	2018	2025	2018	2025
Icoaraci	27	30	33	30	34
Tapana	51	57	64	61	69
Mangueirao	68	75	85	73	83
Coqueiro	-	-	-	26	29
Aguas Lindas	58	65	75	75	90
Marituba	37	40	44	35	40
Cidade Nova	-	-	-	26	28
Total	241	267	301	326	373

5.3.2. NECESSARY NUMBER OF BUSES

(1) Necessary Number of Buses

The necessary number of buses is calculated as shown in 5.3.1 using the following expression as the number needed in order to operate the required frequency of services on each route.

- Necessary number of buses by route = Peak hour operating frequency (times/hour) x (Necessary time per service + Service adjustment time) (hours) x 1.1

The necessary time per service frequency is calculated through dividing the route length by the average operating speed. The average operating speed is assumed to be 25 km/h for trunk buses (ordinary), 30 km/h for express trunk buses, and 15 km/h for feeder line buses. The length of feeder bus routes is assumed to be a uniform value of 4 km.

Service adjustment time refers to the time required for resting and changing the driver at the start point and time needed for simple vehicle maintenance. Moreover, in bus stations, additional time is required for operating between the bus yard and bus station. It is assumed that the service adjustment time is 10 minutes in bus terminals and 30 minutes in bus stations. For the feeder buses, the service adjustment time is set as 5 minutes (bus stations) and 10 minutes (bus terminals).

Finally, considering the idle ratio due to vehicle maintenance and so on, it has been decided to adopt 10% of the number of buses required for operation.

Table 5.3-6 and Table 5.3-7 show the necessary numbers of trunk buses and feeder line buses respectively. The necessary number of trunk buses is calculated as 206 in 2013, 230 in 2018 and 264 in 2025 when only phase-I is introduced. In case phase-II is also introduced, the number of trunk buses is calculated as about 1.5 times as 336 in 2018 and 387 in 2025. Meanwhile, the necessary number of feeder line buses is calculated as 103 in 2013, 113 (127) in 2018 and 129 (143) in 2025. (In parentheses, the value at Phase-II is indicated.)

Table 5.3-6 Necessary Number of Trunk Buses (Phase-I Only)

[Trunk Bus]

No.	Line	Terminal station	Line (km)	Speed (km/h)	Bus capacity (person/veh)	Adjustment time (min)	Peak Max. traffic (person/h/oneway)			Necessary number of buses		
							2013	2018	2025	2013	2018	2025
1	R2104	Icoaraci	56.27	25.0	200	10	438	495	478	6	6	6
8	R2108	Icoaraci	51.31	25.0	200	10	-	-	-	-	-	-
14	R2112	Icoaraci	46.39	25.0	200	10	482	522	512	5	6	6
15	R2113	Icoaraci	46.64	25.0	200	10	-	-	-	-	-	-
27	E2112	Icoaraci	46.39	30.0	200	10	4,171	4,673	5,388	36	41	47
2	R2202	Tapana	36.30	25.0	200	30	361	418	527	4	5	6
9	R2204	Tapana	31.34	25.0	200	30	-	-	-	-	-	-
16	R2212	Tapana	26.43	25.0	200	30	238	290	310	2	3	3
17	R2213	Tapana	26.67	25.0	200	30	-	-	-	-	-	-
28	E2212	Tapana	26.43	30.0	200	30	3,839	4,344	5,154	27	30	36
3	R2302	Mangueirao	26.70	25.0	200	30	708	789	887	6	7	7
10	R2304	Mangueirao	29.05	25.0	200	30	-	-	-	-	-	-
18	R2312	Mangueirao	16.82	25.0	200	30	337	361	384	2	3	3
19	R2313	Mangueirao	24.38	25.0	200	30	-	-	-	-	-	-
29	E2312	Mangueirao	16.82	30.0	200	30	2,119	2,253	2,657	12	12	15
4	R2402	Coqueiro	32.17	25.0	200	10	-	-	-	-	-	-
11	R2404	Coqueiro	35.52	25.0	200	10	-	-	-	-	-	-
20	R2412	Coqueiro	22.29	25.0	200	10	-	-	-	-	-	-
21	R2413	Coqueiro	30.85	25.0	200	10	-	-	-	-	-	-
30	E2412	Coqueiro	22.29	30.0	200	10	-	-	-	-	-	-
5	R2502	Aguas Lindas	32.96	25.0	200	30	449	495	647	5	5	6
12	R2504	Aguas Lindas	41.42	25.0	200	30	-	-	-	-	-	-
22	R2512	Aguas Lindas	23.08	25.0	200	30	379	404	426	3	3	4
23	R2513	Aguas Lindas	36.76	25.0	200	30	-	-	-	-	-	-
31	E2512	Aguas Lindas	23.08	30.0	200	30	3,053	3,743	4,666	20	24	30
6	R2602	Marituba	44.70	25.0	200	10	2,824	2,913	3,000	28	29	30
24	R2612	Marituba	34.83	25.0	200	10	1,580	1,602	1,765	13	13	14
32	E2612	Marituba	34.83	30.0	200	10	2,675	3,187	3,933	18	22	27
7	R2704	Cidade Nova	40.02	25.0	200	10	-	-	-	-	-	-
13	R2706	Cidade Nova	35.06	25.0	200	10	-	-	-	-	-	-
25	R2712	Cidade Nova	30.14	25.0	200	10	-	-	-	-	-	-
26	R2713	Cidade Nova	30.39	25.0	200	10	-	-	-	-	-	-
33	E2712	Cidade Nova	30.14	30.0	200	10	-	-	-	-	-	-

	2013	2018	2025
Icoaraci	47	53	59
Tapana	33	38	45
Mangueirao	20	22	25
Coqueiro	0	0	0
Aguas Lindas	28	32	40
Marituba	59	64	71
Cidade Nova	0	0	0
Sub-Total	187	209	240
Total（Sub-Total*1.1)	206	230	264
Necessary number of bues (ordinary)	87	84	90
Necessary number of bues (express)	119	146	174

[Feeder Bus]

Terminal station	Number of passengers (person/h)			Line (km)	Speed (km/h)	Bus capacity (person/veh)	Adjustment time (min)	Necessary number of buses		
	2013	2018	2025					2013	2018	2025
Icoaraci	3,504	3,955	4,635	4.0	15	72	10	22	24	28
Tapana	3,597	3,932	4,412	4.0	15	72	5	18	20	22
Mangueirao	1,919	1,951	2,068	4.0	15	72	5	10	10	11
Coqueiro	-	-	-	4.0	15	72	10	-	-	-
Aguas Lindas	4,991	6,030	7,601	4.0	15	72	5	25	30	37
Marituba	2,916	2,966	3,111	4.0	15	72	10	18	18	19
Cidade Nova	-	-	-	4.0	15	72	10	-	-	-
Sub-Total	16,927	18,834	21,827					93	102	117
Total (Sub-Total*1.1)								103	113	129

Table 5.3-7 Necessary Number of Trunk Buses (Phase-I + II)

[Trunk Bus]

No.	Line	Terminal station	Line (km)	Speed (km/h)	Bus capacity (person/veh)	Adjustment time (min)	Peak Max. traffic (person/h/oneway)			Necessary number of buses		
							2013	2018	2025	2013	2018	2025
1	R2104	Icoaraci	56.27	25.0	200	10	438	145	151	6	2	2
8	R2108	Icoaraci	51.31	25.0	200	10	-	677	705	0	8	8
14	R2112	Icoaraci	46.39	25.0	200	10	482	167	177	5	2	2
15	R2113	Icoaraci	46.64	25.0	200	10	-	305	310	0	4	4
27	E2112	Icoaraci	46.39	30.0	200	10	4,171	4,319	5,057	36	37	44
2	R2202	Tapana	36.30	25.0	200	30	361	136	153	4	2	2
9	R2204	Tapana	31.34	25.0	200	30	-	13	13	0	1	1
16	R2212	Tapana	26.43	25.0	200	30	238	60	76	2	1	1
17	R2213	Tapana	26.67	25.0	200	30	-	93	98	0	1	1
28	E2212	Tapana	26.43	30.0	200	30	3,839	5,209	6,048	27	36	42
3	R2302	Mangueirao	26.70	25.0	200	30	708	361	425	6	3	4
10	R2304	Mangueirao	29.05	25.0	200	30	-	655	734	0	6	7
18	R2312	Mangueirao	16.82	25.0	200	30	337	125	152	2	1	1
19	R2313	Mangueirao	24.38	25.0	200	30	-	404	535	0	3	4
29	E2312	Mangueirao	16.82	30.0	200	30	2,119	2,408	2,797	12	13	15
4	R2402	Coqueiro	32.17	25.0	200	10	-	170	205	0	2	2
11	R2404	Coqueiro	35.52	25.0	200	10	-	1,416	1,577	0	12	13
20	R2412	Coqueiro	22.29	25.0	200	10	-	62	74	0	1	1
21	R2413	Coqueiro	30.85	25.0	200	10	-	912	1,066	0	7	8
30	E2412	Coqueiro	22.29	30.0	200	10	-	1,017	1,264	0	5	6
5	R2502	Aguas Lindas	32.96	25.0	200	30	449	1,362	1,822	5	13	17
12	R2504	Aguas Lindas	41.42	25.0	200	30		1,366	1,558	0	15	17
22	R2512	Aguas Lindas	23.08	25.0	200	30	379	894	1,169	3	7	9
23	R2513	Aguas Lindas	36.76	25.0	200	30		1,025	1,329	0	11	14
31	E2512	Aguas Lindas	23.08	30.0	200	30	3,053	2,949	3,732	20	19	24
6	R2602	Marituba	44.70	25.0	200	10	2,824	2,946	3,008	28	29	30
24	R2612	Marituba	34.83	25.0	200	10	1,580	1,653	1,873	13	13	15
32	E2612	Marituba	34.83	30.0	200	10	2,675	2,142	2,624	18	15	18
7	R2704	Cidade Nova	40.02	25.0	200	10	-	52	67	0	1	1
13	R2706	Cidade Nova	35.06	25.0	200	10	-	2,850	3,012	0	23	24
25	R2712	Cidade Nova	30.14	25.0	200	10	-	16	17	0	1	1
26	R2713	Cidade Nova	30.39	25.0	200	10	-	1,261	1,529	0	9	11
33	E2712	Cidade Nova	30.14	30.0	200	10	-	271	336	0	2	2
								Icoaraci		47	53	60
								Tapana		33	41	47
								Mangueirao		20	26	31
								Coqueiro		0	27	30
								Aguas Lindas		28	65	81
								Marituba		59	57	63
								Cidade Nova		0	36	39
								Sub-Total		187	305	351
								Total (Sub-Total*1.1)		206	336	387
								Necessary number of bues (ordinary)		81	196	220
								Necessary number of bues (express)		125	140	167

[Feeder Bus]

Terminal station	Number of passengers (person/h)			Line (km)	Speed (km/h)	Bus capacity (person/veh)	Adjustment time (min)	Necessary number of buses		
	2013	2018	2025					2013	2018	2025
Icoaraci	3,504	4,046	4,755	4.0	15	72	10	22	25	29
Tapana	3,597	3,407	3,697	4.0	15	72	5	18	17	18
Mangueirao	1,919	1,808	1,865	4.0	15	72	5	10	9	10
Coqueiro	-	441	480	4.0	15	72	10	-	3	3
Aguas Lindas	4,991	3,720	4,790	4.0	15	72	5	25	19	24
Marituba	2,916	3,084	3,278	4.0	15	72	10	18	19	20
Cidade Nova	-	3,780	4,214	4.0	15	72	10	-	23	26
Sub-Total	16,927	20,286	23,079					93	115	130
Total (Sub-Total*1.1)								103	127	143

Note) Since Coquero and Cidade Nova will be constructed in 2018, Tapana and Aguas Lindas show the highest values in 2013.

(2) Necessary Number of Berths

Table 5.3-8 shows the necessary number of berths in each terminal and station. However, these values do not take actual operation into consideration (separating berths according to direction, and the operating condition of feeder lines). The value shows minimum necessary number of berths which is examined in 2003 F/S. The number of berths is examined in safety.

Table 5.3-8 Necessary Number of Berths in Each Terminal (Station)

[Phase-I Only]

■Trunk Bus

	Peak frequency (times/h)	Handling capacity per berth (veh/h)	Necessary number of berths	Adopted value in design	Remarks
Icoaraci	33	20	1.7 → 2	2	
Tapana	64	40	1.6 → 2	2	
Mangueirao	85	40	2.1 → 2	2	
Aguas Lindas	75	40	1.9 → 2	2	
Marituba	44	20	2.2 → 3	3	
Total	301				

■Feeder Bus

	Peak frequency (times/h)	Handling capacity per berth (veh/h)	Necessary number of berths	Adopted value in design	Remarks
Icoaraci	65	30	2.2 → 3	3	
Tapana	62	30	2.1 → 3	3	
Mangueirao	29	30	1.0 → 1	3	
Aguas Lindas	106	30	3.5 → 4	3	
Marituba	44	30	1.5 → 2	5	
Total	306				

[Phase-I + II]

■Trunk Bus

	Peak frequency (times/h)	Handling capacity per berth (veh/h)	Necessary number of berths	Adopted value in design	Remarks
Icoaraci	34	20	1.7 → 2	2	
Tapana	69	40	1.7 → 2	2	
Mangueirao	83	40	2.1 → 3	2	
Coqueiro	29	20	1.5 → 2	3	
Aguas Lindas	90	40	2.3 → 3	2	
Marituba	40	20	2.0 → 2	3	
Cidade Nova	28	20	1.4 → 2	2	
Total	373				

■Feeder Bus

	Peak frequency (times/h)	Handling capacity per berth (veh/h)	Necessary number of berths	Adopted value in design	Remarks
Icoaraci	67	30	2.2 → 3	3	
Tapana	52	30	1.7 → 2	3	
Mangueirao	26	30	0.9 → 1	3	
Coqueiro	7	30	0.2 → 1	5	
Aguas Lindas	67	30	2.2 → 3	3	
Marituba	46	30	1.5 → 2	5	
Cidade Nova	59	30	2.0 → 3	3	
Total	324				

Note) 1. Estimated value in 2025 is adopted as “Peak frequency”.

2 The possible number a berths is calculated the following processing time in the terminal (station).

- Bus terminal: 3 minutes /vehicle
- Bus station: 1.5 minutes /vehicle
- Feeder bus: 2 minutes /vehicle

5.3.3. IMPACT OF REORGANIZING BUS ROUTES

Consolidating the existing bus lines that are in competition with trunk bus routes alter the demand volume on trunk buses. Table 5.3-9 shows the results of calculating bus demand volume in 2018 in three cases, i.e. the case where existing bus lines which compete with trunk bus lines over 50% or more of the length are abolished, the case where existing bus lines which compete with trunk bus lines over 70% or more of the length are abolished, and the case where existing bus lines are left unchanged.

In the case where existing bus lines which compete with trunk bus lines over 70% or more of the length are abolished, the demand for trunk buses increases by more than 10% compared to the case where existing bus lines are left unchanged. However, in the case where existing bus lines which compete with trunk bus lines over 50% or more of the length are abolished, demand increases by more than 80%, indicating that consolidation of existing bus routes has a major impact on the demand volume on trunk bus routes. Especially impact of reorganizing is high when the phase-I is introduced.

Table 5.3-9 Changes in Trunk Bus Demand Volume due to Consolidation of Existing Bus Routes (2018)

[Phase-I Only, Based on the number of passengers]

		No line reorganization		70% line reorganization		50% line reorganization	
		Passengers	Share	Passengers	Share	Passengers	Share
Trunk buses	Ordinary	12,237	2.9%	13,969	3.2%	31,020	7.0%
	Express	19,974	4.7%	23,122	5.3%	33,290	7.5%
	Sub Total	32,211	7.6%	37,091	8.5%	64,310	14.6%
Conventional buses		394,019	92.4%	396,760	91.5%	377,584	85.4%
Total		426,230	100.0%	433,851	100.0%	441,894	100.0%

[Phase-I + II, Based on the number of passengers]

		No line reorganization		70% line reorganization		50% line reorganization	
		Passengers	Share	Passengers	Share	Passengers	Share
Trunk buses	Ordinary	33,822	7.8%	34,321	7.7%	64,077	13.9%
	Express	18,046	4.2%	22,757	5.1%	30,014	6.5%
	Sub Total	51,868	12.0%	57,078	12.9%	94,091	20.4%
Conventional buses		382,106	88.0%	385,872	87.1%	367,584	79.6%
Total		433,974	100.0%	442,950	100.0%	461,675	100.0%

Table 5.3-10 shows the results of calculating the demand volume on trunk buses depending on whether or not there is reorganization of existing bus routes in 2013. According to this, demand increases by around 15% (in the case where existing bus lines which compete with trunk bus lines over 70% or more of the length are abolished) compared to the case of no reorganization. Conversely speaking, this shows that demand fall by 13% in the case where there is no line reorganization. Accordingly, this indicates a high need for reorganization of existing bus routes in order to effectively introduce trunk buses and improve financial conditions.

Table 5.3-10 Changes in Trunk Bus Demand Volume due to Consolidation of Existing Bus Routes (2013)

【Based on the number of passengers】

		No line reorganization		70% line reorganization	
		Passengers	Share	Passengers	Share
Trunk buses	Ordinary	11,108	2.8%	12,668	3.1%
	Express	18,011	4.5%	20,867	5.1%
	Sub Total	29,119	7.3%	33,535	8.2%
Conventional buses		370,832	92.7%	373,005	91.8%
Total		399,951	100.0%	406,540	100.0%

5.4. BASIC FACILITIES PLAN

Figure 5.4-1 shows the trunk bus system projects, while Table 5.4-1 shows the summary table of specifications for the trunk bus system projects.

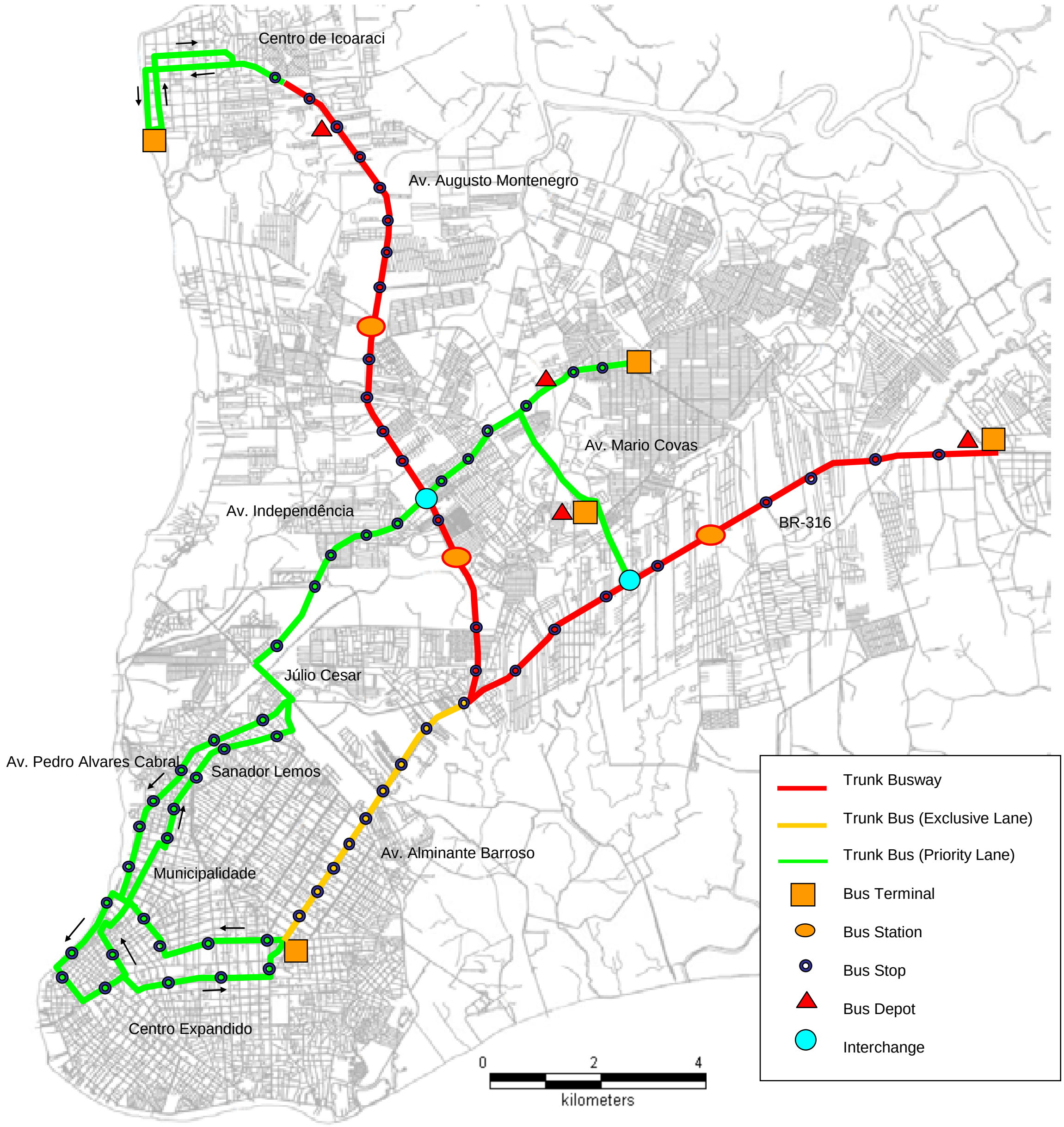


Figure 5.4-1 Trunk Bus System Projects

Table 5.4-1 Summary Table of the Trunk Bus System Projects

I. TRUNK BUS ROAD

NO.	ROAD	SECTION	SPECIFICATION	LENGTH M	REMARKS
1	AV. ALMIRANTE BARROSO	J.Bonifácio - Entroncamento	Exclusive Bus Lane	6,000	
2	BR - 316	Entroncamento - Alça Viária	Exclusive Busway	10,750	
3	AV. AUGUSTO MONTENEGRO	São Roque - Entroncamento	Exclusive Busway	13,900	
4	CENTRO DE ICOARACI		Priority Bus Lane	5,837	
	Manuel Barata	Soledade - Cristovão Colombo			No Bus Stops
	São Roque	Siqueira Mendes - Augusto Montebegro			
	Cristovão Colombo	Augusto Montenegro - Manuel Barata			
	Siqueira Mendos	São Roque - Soledade			
	Soledade	Manuel Barata - Siqueira Mendos			
5	CENTRO EXPANDIDO		Priority Bus Lane	10,389	
	Gov. José Malcher	Almirante Barroso - Visconde Souza Franco			
	Visconde Souza Franco	Gov. José Malcher - Marechal Hemes			
	Marechal Hermes	Visconde Souza Franco - Castilhos França			
	Castilhos França	Marechal Hermes - Portugal			
	Portugal	Castilhos França - João Diogo			
	16 de Novembro	João Diogo - Aliminante Tamandaré			
	Alminante Tamandaré	16 de Novembro - Padre Eutíquio			
	Gama Abreu	Padre Eutíquio - Serzedelo Correa			
	Serzedelo Correa	Gama Abreu - Gentil Bittencourt			
	Gentil Bittencourt	Serzedelo Correa - José Bonifácio			
	José Bonifácio	Gentil Bittencourt - Megalhães Barata			
6	AV. MARIO COVAS	BR-316 - Av. Indepenência	Priority Bus Lane	4,000	No Bus Stops
7	AV. INDEPENDÊNCIA (WEST)	Augusto Montenegro - Júlio César	Priority Bus Lane	6,202	
8	AV. INDEPENDÊNCIA (EAST)	Arterial Cinco - Augusto Montenegro	Priority Bus Lane	5,447	
9	BINÀRIO		Priority Bus Lane	11,102	
	Av. Pedro Alvares Cabral	Júlio Cesár - Visconde Souza Franco			
	Av. Assis Vasconcelos	Nazaré - Castilhos França			
	Castilhos França	Av. Assis Vasconcelos - Benjamin Constant			
	Benjamin Constant	Castilhos França - Municipalidade			
	Municipalidade	Benjamin Constant -Djalma Dutra			
	Djalma Dutra	Municipalidade - Senador Lemos			
	Senador Lemos	Djalma Dutra - Júlio César			
	TOTAL			**73,627**	

2. BUS TERMINAL

NO.	NAME	LOCATION	SPECIFICATION	AREA M2	REMARKS
1	ICOARACI	Centro de Icoaraci		15,449	
2	COQUEIRO	Av. Mario Covas		14,266	
3	MARITUBA	BR-316		22,080	
4	CIDADE NOVA	Av. Independência		8,109	
	TOTAL			**59,904**	

3. BUS STATION

NO.	NAME	LOCATION	SPECIFICATION	AREA M2	REMARKS
1	TAPANÂ	Av. Augusto Montenegro		21,430	
2	MANGUEIRÁO	Av. Augusto Montenegro		21,430	
3	AGUAS LINDAS	BR-316		22,140	
	TOTAL			**65,000**	

4. BUS OPERATION FACILITIES

NO.	NAME	LOCATION	SPECIFICATION	QUANT.	REMARKS
1	Bus Stop	Av. Almirante Barroso	Type I-1	9	
		BR-316, Augusto Montenegro, Independência	Type I-2	25	
		Independência, Centro de Belém	Type II	41	
		SUB-TOTAL		75	
2	São Braz Terminal Rehabilitation			1	
3	Bus Yards				
		Icoaraci		22,032	
		Coqueiro		24,375	
		Marituba		46,400	
		Cidade Nova		34,127	
		SUB-TOTAL		126,934	M2

5. OTHER PROJECTS

NO.	NAME	LOCATION	SPECIFICATION	QUANT.	REMARKS
1	Interchange	Independência X Augusto Montenegro			
2	Av. João Paulo II		6 lanes	2,854	M

5.4.1. TRUNK BUSWAY PLANS

As is described in Section 5.2, there are three types of trunk busways, i.e. trunk bus exclusive roads, trunk bus exclusive lanes, and trunk bus priority lanes. The sections where trunk bus exclusive roads are introduced are BR-316 and Av. Augusto Montenegro shown in Figure 5.4-1; trunk bus exclusive lane is introduced to Av. Almirante Barroso; and trunk bus priority lanes are introduced to Av. Independência and arterial roads in Centro and Icoaraci districts. On the exclusive roads, the trunk bus exclusive lane is completely separated from ordinary traffic by a median; while on bus exclusive lanes, the bus exclusive lane is partitioned from ordinary traffic lanes by a chatter bar, etc. prohibiting passage by ordinary vehicles. Meanwhile, on the bus priority lanes, no structural separation with ordinary vehicle lanes is installed, and ordinary vehicles can use the lane during times other than the bus running time.

(1) Basic Policy

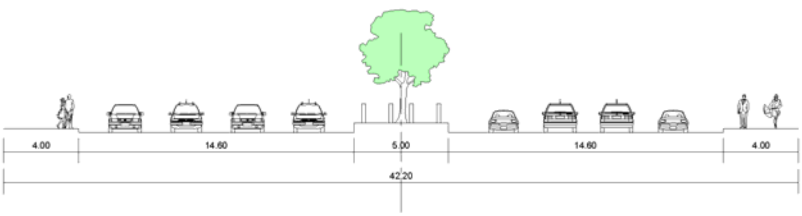
Since the existing roads that are to be converted into trunk busways are tightly surrounded by shops, office buildings and houses, etc. on both sides, it is extremely difficult to widen the roads. Accordingly, trunk busways will be constructed without widening the existing right of way. Meanwhile, trunk bus exclusive roads and bus exclusive lanes occupy the central part of roads, while bus priority lanes are constructed on the furthest left side of roadways.

(2) Road Cross Section

1) Avenida Almirante Barroso (Trunk Bus Exclusive Lane)

The right of way of the existing road ranges from 42.2 m to 45.0 m and comprises 8 lanes going in both directions separated by a central median. In F/S in 2003, no bicycle lane was provided on the Centro side in 42.2 m sections, however, bicycle lanes have since been added inside the central median, which has been widened to 4.5~5 m. Underground structures such as water and sewage pipes, electricity lines and road drainage pipes, etc. are buried under the sidewalks. In F/S in 2003, the basic policy was to minimize transfers of underground structures so as not to impact the existing sidewalks, however, in the plan here, it has become necessary to slightly downsize the width of sidewalks in bus stop sections. Figure 5.4-2 and Figure 5.4-3 show the cross section composition of the existing road and when the trunk bus exclusive lanes are introduced.

Existing



Planned

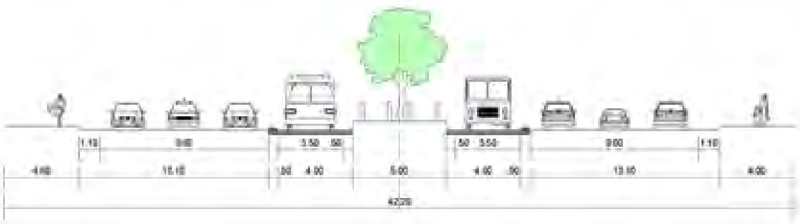
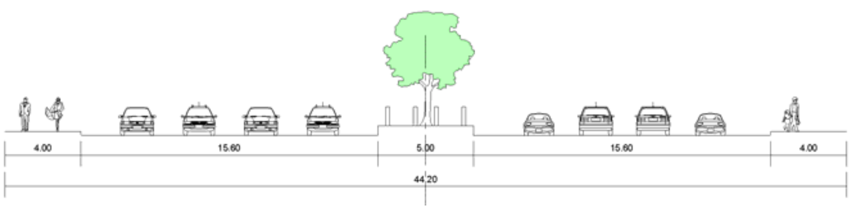


Figure 5.4-2 Existing and Planned Cross Sections on Av. Almirante Barroso (1)

Existing



Planned

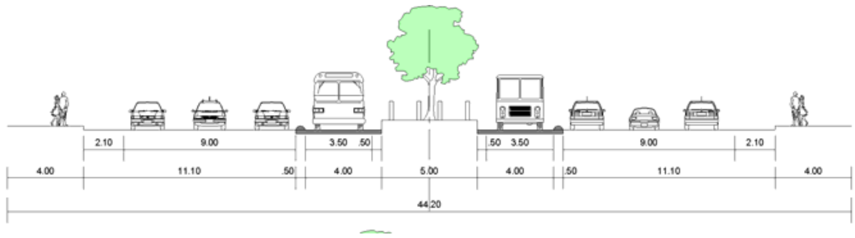
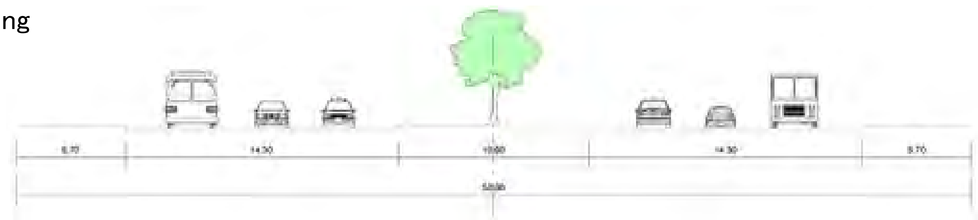


Figure 5.4-3 Existing and Planned Cross Sections on Av. Almirante Barroso (2)

2) BR-316 (Trunk Bus Exclusive Road)

The right of way of BR-316 leading from Entroncamento intersection to Alca Viaria is approximately 50.0 m. The trunk bus exclusive road is constructed inside the existing right of way. Figure 5.4-4 shows the cross section composition of the existing and planned roads.

Existing



Planned

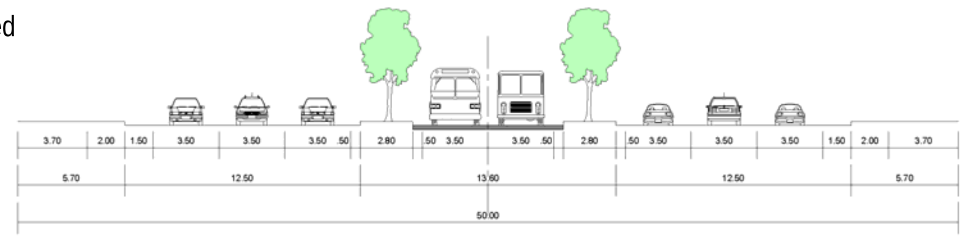
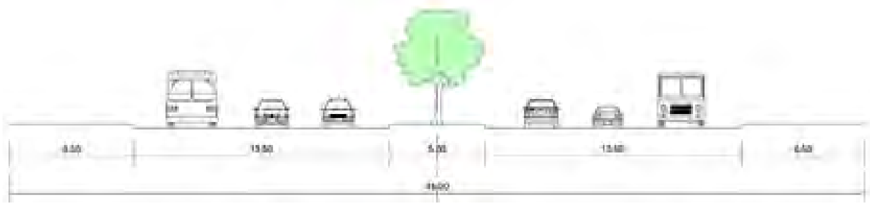


Figure 5.4-4 Existing and Planned Cross Sections of BR-316

3) Av. Augusto Montenegro (Busway)

The right of way of the road leading from Entroncamento intersection to Passagem Douglas Coheu is approximately 45.0 m. Based on the same thinking that was adopted in F/S in 2003, the bicycle ways currently running alongside the central median of the existing road are transferred to the sidewalk sides. Figure 5.4-5 shows the cross section composition of the existing and planned roads.

Existing



Planned

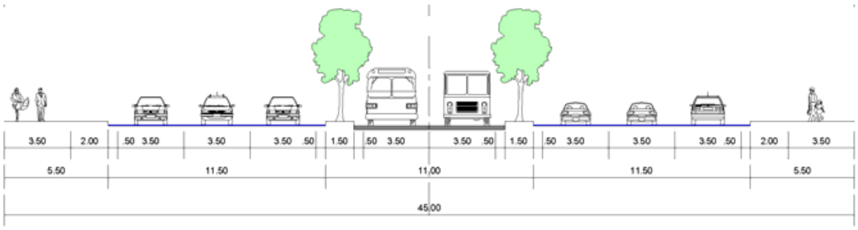


Figure 5.4-5 Cross Section of Av. Augusto Montenegro

On this route, concerning the approximately 350 m section from the start point of Entroncamento intersection and the approximately 1,000 m section from Icoaraci bus yard at the end side, it is difficult to secure the right of way (45 m) due to concentrated building alongside the road. Accordingly, on these sections, in F/S in 2003, it was planned to not adopt a trunk bus exclusive road but to utilize the existing road and have trunk buses run on the side of the central lane. In other words, plans for a trunk bus exclusive road have been omitted from these sections. In this review study too, the findings of the feasibility study are utilized as they are. On these sections, it is necessary to examine the installation of just a trunk bus exclusive road as far as possible during the detailed design stage. Concerning other sections, there are some parts where it cannot be discerned whether or not obstructions will arise judging from the scale of existing drawings (1/10,000). On such sections, it should be possible to manage within the existing right of way without changing running lanes through 1) downsizing outer side medians, 2) downsizing bicycle ways, and 3) downsizing sidewalks, etc. (see Figure 5.4-6). In any case, it is necessary to further examine alignment to ensure that no impediments arise in the detailed design.

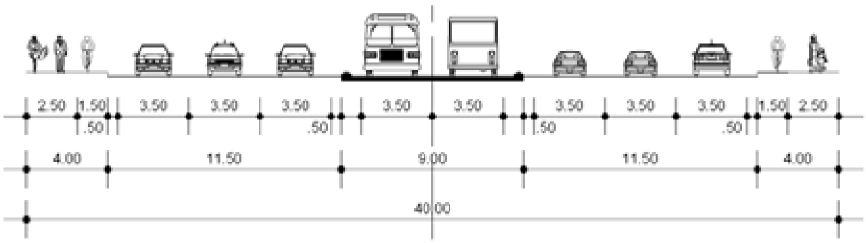


Figure 5.4-6 Downsized Cross Section of Av. Augusto Montenegro

4) Av. Independência (Trunk Bus Priority Lane)

Av. Independência east of Av. Augusto Montenegro comprises two lanes on each side, however, it is difficult to make the road any wider. Meanwhile, road construction of three lanes on each side is being advanced on the section west of Av. Augusto Montenegro. Figure 5.4-7 through Figure 5.4-10 show the cross section compositions when trunk bus priority lanes are introduced.

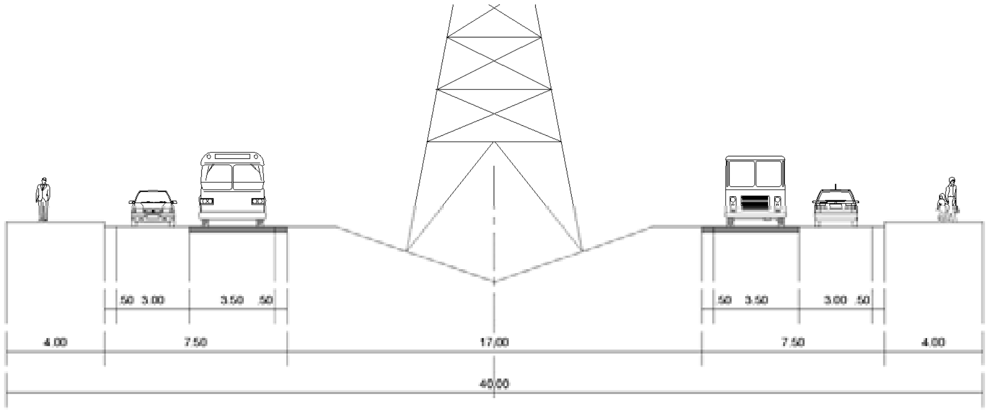


Figure 5.4-7 Cross Section of Av. Independência (East Side) (Bus Priority Lane) around High Tension Line

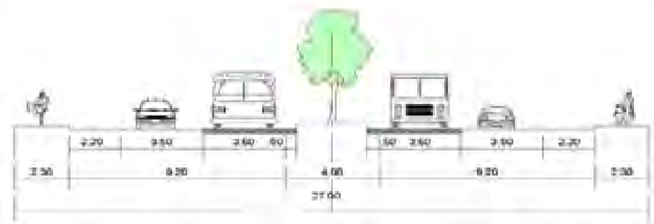


Figure 5.4-8 Cross Section of Av. Independência (East Side) (Bus Priority Lane) in Normal Parts

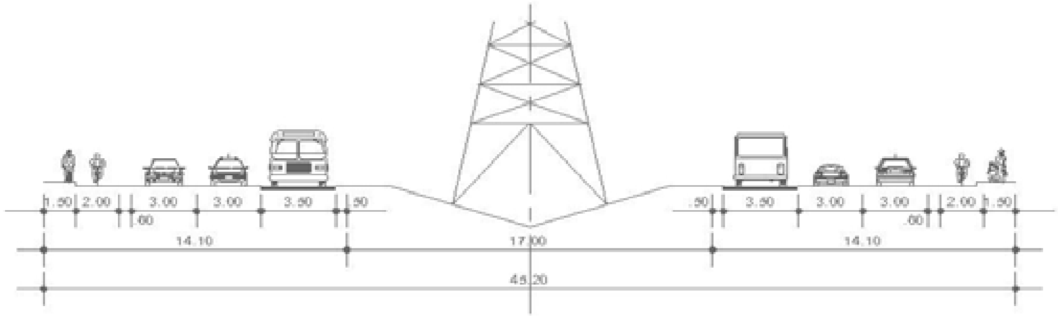


Figure 5.4-9 Cross Section of Av. Independência (West Side) (Bus Priority Lane) around High Tension Line

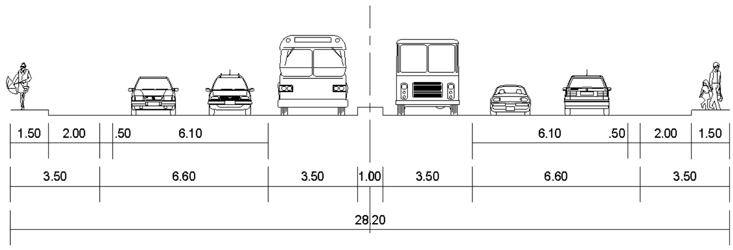


Figure 5.4-10 Cross Section of Av. Independência (West Side) (Bus Priority Lane) in Normal Parts

5) *Other Bus Priority Lane Sections*

Other trunk bus priority lanes are provided through occupying the left-side lanes of existing roads for priority running by trunk buses. The left side is chosen because there is no effect in installing priority lanes on the right side because conventional buses already run on this side. There is no structural separation from the general roadway, however, as a rule priority lanes are paved with concrete in order to ensure the smooth running of trunk buses. When introducing bus priority lanes, no structural modifications are made to the existing roads. Figure 5.4-11 through Figure 5.4-13 show the routes where bus priority lanes are introduced.

Moreover, since bus priority lanes utilize existing road facilities, the cross sectional composition of existing roads is followed. Figure 5.4-14 shows the cross section of the Centro section (one-way section) where a bus priority lane is introduced.

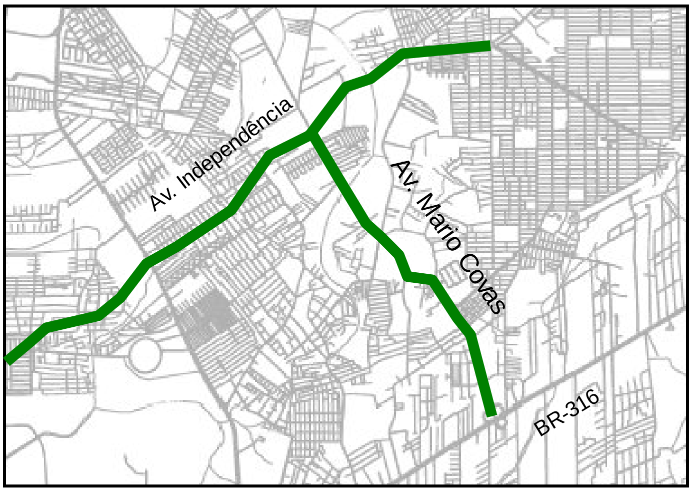


Figure 5.4-11 Map of Av. Mario Covas Trunk Bus Priority Lane

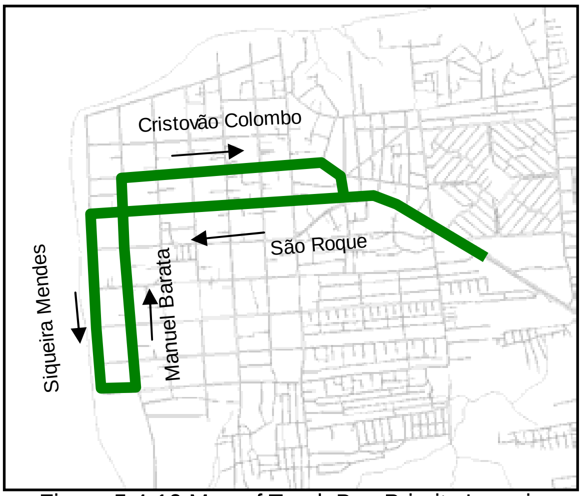


Figure 5.4-12 Map of Trunk Bus Priority Lane in Icoaraci

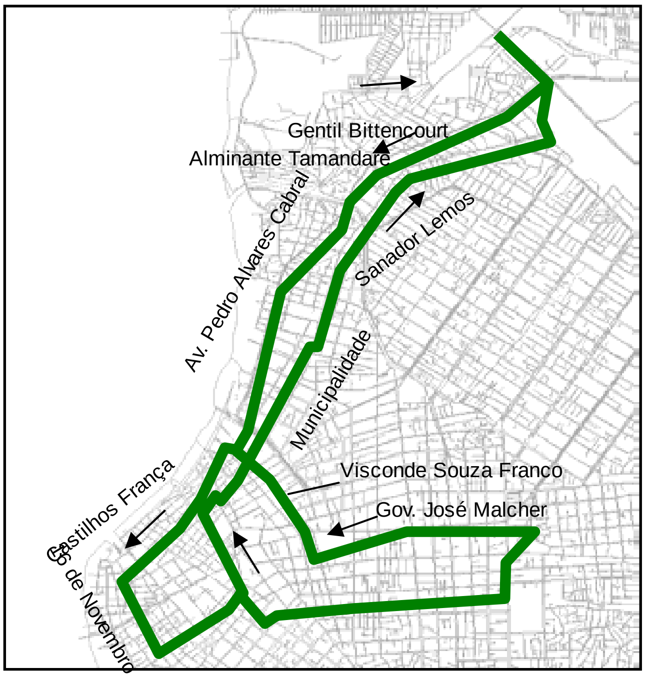


Figure 5.4-13 Map of Trunk Bus Priority Lane in Centro

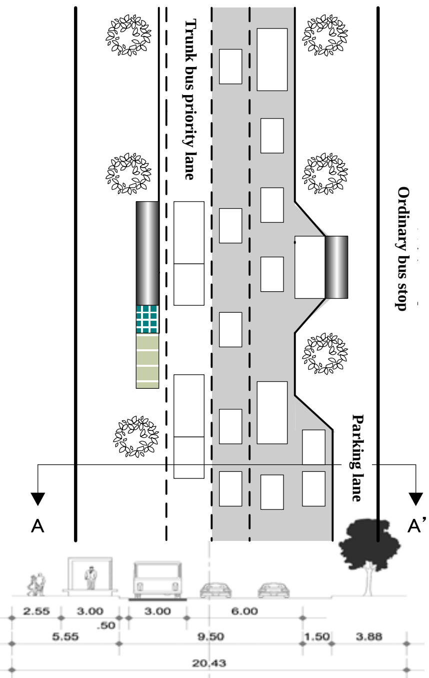


Figure 5.4-14 Cross Section of Trunk Bus Priority Lane in Centro

(3) Pavement Design

1) Pavement of Busways and Bus exclusive lanes

As was similarly decided in F/S in 2003, concrete pavement is adopted on the bus exclusive road and the bus exclusive lanes primarily for the following reasons:

(1) Buses are large vehicles carrying a heavy load and they also impart a large braking load when starting and stopping.

(2) Bus still load is large around bus stops.

(3) Temperatures in the target area are high.

(4) Maintenance costs are low.

Judging from pavement conditions in Belem, the following composition is adopted for cement concrete pavement.

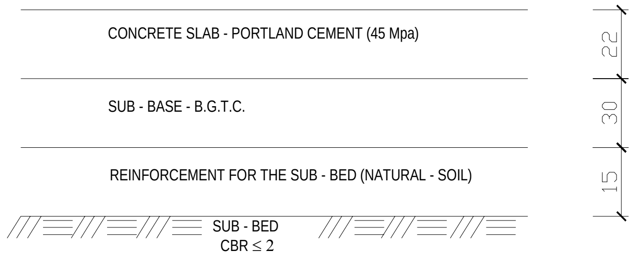


Figure 5.4-15 Composition of Bus exclusive lane Paving

2) Paving of Bus Priority Lanes

As a rule, cement concrete pavement is also adopted on bus priority lanes. However, sections of Av. Independência that has just been constructed or constructed from now on is not included in this. Also, Av. Mario Covas is excluded because it is too narrow and there are too many problems when executing the work. Table 5.4-2 shows the road lengths where it is planned to implement concrete pavement.

Table 5.4-2 Lengths of Cement Concrete Paving on Priority Lanes

Road Name	Length (m)	Road Name	Length (m)
		Bourevard Castilhos França (East)	281
Centro		Trav. Benjamin Constant	94
Gov. José Malcher	2,181	Rua Municipalidade	1,727
Av. Visconde Souza Franco	1,551	Trav. Djalma Dutra	95
Av. Marechal Hermes	1,250	Av. Senador Lemos	3,250
Bourevardo Castilhos França (West)	500	**Subtotal**	**11,102**
Av. Portugal	475	Iacoaraci	
Av. 16 de Novembro	363	Trav. São Roque	1,627
Av. Almirante Tamandaré	462	Rua Siqueira Mendos	1,103
Rua Gama Abreu	422	Trav. Soledade	207
Av. Serzedelo Correa	409	Rua Manoel Barata	1,361
Av. Gentil Bittencourt	2,426	Trav. Cristovão Colombo	1,539
Av. José Bonifácio	350	**Subtotal**	**5,837**
Subtotal	**10,389**		
Vinario			
Av. Pedro Alvares Cabral	4,750		
Av. Assis de Vasconcelos	905	**Total**	**27,328**

(4) Intersection Design

Since Av. Independência is a principal arterial road, separate grade intersections shall basically be adopted with other arterial roads. In F/S in 2003, separate grade intersections were planned with the following two routes.

a) Av. Julio Cezar (Principal Colletor)

b) Av. Augusto Montenegro (Principal Arterial Road)

1) Av. Julio Cezar

Av. Julio Cesar is a principal collector road. For this road, single grade intersections shall basically be adopted. However, since Av. Independencia is an important access road to the airport while Av. Julio Cesar forms part of the Primeira Legua Patrimonial ring road, the intersecting traffic volume is heavy. Therefore, in F/S in 2003, it was decided to adopt a grade-separated intersection between these two routes.

Following the F/S, Para State drew up a grade separation plan for this intersection, and it is scheduled to construct the intersection as shown in Figure 5.4-16. Accordingly, in this study too, a trunk bus route is planned assuming this intersection scenario.

Figure 5.4-16 Av.Independencia X Julio Cesar

2) Av. Augusto Montenegro

Av. Augusto Montenegro is a principal arterial road, and since this intersects with other principal arterial roads, it was proposed that a clover leaf full-access interchange be adopted as the grade separated intersection in F/S in 2003.

Design conditions for the grade-separated intersection are as follows.

a) Following the F/S in 2003 Av. Independência was constructed in east side of Av. Augusto Montenegro, however, due to difficulties with land acquisition, the road was constructed with a width of 35 m rather than the originally planned 40 m.

b) There is a major supermarket in the northeast side of the intersection. If the ramp is designed to avoid the supermarket, the structure of the ramp becomes large-scale and the project cost increases.

c) Meanwhile, in terms of traffic management, removal of the two ramps on the east side is hindering traffic flow because the road can no longer service traffic in the directions of Centro → Icoaraci, Entroncamento →Centro and Cidade Nova → Icoaraci.

d) Accordingly, in this study, judging it is impossible to build a ramp on the east side of the intersection, it is decided to build a ramp on the west side where land can be purchased, to construct an adjoining service side-road that act as a bridge on the east side of Av. Augusto Montenegro, and to intersect this side-road with Av. Independência on the same grade (see Figure 5.4-17).

e) However, since Para State is proposing to construct a clover leaf full-access interchange, it is proposed that a structure that doesn't hinder this plan be constructed.

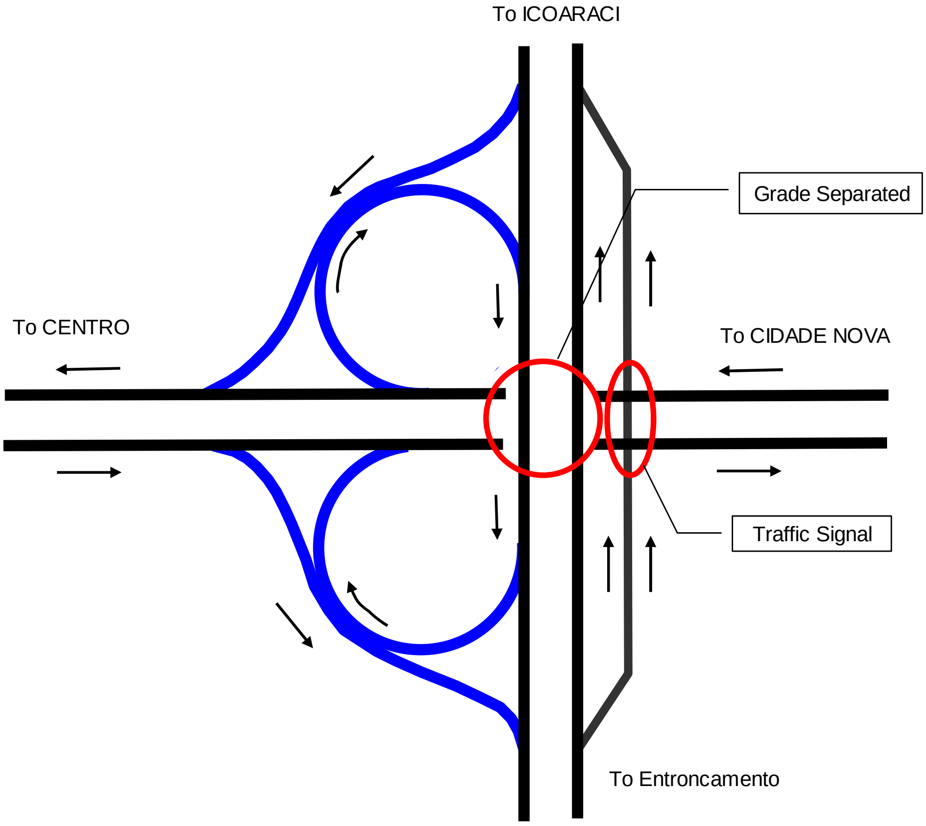


Figure 5.4-17 Av. Independencia X Av. Augusto Montenegro (Traffic Line Drawing)

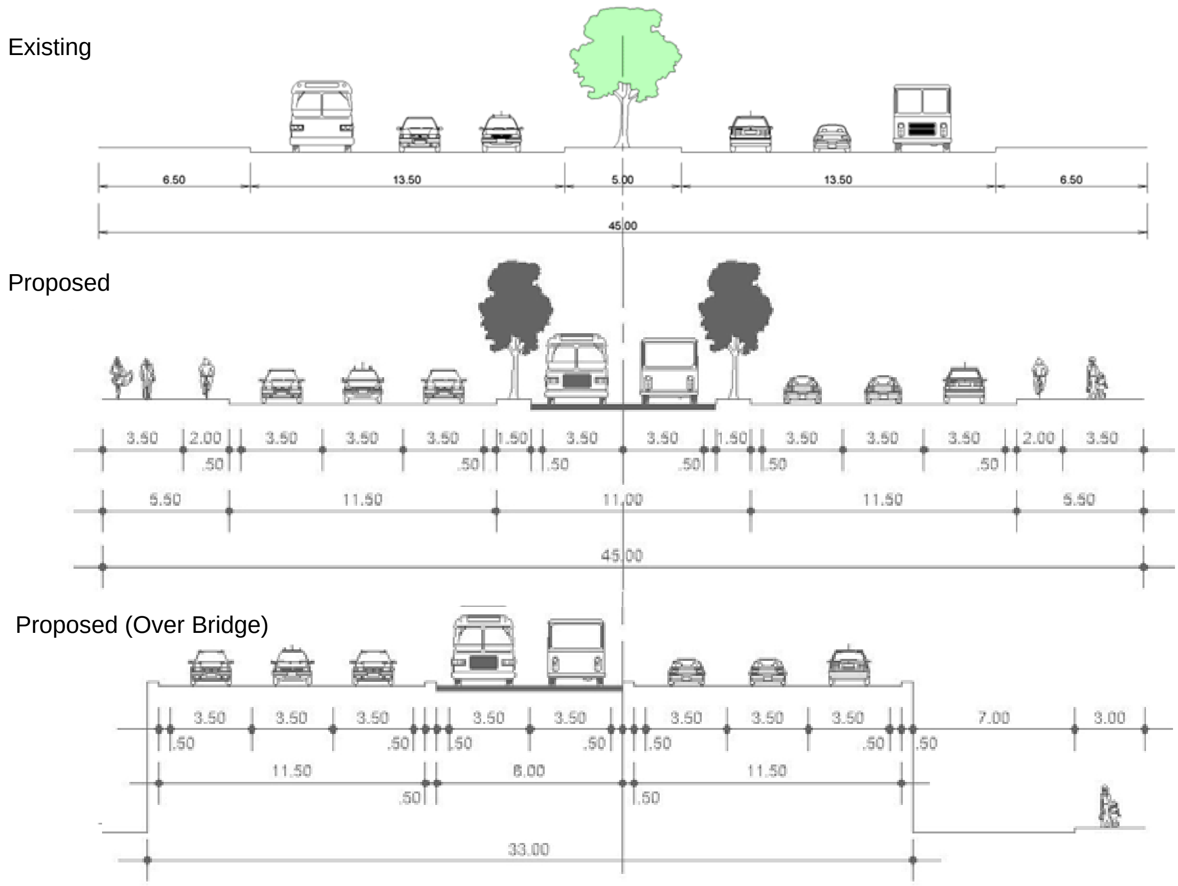


Figure 5.4-18 Av. Independencia X Av. Augusto Montenegro (Design Drawing)

5.4.2. CONSTRUCTION PLAN FOR TRUNK BUS TERMINALS AND STATION FACILITIES

(1) Necessary Scale of Trunk Bus Terminals

Bus terminals are used by trunk buses and feeder buses. Based on the findings in F/S in 2003 the number of berths required in each terminal is as shown in Table 5.4-3.

Table 5.4-3 Required Number of Berths

Berth		Trunk Bus		Feder Bus	
		Inbound	Outbound	Boarding	Alighting
Terminal	A. Icoaraci	2	2	3	3
	B. Coqueiro	3	3	5	5
	C. Marituba	3	3	5	5
	D. Cidade Nova	2	2	3	3
Station	A. Tapanã	2	2	3	3
	B. Mangueirão	2	2	3	3
	C. Águas Lindas	2	2	3	3

(2) Construction Plan for Bus Stations

The followings show the basic ideas of the facilities plan in the bus terminals. The plan of each facility is shown in Figures 5.4-19 through 5.4-25.

a) Giving consideration to the smooth movement of users, adopt barrier-free facilities as much as possible and introduce elevators and ramps, etc. for wheelchair users.

b) As essential terminal facilities, provide basic items such as ticket sales points and waiting rooms, etc., and if there is room also secure space for shopping facilities and public service facilities, etc.

c) In order to prevent confusion between trunk buses, feeder buses and ordinary traffic going into and out of bus terminals, construct a grade-separate ramp for entry and exit to Marituba Terminal.

d) In order to safely guide passengers who use bus terminals on foot from both sides of the road, construct pedestrian signals or pedestrian overpasses on the roads in front of bus terminals.

e) In order to control passengers in bus stations, form enclosed spaces between feeder bus stops and trunk bus stops and provide gates for passengers coming from bus stations.

f) Since Sao Braz Bus Terminal, which is used as a long-distance bus terminal, is transferred to the suburbs, carry out modifications to enable it to function as a terminal for trunk buses and transfer facility for conventional buses.

Figure 5.4-19 Plan of Icoaraci Bus Terminal

Área=15.449m^2

Figure 5.4-20 Plan of Coqueiro Bus Terminal

Terminal de Integração - Planta

Terminal Marituba

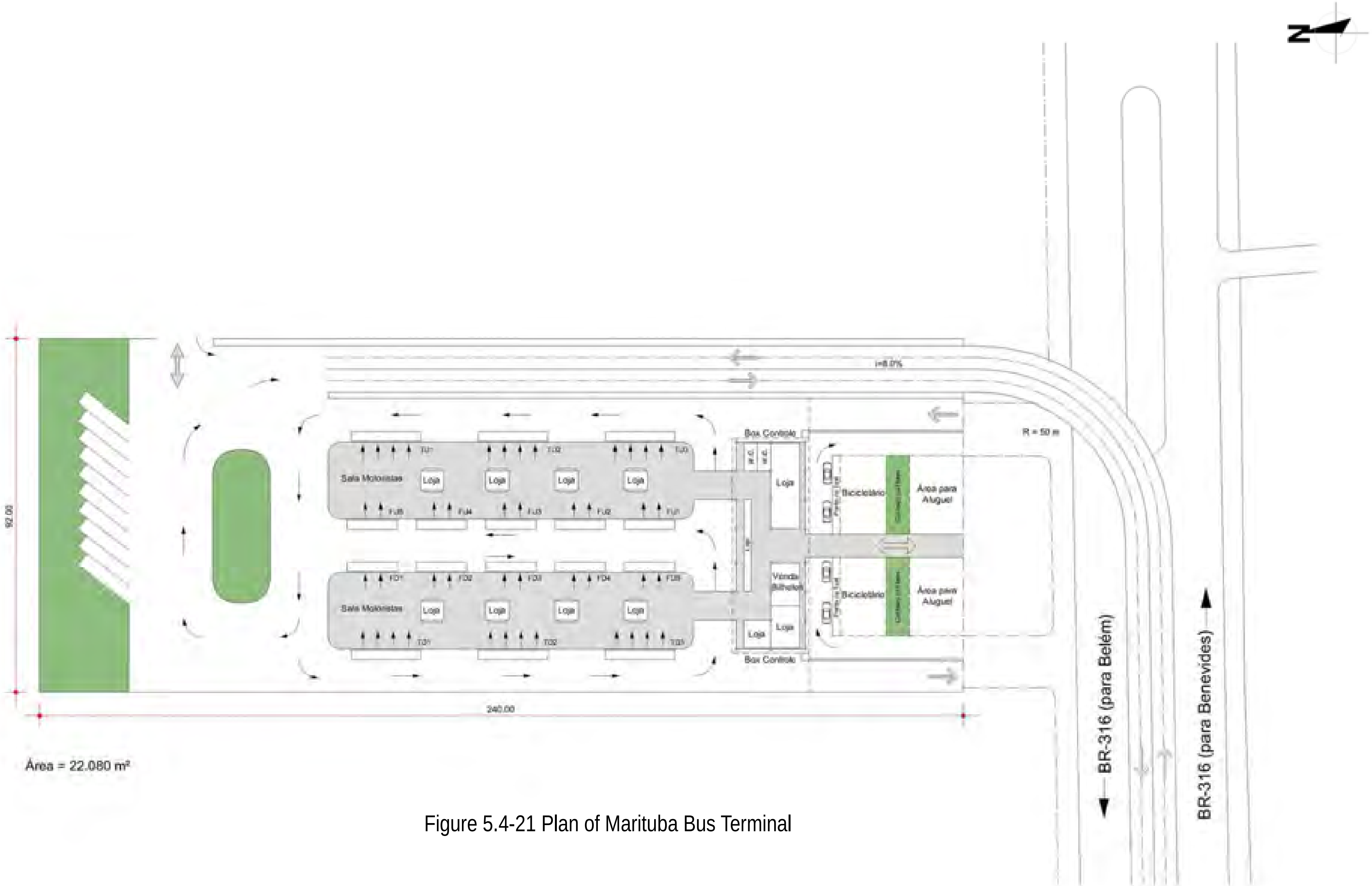


Figure 5.4-21 Plan of Marituba Bus Terminal

Terminal de Integração - Planta

Terminal Cidade Nova

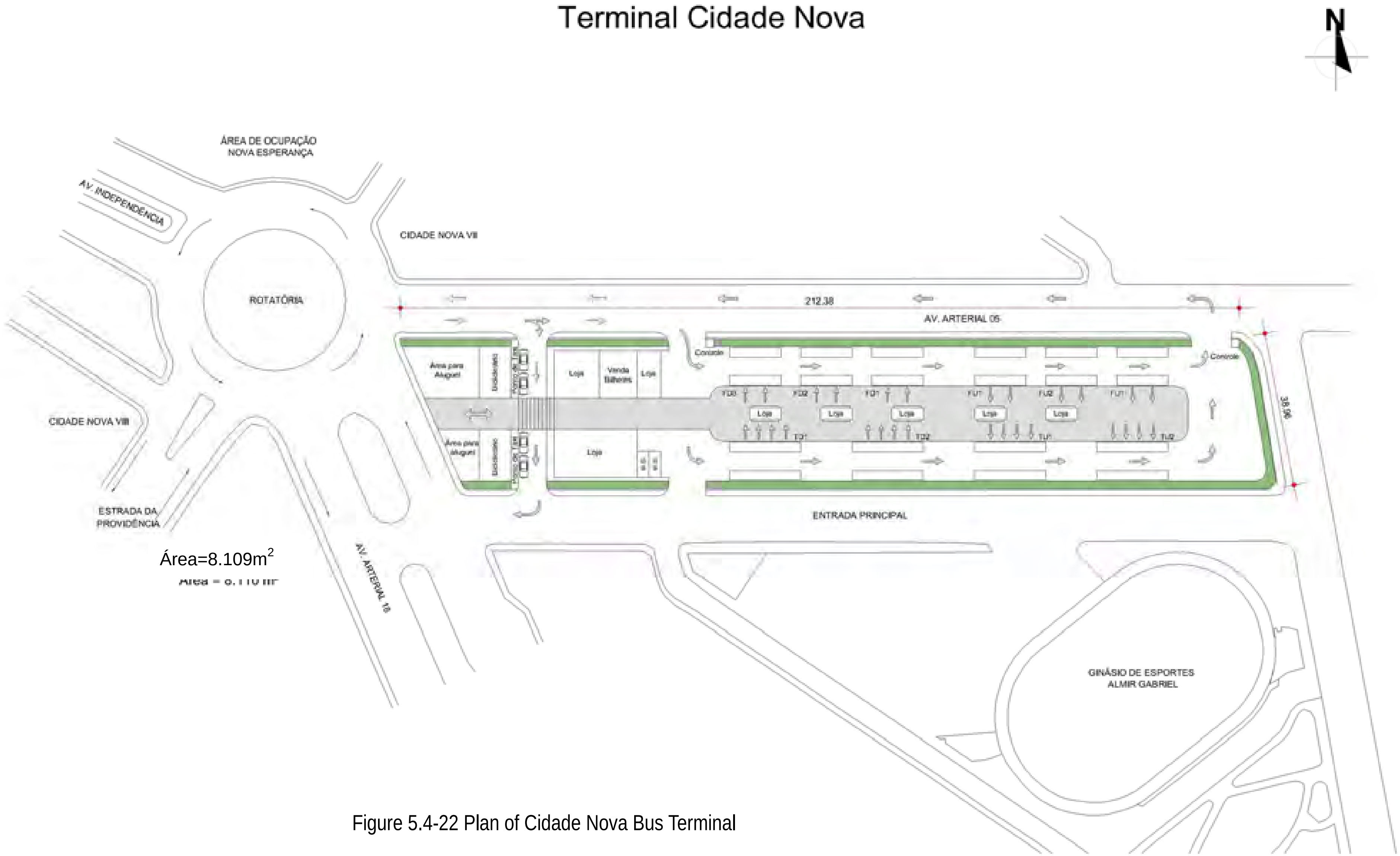


Figure 5.4-22 Plan of Cidade Nova Bus Terminal

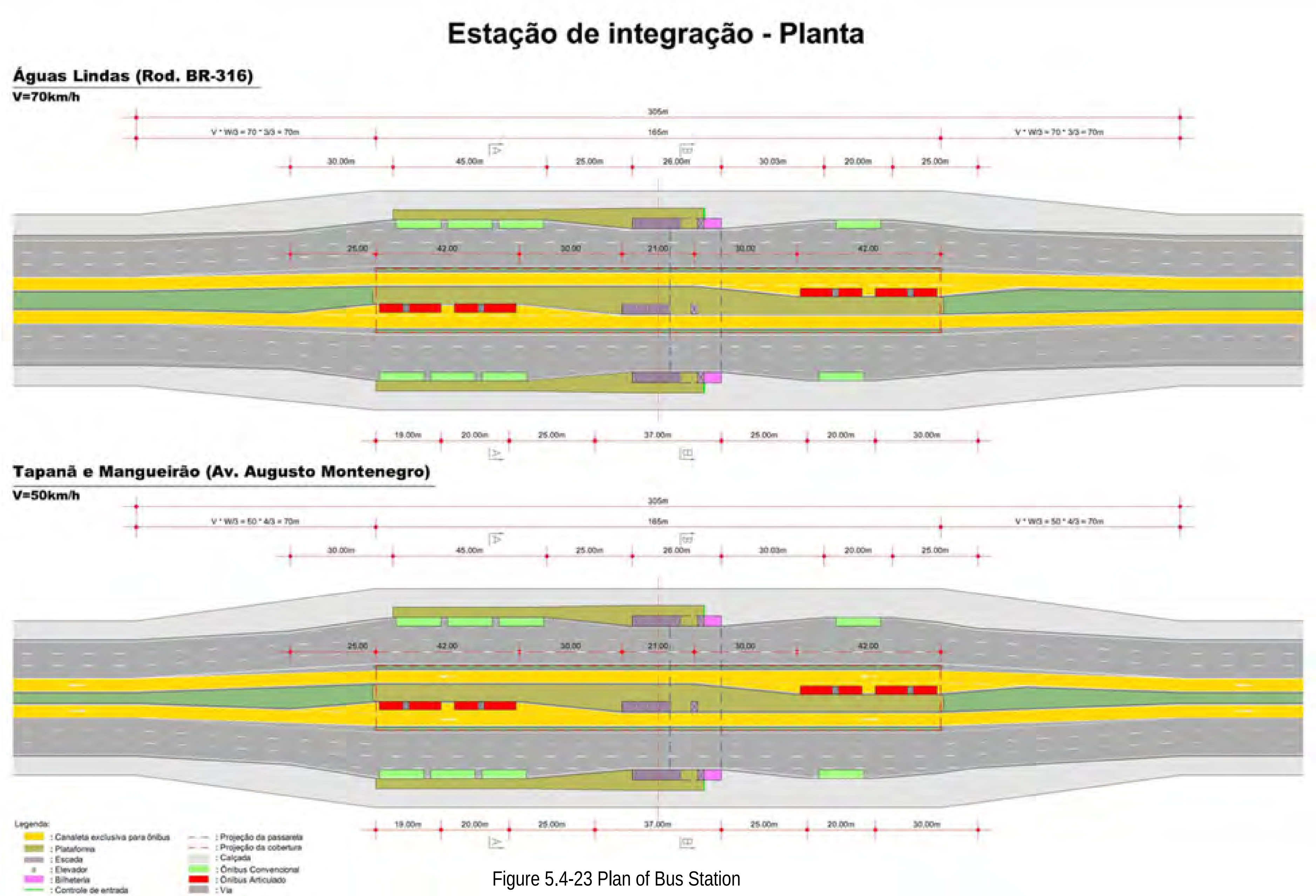
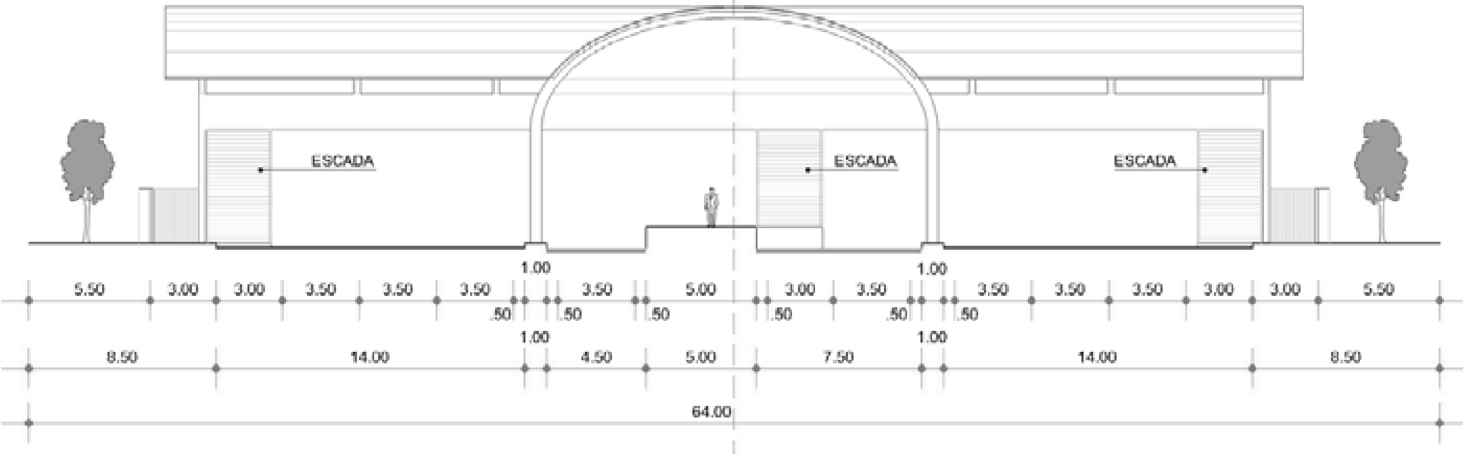


Figure 5.4-23 Plan of Bus Station

Seção A



Seção B

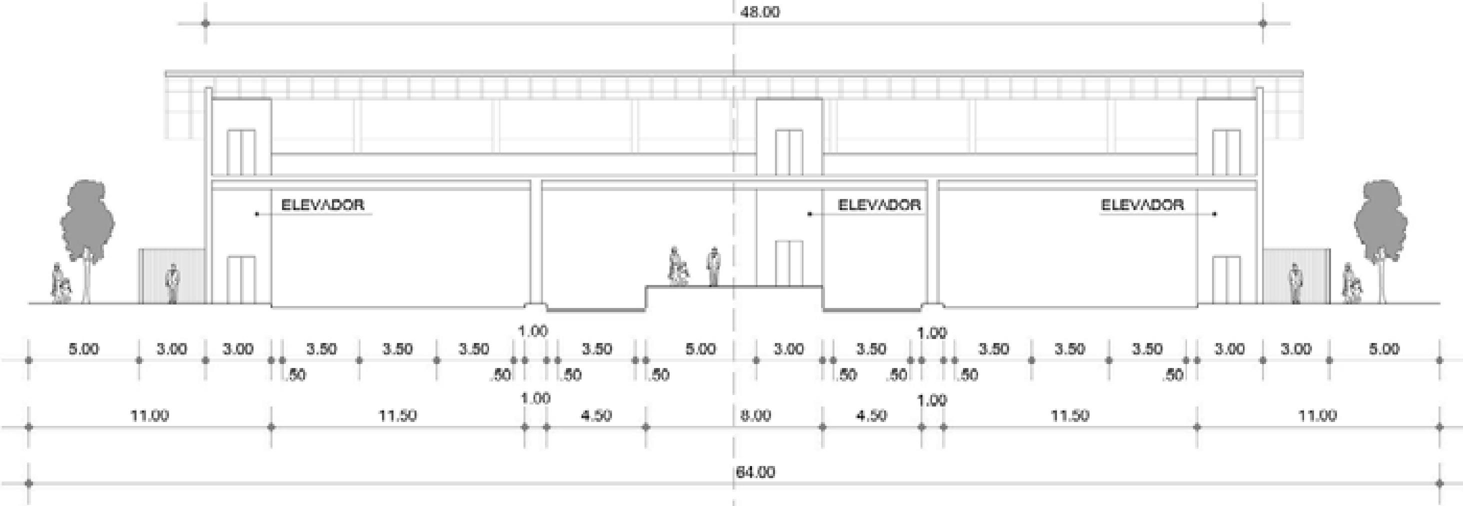


Figure 5.4-24 Facility Plan of Bus Station

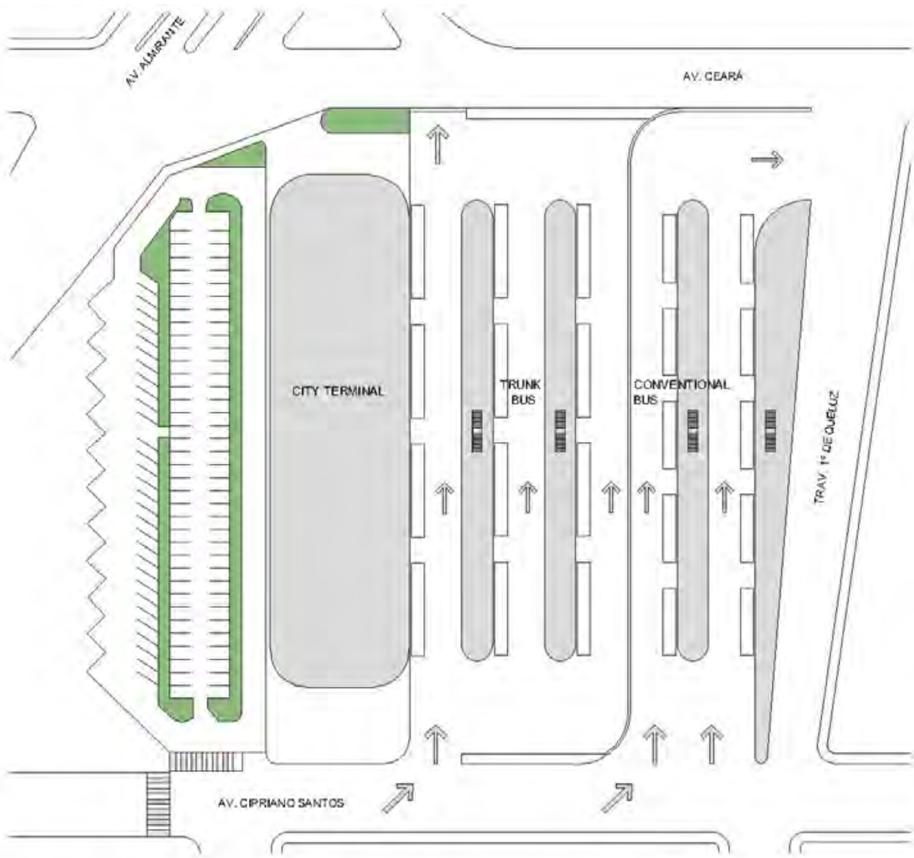


Figure 5.4-25 Modification Plan of Sao Braz Bus Terminal

5.4.3. PLAN FOR TRUNK BUS STOP FACILITIES

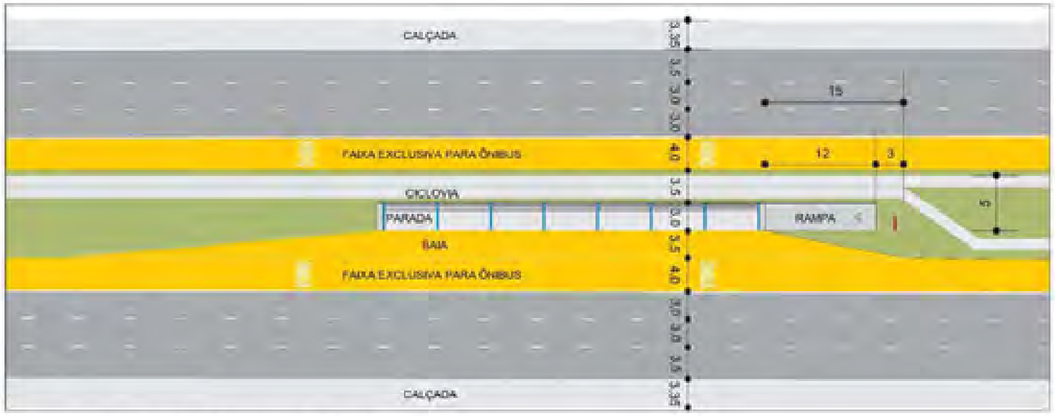
Since trunk bus exclusive lanes and priority lanes occupy the furthest left side of roads, trunk bus stops are constructed on the left side of roads (trunk bus entries and exits are provided on the left side). In order to facilitate boarding and alighting by wheelchair users, bus stops are raised to the same height as trunk bus floors. Bus stops are provided with wheelchair ramps and ticket booths, and construction of kiosks, etc. is also examined if there is enough space.

Figures 5.4-26 and 5.4-27 show the plan and standard cross section of a trunk bus stop on a busway and a bus exclusive lane. In order to increase the line capacity of trunk buses and provide various services to users (express buses), bus stops are constructed with a stopping lane and an overtaking lane. Concerning parking space in bus stops, enough space for two buses (Type I-1) is provided on the busy Av. Almirante Barroso, while enough space for one bus (Type I-2) is provided on other roads.

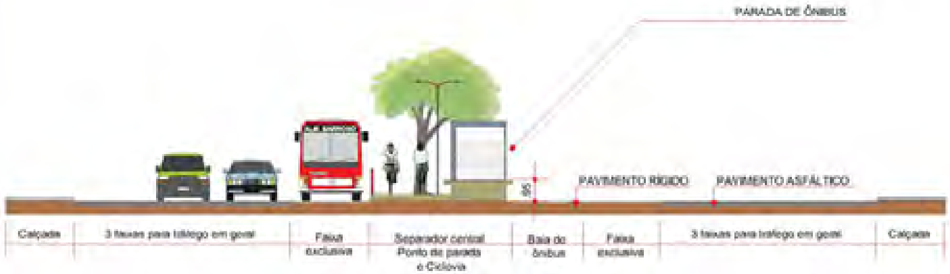
Meanwhile, on bus priority lane sections, since there isn't enough sidewalk space to install a bus bay, as can be seen in Figure 5.4-14, 2.5 m are secured as sidewalk width and the bus stop is constructed inside this (Type II).

Ponto de parada troncal

Av. Almirante Barroso



Localização ao longo da via



Seção Almirante Barroso

Localização em interseções

Figure 5.4-26 Bus Stop Plan (Type I-1)

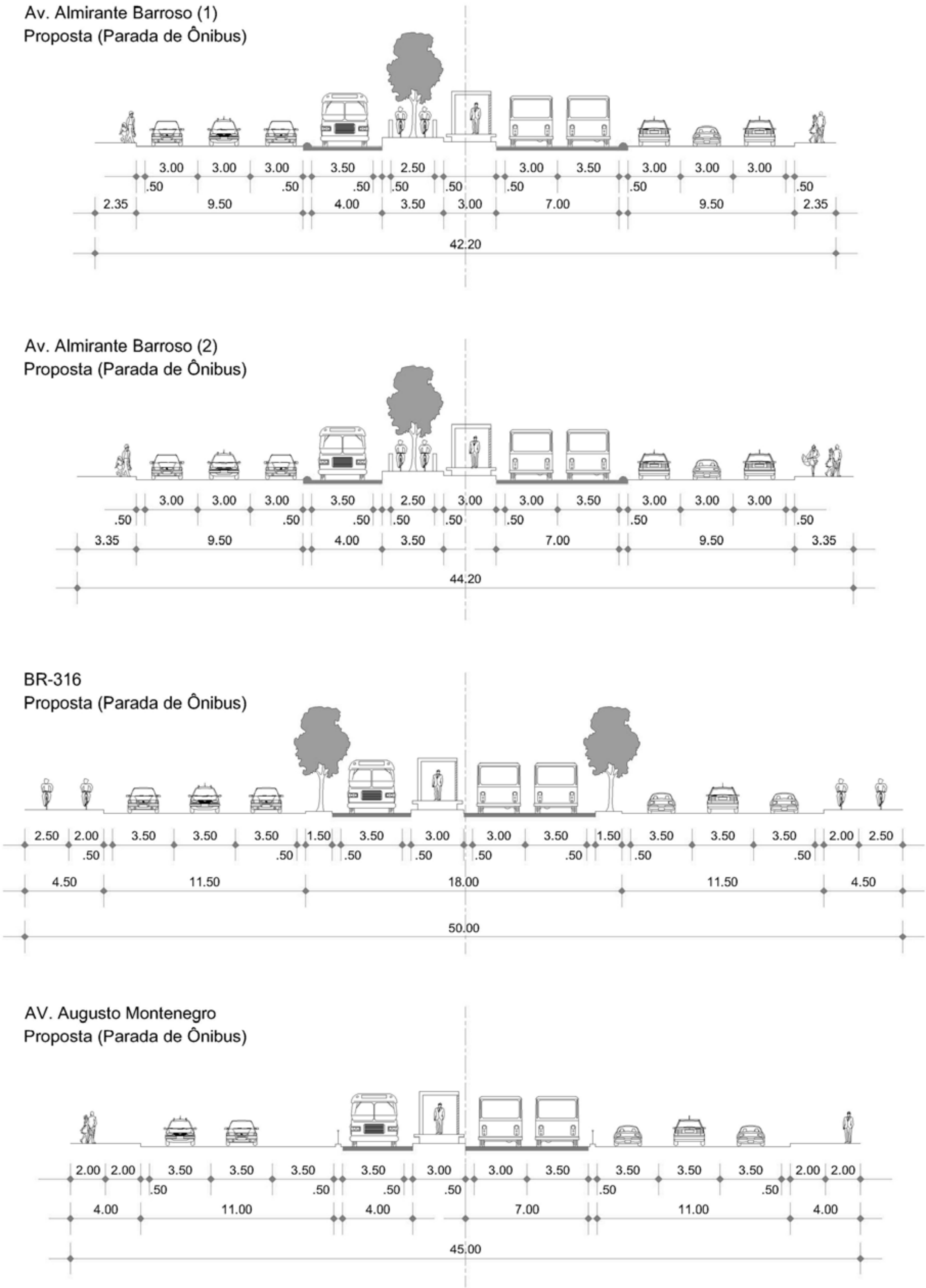


Figure 5.4-27 Standard Cross Sections of Bus Stops on Busways and Bus exclusive lanes

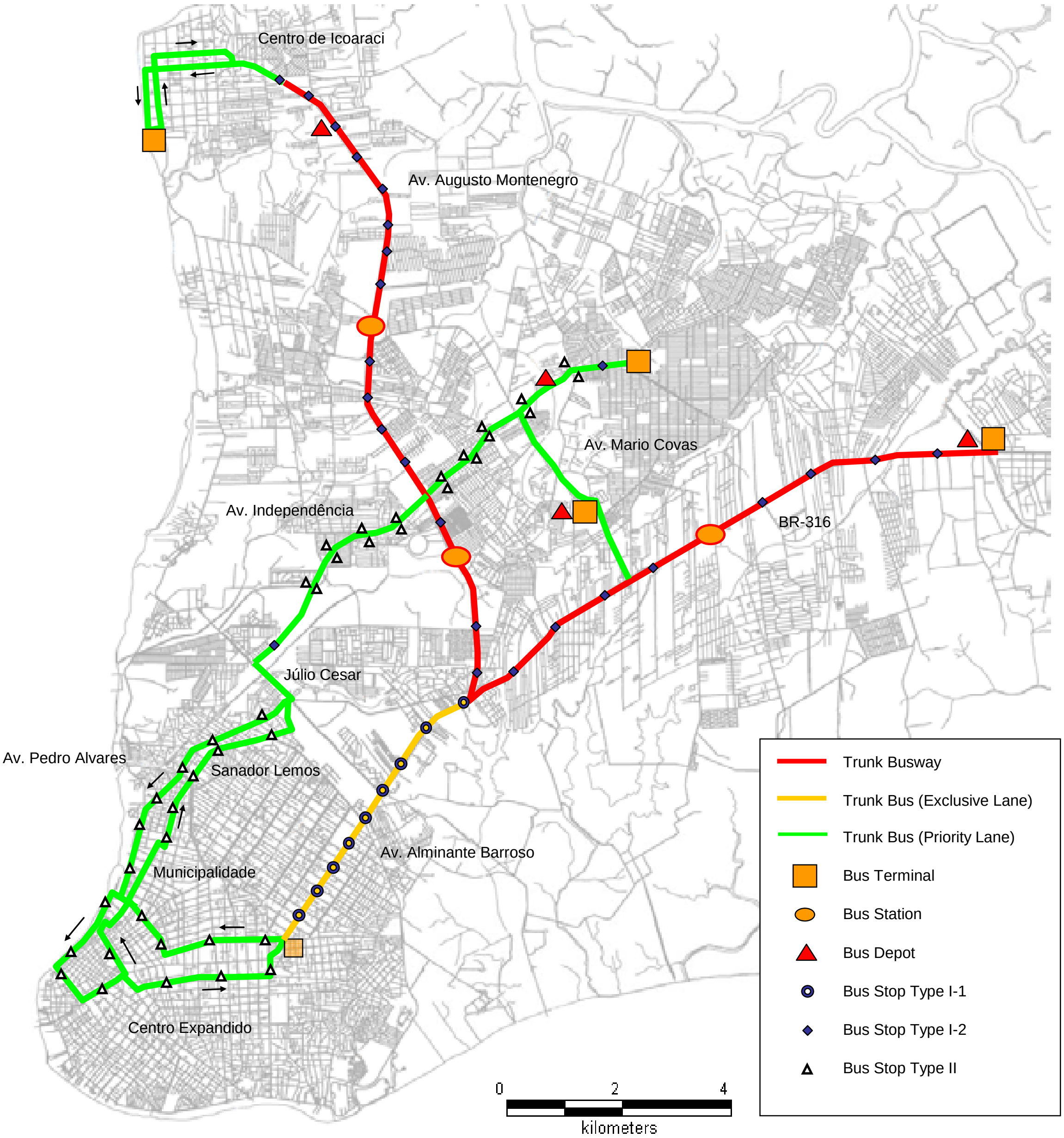


Figure 5.4-28 Layout Plan of Different Types of Bus Stops

5.4.4. TRUNK BUS OPERATION AND MAINTENANCE FACILITY PLAN (DEPOTS)

(1) Purpose and Functions of Trunk Bus Operation and Maintenance Facilities

On the trunk bus routes, bus operation and maintenance facilities for serving seven bus terminals and bus stations are planned. Bus operation and maintenance facilities have the following six functions:

a) Terminal function: Managing bus arrivals and departures from the bus station, as a substitute for the terminal functions of bus stations that don't possess return functions

b) Garage function: Overnight parking of buses

c) Cleaning, maintenance and repair functions: Implementation of bus cleaning, simple maintenance and full-scale repairs

d) Service adjustment function: Increasing frequency of services as required according to the level of congestion on buses

e) Bus route maintenance function: Routine inspection and maintenance of bus routes and emergency response to traffic accidents and vehicle breakdowns, etc.

f) Office function: Functioning as bus company offices and rest facilities for drivers and so on

(2) Locations and Scale of Facilities

Figure 5.4-29 shows the layout drawing of the necessary trunk bus operation and maintenance facilities. Icoaraci, Cidade Nova and Marituba manage one bus terminal and one bus station, and Coqueiro manages one bus terminal, and these facilities are located in positions that allow immediate measures to be taken in the event of emergencies.

The scale of facilities in the depots is as follows, and the necessary bus fleets are accommodated with the whole facilities.

Table 5.4-4 Scale of Bus Operation and Maintenance Facilities

Function	Planning Specifications	Remarks
Parking space (trunk buses)	Totaled 400 vehicles	
Parking space (feeder buses)	Totaled 150 vehicles	
Parking space (employees and visitors)		
Vehicle washing area	4 vehicles can be washed at the same time	
Inspection area	2 vehicles can be inspected at the same time	
Repair workshop		
Refueling station		
Office (administration office)		
Office (maintenance office)		
Office (service management office)		
Landscaping (trees and plants, etc.)		

(3) Facilities Plan Drawings

Figures 5.4-30 through 5.4-33 show the plan drawings of bus operation and maintenance facilities.

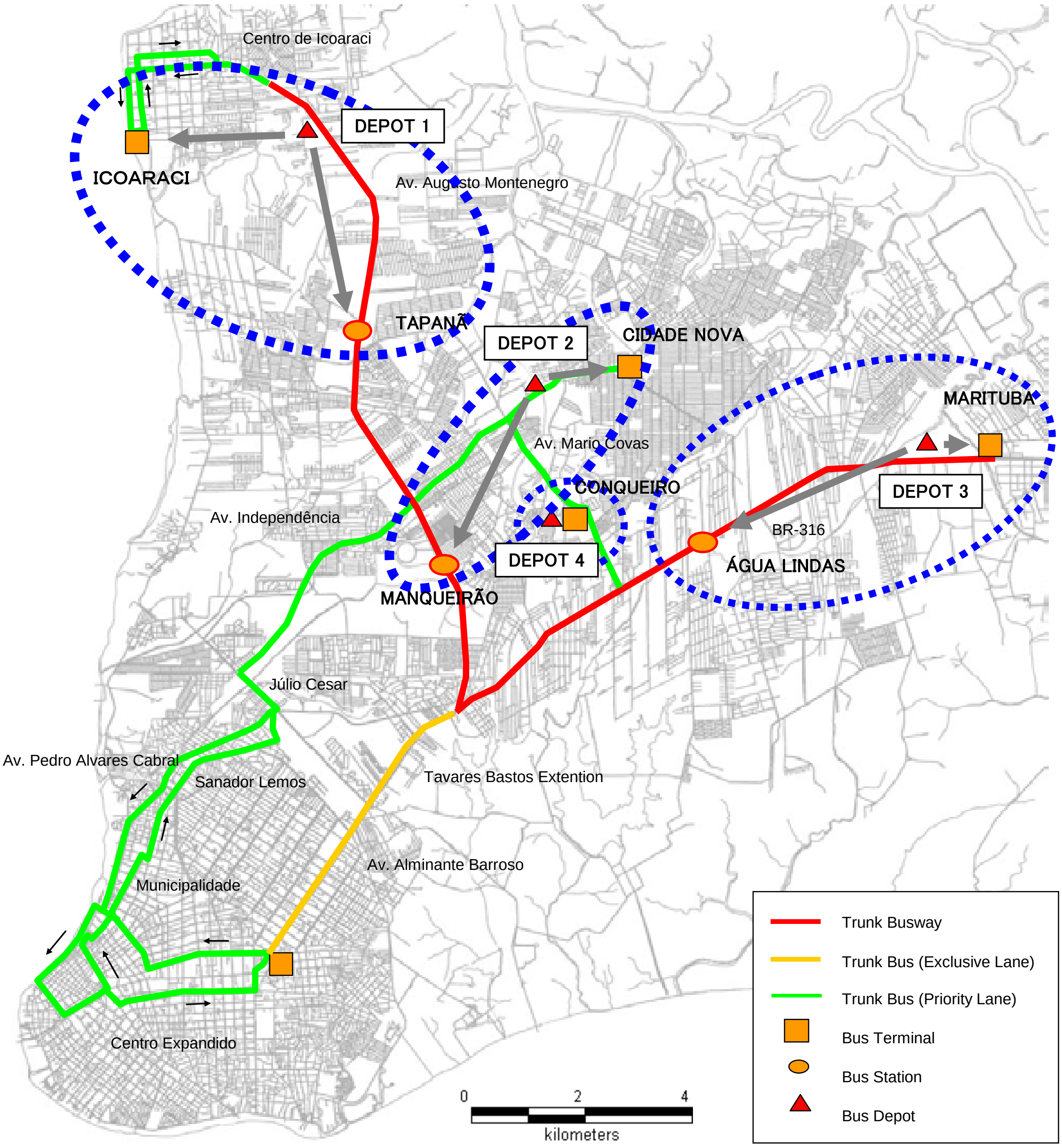


Figure 5.4-29 Layout Plan of Bus Operation and Maintenance Facilities (Depots)

Área = 22.033 m²

Figure 5.4-30 Floor Plan of Icoaraci Bus Depot

Garagem de ônibus - Planta

Garagem Cidade Nova

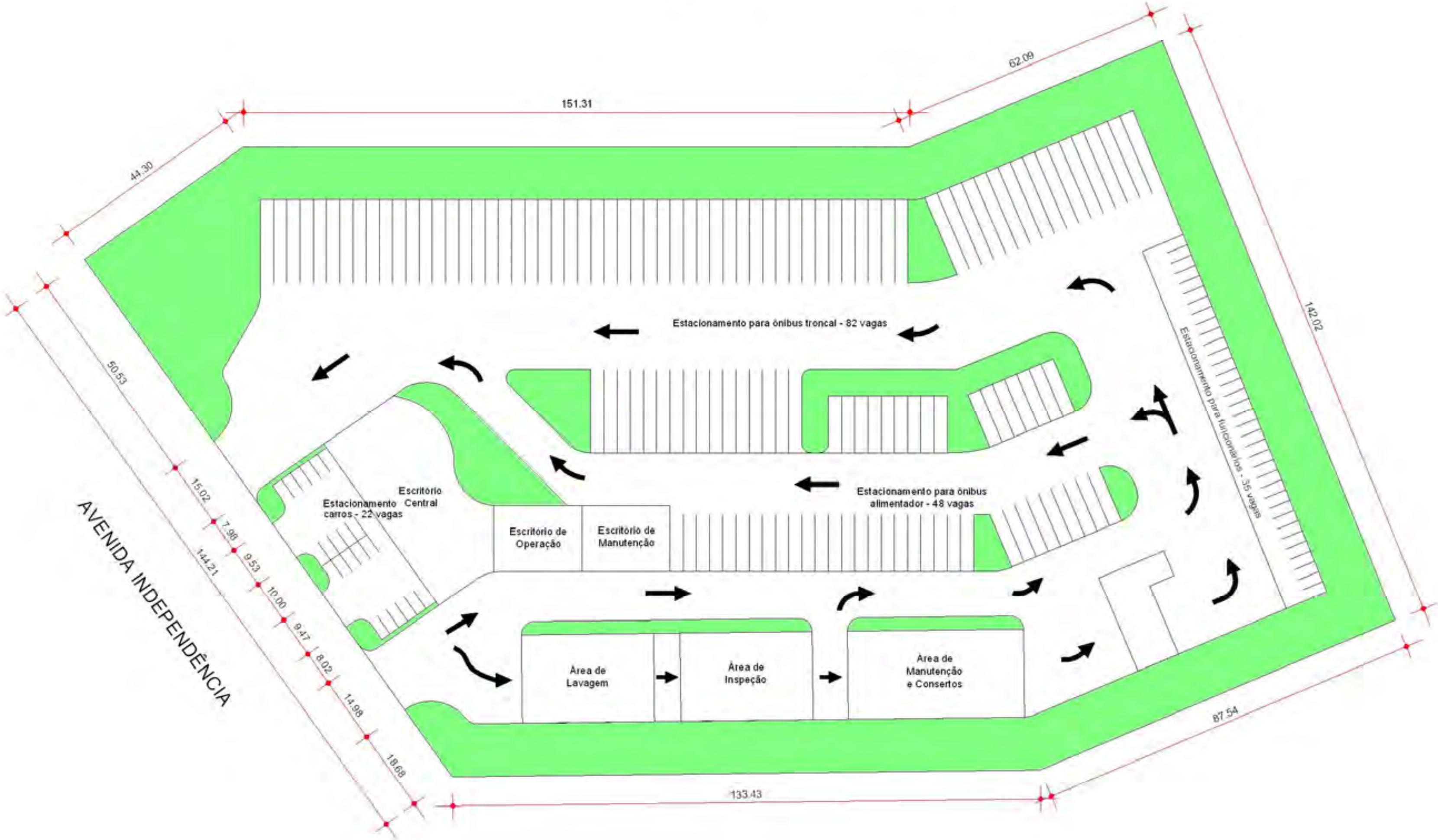


Figure 5.4-31 Floor Plan of Cidade Nova Bus Depot

Área = 34.127 m²

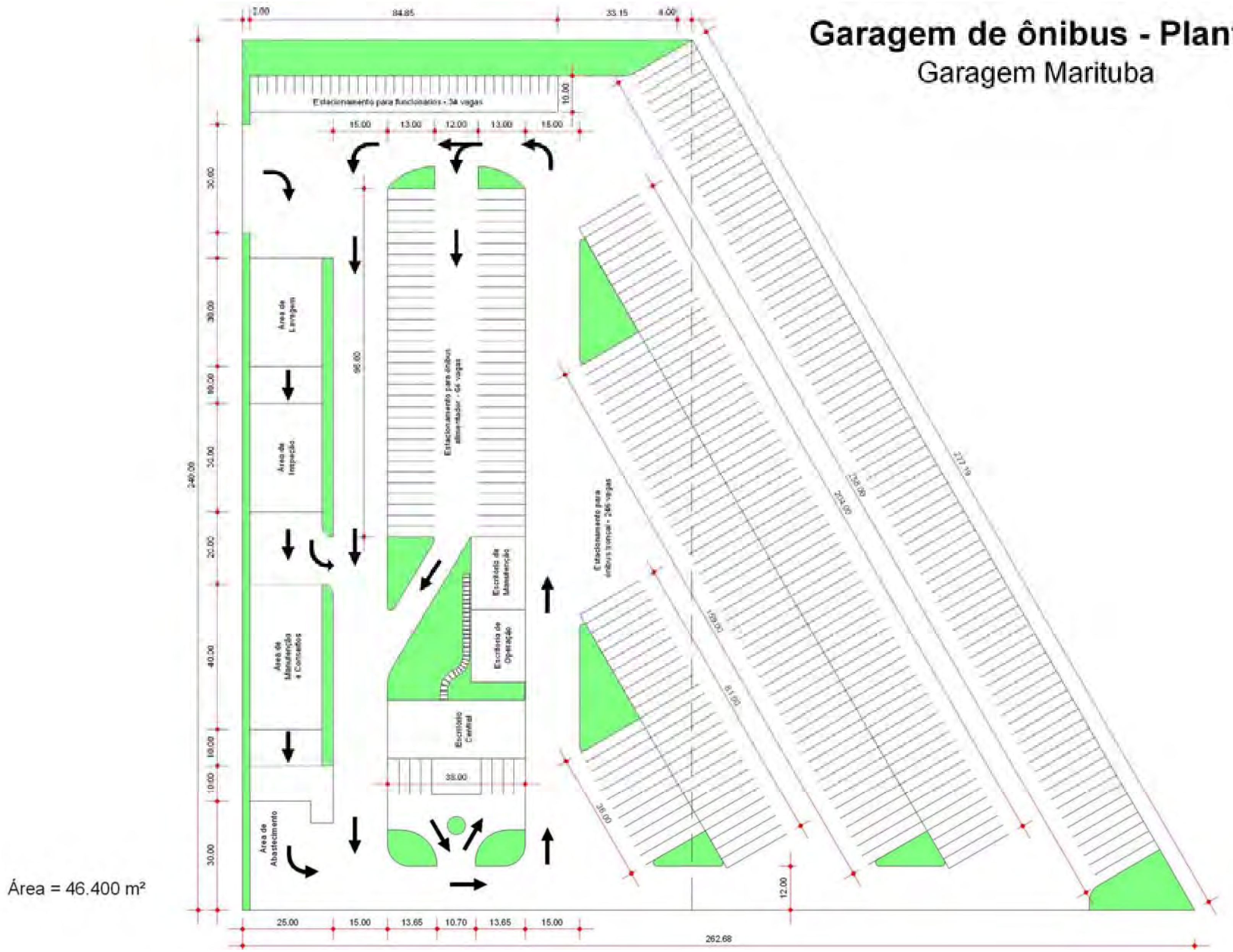


Figure 5.4-32 Floor Plan of Marituba Bus Depot

Garagem de ônibus - Planta

Garagem Coqueiro

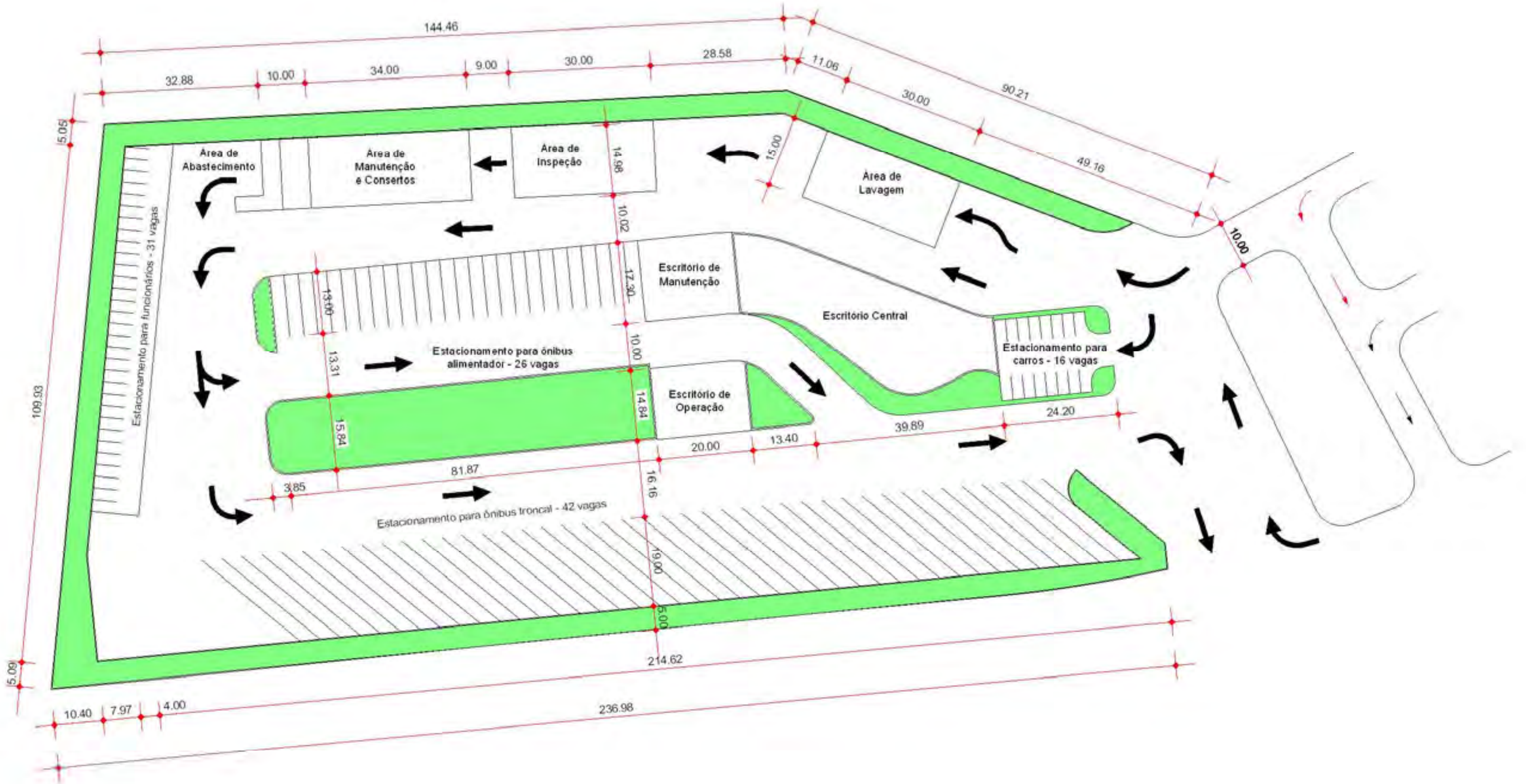


Figure 5.4-33 Floor Plan of Coqueiro Bus Depot

Área = 24.375 m²

CHAPTER 6
Project Implementation Planning

6. PROJECT IMPLEMENTATION PLANNING

6.1. PROJECT COSTING

The costing is done on the proposed trunk bus system as a whole and then narrowed down to the selected group of projects (i.e., the Y net development) judged applicable to JICA financing. Finally, the group is reduced further to single out the components (i.e., the I net development) financeable by the Japan's ODA Loan.

6.1.1. Policy for Updating Cost Estimation

The method and procedure employed by the 2003 F/S Study are reviewed regarding the required quantities and unit prices of construction materials, the exchange rate and other elements needed for cost estimation.

(1) Unit Prices of Direct Construction Cost

Unit prices for wages and salaries, construction materials and equipment in 2009 are higher than those employed by the F/S Study 2003. Their updating relied on the SINAPI price list[1] regarding Belem City and on the unit prices cited in the tender documents of similar projects.

It was found that wages and salaries increased 1.9 times, construction materials 2.5 times and construction equipment 1.8 times.

(2) Exchange Rate

The exchange rate of Brazilian real (BRL) changed substantially after 2003 (Table 6.1-1). The present Study uses the average exchange rate during six months from November 2008 to April 2009.

Table 6.1-1 Exchange Rate in 2003 and 2009

Year	2003	2009
1USD=	2.9000BRL	2.3001BRL
1USD=	¥120.00	¥95.79

(3) Construction Materials

The required quantities of construction materials are adjusted in accordance with the trunk bus facilities plan detailed in Chapter 5. The quantitative updating is needed regarding trunk busways, integrated terminals and stations, bus stops and bus yards or depots.

[1] SINAPI: Sistema Nacional de Pesquisa de Custos e Indices da Construcao Civil

(4) Indirect Cost

The indirect cost (common erection works, construction site management and general overhead) is assumed to be worth 30% of the direct construction cost, following the general practice in the State of Para. The total construction cost is the aggregation of the direct and the indirect cost.

The common erection works include the expenses for transporting construction equipment, preliminary preparations, safety management, technical management, repairs and so on. The construction site management includes the costs of labor management, medical care, insurance, staff salaries, travel allowances (fare, daily personal allowance and room charge), employee welfare, office supplies, postage and telecommunication and miscellaneous expenses.

(5) Consulting Services Cost

Following the general practice in the State of Para, the cost of consulting services is 10% of the total construction cost. The cost consists of consultants' fee for detailed project design and construction supervision.

(6) Price Escalation

The price escalation is estimated in two parts, domestic and foreign. The project costing allows for 13.3% per annum of domestic inflation and 2.6% per annum for foreign exchange.

(7) Physical Contingency

The physical contingency is worth 5% of the consulting services cost.

(8) Administration Cost

The administration cost consists of the expenses incurred by the State Government of Para as the primary executor of project management. The cost is worth 5% of the aggregation of the total project cost, consulting services cost and resettlement compensations for land and buildings.

Table 6.1-2 Various Costs of Project Management and Contingency

(%)

Costing Item	2003	2009
Common erection works, Construction Site Management and General Overhead	30.0	30.0
Consulting Services	10.0	10.0
Price Escalation	15.0	13.3
Physical Contingency		5.0
Administration	5.0	5.0

6.1.2. CONSTRUCTION COST OF TRUNK BUS SYSTEM

The estimated construction cost of the trunk bus system as a whole is shown in Table 6.1-3. The system consists of 9 busway projects, 7 integrated terminals and stations, bus facilities and bus depots.

Table 6.1-3 Direct Construction Cost of Trunk Bus System

Busway Projects						
	Road Name			Cost(BRL)	Cost(USD)	Cost(JPY)
1)	Av. Almirante Barroso	Exclusiva Lane	6.00	63, 507, 447. 46	27, 610, 733. 21	2, 645, 085, 187
2)	BR-316	Bus Way	10.75	125, 926, 621. 11	54, 748, 324. 47	5, 244, 843, 769
3)	Av.Augusto Montenegro	Bus Way	13.90	141, 002, 394. 31	61, 302, 723. 50	5, 872, 749, 723
4)	Centro De Icoaraci	Priority Lane	5.84	30,974,704.34	13,466,677.25	1,290,096,436
5)	Centro Expandido	Priority Lane	10.39	47,197,314.78	20,519,679.48	1,965,768,160
6)	Av.Mario Covas	Priority Lane	4.00	405,740.79	176,401.37	16,899,104
7)	Av.Independencia(East)	Priority Lane	5.45	32, 835, 804. 14	14, 275, 815. 90	1, 367, 611, 243
8)	Av.Independencia(West)	Priority Lane	6.20	4, 201, 962. 52	1, 826, 860. 80	175, 011, 739
9)	Binario	Priority Lane	11.10	38,172,768.50	16,596,134.30	1,589,895,808
	Total		73. 626	484, 224, 757. 95	210, 523, 350. 28	20, 167, 961, 169
Integrated Bus Terminal and Station						
	Terminal Name			Cost(BRL)	Cost(USD)	Cost(JPY)
1)	Icoaraci	Terminal	15,449	19,283,820.33	8,383,905.19	803,171,117
2)	Tapana	Station	21,430	9,754,137.64	4,240,745.03	406,259,833
3)	Mangueirao	Station	21,430	9,754,137.64	4,240,745.03	406,259,833
4)	Aguas Lindas	Station	22,140	9,754,137.64	4,240,745.03	406,259,833
5)	Marituba	Terminal	22,080	28,953,970.24	12,588,135.40	1,205,932,860
6)	Coqueiro	Terminal	14,266	21,607,540.23	9,394,174.27	899,954,050
7)	Cidade Nova	Terminal	8,109	11,882,180.04	5,165,940.63	494,892,799
	Total		124,904	110,989,923.76	48,254,390.57	4,622,730,325
Bus Facilities						
	Item			Cost(BRL)	Cost(USD)	Cost(JPY)
1)	Type1-2	L=24m	25	15,126,081.75	6,576,271.36	630,001,305
2)	Type1-1	L=42m	9	9,113,746.59	3,962,326.24	379,587,545
3)	Type2	L=24m	41	10,730,889.00	4,665,401.07	446,941,527
4)	Sao Braz Terminal Rehabilitaion		1	1,414,042.50	614,774.36	58,894,870
	Total			36,384,759.84	15,818,773.03	1,515,425,247

Bus Depot						
	Depo Name		m2	Cost(BRL)	Cost(USD)	Cost(JPY)
1)	Icoaraci		22,032	9, 374, 981. 14	4, 075, 901. 54	390, 467, 964
2)	Marituba		46,400	13, 255, 988. 92	5, 763, 222. 87	552, 111, 938
3)	Coqueiro		24,375	9, 523, 695. 68	4, 140, 557. 23	396, 661, 925
4)	Cidade Nova		34,127	10, 891, 923. 58	4, 735, 413. 06	453, 648, 617
	Total		126,934	43, 046, 589. 30	18, 715, 094. 69	1, 792, 890, 444

6.1.3. PURCHASE OF BUS FLEETS

The required frequency of trunk bus service is estimated from the demand forecast. The total number of trunk and feeder buses necessary to run the system is calculated from the service frequency. The cost of purchasing bus fleets is shown in Table 6.1-4.

Table 6.1-4 Purchasing Cost of Bus Fleets

Bus Type	Cost(BRL)	Cost(USD)	Cost(JPY)
Trunk Bus	230,265,000.00	100,110,864.75	9,590,537,250
Feeder Bus	26,741,000.00	11,626,016.26	1,113,762,650
Total	257,006,000.00	111,736,881.01	10,704,299,900

6.1.4. RESETTLEMENT COMPENSATIONS FOR LAND AND BUILDINGS

Resettlement compensations paid for land acquisition are shown in Table 6.1-5. The estimation of required land area per trunk bus facility and the costing thereof are done in Chapter 8.

Table 6.1-5 Cost of Resettlement Compensations

Facility Requiring Land	Cost(BRL)	Cost(USD)	Cost(JPY)
Terminal	5,433,120.00	2,362,123.39	226,289,448
Station	1,130,310.00	491,417.76	47,077,412
Bus Yard	8,143,779.00	3,540,619.54	339,188,395
Intersection	2,067,470.00	898,860.92	86,110,126
Total	16,774,679.00	7,293,021.60	698,665,381

6.1.5. PHASING AND PROJECT PACKAGING PROPOSED FOR JAPAN'S ODA LOAN

(1) Phasing of Implementation

The two-phase implementation is proposed for the trunk bus system. Phase 1 consists of those projects to be completed by the end of June, 2013 and Phase 2 comprises the remaining projects to be completed later than mid 2013. The projects selected for Japan's ODA Loan are included in Phase I. Table 6.1-6 shows the proposed phasing and packaging regarding seven road locations where the trunk bus system will be operated.

1) Phase 1: Construction of exclusive lanes or busways on Av. Almirante Barroso, BR-316 and Av. Augusto Montenegro (the Y-net development) and the integrated terminals and stations and bus stops along these arterial roads

2) Phase 2: Projects not part of the Y-net development, viz., the development of trunk bus priority lanes on Av. Independencia and Av. Mario Covas, with construction of terminals, stations and bus stops along the way.

Table 6.1-6 Phasing and Packaging of Trunk Bus Projects

Road for Trunk Bus System	Development for Trunk Bus System	Terminal / Station	Projects under Present Study	Y-net Projects for Japan's ODA Loan	I-net Projects for Japan's ODA Loan	Phase	Package
1. Av. Almirante Barroso	Exclusive lane		○	○	●	Phase 1	Package 1-1
2. BR-316	Exclusive busway	Marituba Aguas Lindas	○	○	●	Phase 1	Package 1-1
3. Av. Augusto Montenegro	Exclusive busway	Tapana Mangueirao	○	○		Phase 1	Package 1-2
4. Icoaraci Area	Priority lane	Icoaraci	○	○		Phase 1	Package 1-2
5. Centro Area of Belem	Priority lane		○	○	●	Phase	Package 1-1
6. Av. Independencia	Priority lane	Cidade Nova	○			Phase 2	
7. Av. Mario Covas	Priority lane	Conqueiro	○			Phase 2	

(2) Project Packaging in Phase 1 (for Japan's ODA Loan)

1) Package Classification

Projects are classified into Packages 1 through 4 by judging from their priority, scale and type of construction, among others. Package 1 pertains to the trunk bus system that constitutes the core of the proposal.

1) Package 1: Construction of busways or lanes (Table 6.1-7), implemented by the State of Para
2) Package 2: Purchase of bus fleets (Table 6.1-8), implemented by a private bus company
3) Package 3: Construction of bus yards (Table 6.1-9), implemented by a private bus company
4) Package 4: Resettlement Compensations for land and buildings (Table 6.1-10), implemented by the State of Para

2) Project Packaging for Japan's ODA Loan

Package 1 is subdivided into Package 1-1 and Package 1-2, of which the former is for financing by the Japan's ODA Loan (Table 6.1-6).

1) Package 1-1 (Japan's ODA Loan): Construction of the busway on BR-316 and exclusive lanes on Av. Almirante Barroso (the I-net development) and the facilities needed along the way. By noting the scale of construction and other factors, the package is divided into the following four construction lots.
    a) Lot-1: The trunk busway on BR-316, the bus station in Aguas Lindas, bus stops along the way and the access road to the bus terminal in Marituba
    b) Lot-2: Exclusive lanes on Av. Almirante Barroso and bus stops along the way
    c) Lot-3: Priority lanes and bus stops in the Centro area
    d) Lot-4: The bus terminal in Marituba
2) Package 1-2: Construction of the trunk busway on Av. Augusto Montenegro and priority lanes elsewhere (the remainder of the Y-net development) and the facilities needed along the way. The package is divided into the following two lots.
    a) Lot-1: Priority lanes and the bus terminal in the center of Icoaraci
    b) Lot-2: Trunk busway on Av. Augusto Montenegro, a bus station each in Tapana and Mangueirao and bus stops along the way

Table 6.1-7 Construction Cost of Packages 1-1 and 1-2

Package 1-1					
	Road or Location	Specification	Cost(BRL)	Cost(USD)	Cost(JPY)
Lot-1			140, 521, 104. 91	61, 093, 476. 33	5, 852, 704, 019
	BR-316		125, 926, 621. 11	54, 748, 324. 47	5, 244, 843, 769
	Aguas Lindas		9, 754, 137. 64	4, 240, 745. 03	406, 259, 833
	Type1-2	8	4, 840, 346. 16	2, 104, 406. 83	201, 600, 418
Lot-2			74, 035, 236. 55	32, 187, 833. 81	3, 083, 567, 602
	Av. Almirante Barroso		63, 507, 447. 46	27, 610, 733. 21	2, 645, 085, 187
	Sao Braz Terminal Rehabilitaion	1	1, 414, 042. 50	614, 774. 36	58, 894, 870
	Type1-1	9	9, 113, 746. 59	3, 962, 326. 24	379, 587, 545

Lot-3			50,076,333.78	21,771,372.45	2,085,679,302
	Centro Expandido		47,197,314.78	20,519,679.48	1,965,768,160
	Type2	11	2,879,019.00	1,251,692.97	119,911,141
Lot-4	Marituba		28,953,970.24	12,588,135.40	1,205,932,860
Package 1-2:					
Lot-1			50,258,524.67	21,850,582.44	2,093,267,553
	Centro de Icoaraci		30,974,704.34	13,466,677.25	1,290,096,436
	Icoaraci		19,283,820.33	8,383,905.19	803,171,117
Lot-2			169,586,318.64	73,729,976.37	7,063,270,171
	Av. Autusto Montenegro		141,002,394.31	61,302,723.50	5,872,749,723
	Tapana		9,754,137.64	4,240,745.03	406,259,833
	Mangueirao		9,754,137.64	4,240,745.03	406,259,833
	Type1-2	15	9,075,649.05	3,945,762.81	378,000,783
Total			513,431,488.78	223,221,376.80	21,384,421,508

Table 6.1-8 Cost of Package 2: Purchase of Fleets

Bus Type	No. of Units	Cost(BRL)	Cost(USD)	Cost(JPY)
Trunk Bus	206	122,570,000	53,288,987.44	5,105,040,500
Feeder Bus	103	19,261,000	8,373,983.74	802,220,650
Total		141,831,000.00	61,662,971.18	5,907,261,150

Table 6.1-9 Cost of Package 3 : Bus Yards

Location	Required Land Area (m^2)	Cost(BRL)	Cost(USD)	Cost(JPY)
Icoaraci (BR-316)	22,032	9,374,981.14	4,075,901.54	390,467,964
Marituba	46,400	13,255,988.92	5,763,222.87	552,111,938
Total	68,432	22,630,970.05	9,839,124.41	942,579,903

Table 6.1-10 Cost of Package 4: Resettlement Compensations for Land and Buildings

Facility Requiring Land	Cost(BRL)	Cost(USD)	Cost(JPY)
Terminal	3,385,024.00	1,471,685.58	140,986,250
Station	1,130,310.00	491,417.76	47,077,412
Bus Yard	4,653,467.00	2,023,158.56	193,816,901
Total	9,168,801.00	3,986,261.90	381,880,562

(3) Project Components for Japan's ODA Loan

The projects considered for JICA application are grouped together as Package 1, the Y-net development. The Package 1-1 for Japan's ODA Loan constitutes the I-net portion of this package. The remainder of the Y-net development, or Package 1-2, is omitted from JICA financing. The costing of Package 1-1 is done by noting the possible schedule of implementation with allowances for price escalation and physical contingency, as shown in Table 6.1-11. The portion eligible for JICA financing totals ¥22,479 million, including payments of interests and commissions during construction. The cost of Package 1-2 (the remainder of the Y-net development) is estimated by adding price escalation, physical contingency, administration cost, taxes and payments of interests and commissions. Table 6.1-12 summarizes the cost estimation in terms of the foreign and the local currency components. The expected JICA loan would account for 43.9% of the total cost of the Y-net development.

Table 6.1-11 Estimated Cost of Y-net Development and JICA Financing

Items		Foreign Currency (¥ million)	Local Currency (R$ million)	Total (¥million)
A. Eligible Portion				
Ⅰ)	Procurement / Construction	0	461	19,206
	Busway Project(Package 1-1)	0	294	12,228
	Base cost for JICA financing	0	294	12,228
	Price escalation	0	146	6,063
	Physical contingency	0	22	915
Ⅱ)	Consulting services	1,537	30	2,792
	Base cost	1,370	21	2,232
	Price escalation	94	8	427
	Physical contingency	73	1	133
Total (Ⅰ + Ⅱ)		1,537	491	21,998
B. Non Eligible Portion				
a	Procurement / Construction	0	614	25,576
	Bus Purchase	0	142	5,907
	Bus Yard	0	23	943
	Busway Project (Package 1-2)	0	220	9,157
	Base cost for JICA financing	0	384	16,006
	Price escalation	0	201	8,352
	Physical contingency	0	29	1,218
b	Land Acquisition	0	12	485
	Base cost	0	9	382
	Price escalation	0	2	80
	Physical contingency	0	1	23
c	Administration cost	0	58	2,403
d	VAT	0	5	213
e	Import Tax	0	0	0
Total (a+b+c+d+e)		0	689	28,677
TOTAL (A+B)		1,537	1,180	50,676
C. Interest during Construction		409	0	409
	Interest during Construction(Const.)	409	0	409
	Interest during Construction (Consul.)	1	0	1
D. Commitment Charge		71	0	71
GRAND TOTAL (A+B+C+D)		2,017	1,180	51,156
E. JICA finance portion incl. IDC (A + C + D)		2,017	491	22,479

Table 6.1-12 Project Cost Summary by Currency Component

Currency Component	Foreign Currency (¥ million)	Local Currency (R$ million)	Total (¥ million)
JICA Portion	2,017	491	22,479
Brazil Portion	0	689	28,677
Total	2,017	1,180	51,156

6.2. IMPLEMENTATION SCHEDULE (PROPOSAL)

To complete the construction of the JICA financed Package 1-1 by July 2013, the scheduling should take into account the following time frame.

(1) Period from the application to SEAIN of the State Government to the L/A signing with the Government of Japan

1) For SEAIN of the State Government to approve the application by October 2009, it is necessary for the State Government to get the approval on the external financing request from COFIEX of the Federal Government.
2) The Government of Japan needs to pronounce its formal pledge, as required by the JICA procedure, by the end of January, 2010.
3) Subsequently, it is necessary to go through the E/N, the formal approval of the Federal Government of Brazil and the signing of L/A by June 2010.

(2) Period from the detailed design preparation through the end of the construction

After signing L/A, the procedure goes on to the selection of the consultant, the preparation of the detailed project design by the consultant, the selection of the contractor(s) and lastly the start of construction works. After the E/N and the formal approval by the Federal Government of Brazil, it is possible to proceed directly to the public announcement of PQ without waiting for the signing of L/A. The construction works are tentatively scheduled to start in May 2012 and end in June 2013. The following time frame is based on the experience in Brazil.

1) Selection of the consultant: 7 months

- After the L/A signing, it would take 3 months to announce D/D, post Pre-Qualification (PQ) and evaluate PQ, or in other words, to shortlist the consultants out of the long list of the hopefuls.
- It would take 3 to 4 months to post the short list, receive and evaluate proposals from the shortlisted consultants and finalize the selection by signing the contract.

2) Detailed Design by the consultant: 12 months

- Under the assumption that the construction would be carried out in four separate lots, the detailed design needs to be prepared for each lot, ensuring the expeditious selection of the contractors.

3) Selection of the contractors: 7 months

- Four contractors would be selected to take charge of the four construction lots.
- PQ posting and short listing of contractors would be done separately for each lot.
- After 8 months from the start of lot-wise detailed design drawing, the D/D announcement, PQ posting and evaluation, and short listing from the long list of contractors could be done in part simultaneously, say, for about 3 to 4 months. The collection, analysis and evaluation of the company documents and other data needed for the tender procedure could be done while the D/D drawing is still going on.
- After four D/Ds are completed, it would take 3 to 4 months to post the D/Ds to the shortlisted contractors, receive and evaluate their proposals and finalize the selection by signing the contracts.

4) Period of Construction Works

- Lot-1: 14 months
- Lot-2: 14 months
- Lot-3: 12 months
- Lot-4: 12 months

Table 6.2-1 Implementation Plan of the Project Financed by Japan's ODA Loan (Tentative)

No.	Working Items	Period	2009												2010												2011												2012												2013											
		Month	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1	Preparatory Survey	8																																																												
2	COFIEX Aproval by Brazil											▲																																																		
3	Apraisal Mission by JICA	3																																																												
4	Pledge by JICA														▲																																														
5	Exchange Note															▲																																													
6	Loan Agreement																			▲																																										
7	Approval of Environmental License(LI)	6																																																												
【Phase-1】																																																														
Package-1-1																																																														
1	Consultant Evaluation	7																																																												
2	Detail Design	12																																																												
3	Contractor Evaluation																																																													
	Lot-1:BR-316, Aguas Lindas, Approach Roads, Bus Stops	7																																																												
	Lot-2: AV.ALMIRANTE BARROSO, Bus Stops	7																																																												
	Lot-3: CENTRO EXPANDIDO, Bus Stops	7																																																												
	Lot-4: Marituba Terminal	7																																																												
4	Construction																																																													
	Lot-1:BR-316, Aguas Lindas, Approach Roads, Bus Stops	14																																																												
	Lot-2: AV.ALMIRANTE BARROSO, Bus Stops	14																																																												
	Lot-3: CENTRO EXPANDIDO, Bus Stops	12																																																												
	Lot-4: Marituba Terminal	12																																																												
Package-1-2																																																														
1	Consultant Evaluation	7																																																												
2	Detail Design	10																																																												
3	Contractor Evaluation																																																													
	Lot-1: Centro Icoaraci, Termina	7																																																												
	Lot-2: August Montenegro, 2-Stations, Bus Stops	7																																																												
4	Construction																																																													
	Lot-1: Centro Icoaraci, Terminal	12																																																												
	Lot-2: August Montenegro, 2-Stations, Bus Stops	14																																																												

Table 6.2-2 Implementation Plan of the Entire Project (Tentative)

No.	Working Items		Period Month	2009	2010	2011	2012	2013	2014	2015
1	Preparatory Survey		8							
2	COFIEX Aproval by Brazil									
3	Apraisal Mission by JICA		3							
4	Pledge by JICA									
5	Exchange Note									
6	Loan Agreement									
7	Approval of Environmental License(LI)		6							
【Phase-1】										
Package-1-1										
1	Consultant Evaluation		7							
2	Detail Design		12							
3	Contractor Evaluation									
		Lot-1:BR-316, Aguas Lindas, Approach Roads, Bus Stops	7							
		Lot-2: AV.ALMIRANTE BARROSO, Bus Stops	7							
		Lot-3: CENTRO EXPANDIDO, Bus Stops	7							
		Lot-4: Marituba Terminal	7							
4	Construction									
		Lot-1:BR-316, Aguas Lindas, Approach Roads, Bus Stops	14							
		Lot-2: AV.ALMIRANTE BARROSO, Bus Stops	14							
		Lot-3: CENTRO EXPANDIDO, Bus Stops	12							
		Lot-4: Marituba Terminal	12							
Package-1-2										
1	Consultant Evaluation		7							
2	Detail Design		10							
3	Contractor Evaluation									
		Lot-1: Centro Icoaraci, Termina	7							
		Lot-2: August Montenegro, 2-Stations, Bus Stops	7							
4	Construction									
		Lot-1: Centro Icoaraci, Terminal	12							
		Lot-2: August Montenegro, 2-Stations, Bus Stops	14							
5	Package-2	Bus Perchase	6							
	Package-3	Bus Depots	10							
	Package-4	Compensation for House and Land Acquisition	18							
【Phase-2】										
1	Consultant Evaluation		4							
2	Detail Design		12							
3	Contractor Evaluation		4							
4	Construction									
		Av. Mario Covas	5							
		Av. Independencia (East)	20							
		Av. Independencia (West)	5							
		Binario	15							
5	Bus Depots		10							
6	Compensation for House and Land Acquisition		18							

CHAPTER 7
Framework Of Implementation And Operation

7. FRAMEWORK OF IMPLEMENTATION AND OPERATION

7.1. MANAGEMENT OF PROJECT IMPLEMENTATION

7.1.1. ORGANIZATIONS FOR PROJECT IMPLEMENTATION

(1) State Secretariat of Strategic Projects-SEPE

The SEPE is the primary organization in charge of project implementation for the trunk bus system. Figure 7.1-1 shows the organizational chart of SEPE. The secretariat was established by the Statute No. 7018 of July 24th, 2007. Its mandate is to formulate and manage those projects which the state government formally approves. The secretariat consists of the following three divisions.

1) Para Rural Program Division (NGPR)

This division was created by the Statute No. 6796 of Nov. 16th, 2005. Its responsibility is to strengthen the state policy on land management by promoting the development of natural resources with appropriate environmental consideration. The division also supports area development efforts in the State of Para with the aim of raising the income of poor rural families. The division has a staff of 66.

2) Finance Division (NUCAP)

The division was created by the Statute No. 7018 of July 24th, 2007. It is in charge of securing finance for important projects that are of strategic interest from the viewpoint of the state economy and society. The division engages in the procurement of domestic and external funds needed for programs, projects and other activities for development and takes charge of negotiations with lending institutions. The division also gives support to other governmental organs by referring to appropriate financing sources. The stance in negotiation is to promote economic growth by encouraging increased investment in the public and the private sectors. The division is manned by a staff of four.

3) *Nucleus of Administration of Metropolitan Transport (**NGTM)***

The division was created by the Statute No. 1230/08 of August 28th, 2008. Its mandate is to implement and manage the projects proposed in the Metropolis Action Plan. More specifically, the division is in charge of four activities: viz., control and management of metropolitan public transport, urban development activities, planning and implementation of transport infrastructure development, and fare policy and licensing. The division is currently staffed with 16 personnel. The division consists of two units respectively in charge of the following activities. NGTM is directly responsible for the project implementation for the trunk bus system.

- Planning and Management Unit (6 personnel): the unit directly and indirectly coordinates and manages the implementation of the Metropolis Action Plan.
- Construction Unit (3 personnel): the unit arranges and processes tenders on civil engineering works on roads, bridges and other structures, and after the signing of contracts, directly and indirectly coordinates and supervises construction works by the contractors.

The official responsibility of NGTM includes the control and management of the public transport system in the Belem metropolitan area. The state government and the municipalities in the Belem metropolitan area have agreed to organize a public consortium for the management of the public transport system.

It has been agreed so far that the institutional development will take the following form in outline.

- NGTM of SEPE takes charge of the implementation. Its staff will be increased by seconding from the personnel of other government bureaus and divisions along with the start of construction works.
- A public consortium is organized to manage the operation of the trunk bus system.
- NGTM continues its mandated tasks during the project implementation, and the personnel are then transferred to the proposed consortium after the completion of the construction works.
- The Planning and Management Unit of NGTM makes preparation for the establishment of the consortium.

The exact form of trunk bus operation will be described in the next section where the organizational structure and functions and the administrative jurisdiction are proposed for the public consortium.

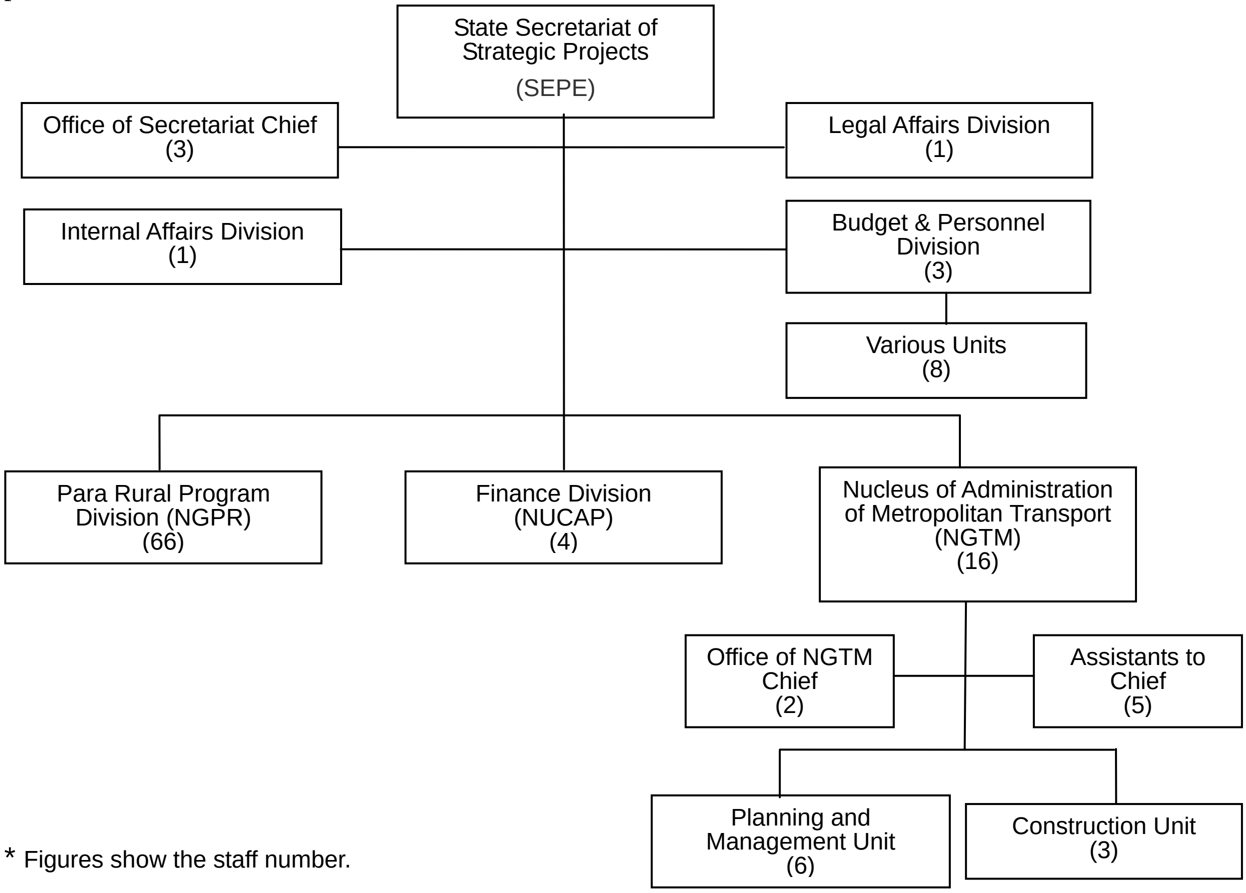


Figure 7.1-1 Organizational Structure of SEPE, the State Government of Para

7.1.2. FINANCIAL CAPACITY OF THE STATE GOVERNMENT OF PARA

Before the loan application to JICA, the State Government of Para requires the approval of the Federal Government. Along with the progress of the present Study, the state government needs to submit its request for approval to the Department of International Affairs (Secretaria de Assuntos Internacionais: SEAIN) of the Federal Ministry of Planning. The financial situation of the State Government of Para is by far the important factor for evaluating the credit worthiness for approval.

The present Study ascertained the adequacy of the state finance by checking the data made available by the State Secretariat of Finance. The credit worthiness of the state government described below is based entirely on the information supplied by the secretariat.

(1) Ceiling on New External Borrowing

Pursuant to the Statute No. 9496/97, the State Government of Para signed the agreement with the National Treasury of the Federal Ministry of Finance on the Program of Reconstruction and Fiscal Adjustment in the State of Para in March 1998. The statute requires that all state governments need the approval of the National Treasury (STN) to borrow from domestic and external lending institutions. The upper limit to the total borrowings regarding the said Program in Para is set at 11.5% of the real net revenue (RLR) in the state finance. The ceiling percentage varies from state to state. The promulgation of the statute and the subsequent agreements signed by the state governments removed the possibility of default by the respective state governments. The state fiscal revenue and the transfer from the federal fund would provide the security for lenders.

Regarding the cases like Japan's ODA loan, the possibility of default would be reduced further, because SEAIN undertakes a technical and financial feasibility study of its own on a proposal submitted by a state government and provides the guarantee of the Federal Government when the feasibility is justified by the study. The guarantee is provided in the form of a transfer from the federal fund (FPM: the fund for transfers to the state governments, allocated from the federal income tax revenue).

Since the signing on the said Program, the State Government of Para has never been disciplined regarding its compliance with financial obligations. The borrowings are kept at a relatively low level and the state finance has been in a good fiscal balance compared with other states. The State of Para retains a sizeable margin for additional borrowing and could take pride in its credit worthiness, as described in the following paragraphs.

1) State Performance in Relation to Primary Target

Table 7.1-1 shows the fiscal performance from 2002 to 2009 vis-a-vis the primary target expressed by the surplus of revenue over expenditure. The performance exceeded the annual targets stipulated in the Program of Reconstruction and Fiscal Adjustment. The only exception occurred in 2006 when a deficit was recorded. However, the reserved fund from the preceding years was more than enough to handle the setback and meet financial obligations. In 2007 and 2008, moreover, the annual surplus increased sharply in relation to the target. Because the primary target for 2009 in the agreement with STN retains the equivalent level to the previous years, it should not be hard for the state government to sustain another sound performance.

Table 7.1-1 Performance of State Finance during 2002 - 2009

(R$ million)

Fiscal Surplus	2002	2003	2004	2005	2006	2007	2008	2009
Primary Target	51	109	156	169	155	155	158	151
Performance	147	134	197	306	-1	408	393	
Financial Surplus	26	10	2	141	6	260	231	

Source: *The Program of Reconstruction and Fiscal Adjustment in the State of Para.*

2) Real Net Revenue and Debts Outstanding

The Statute No. 9496/97 requires that the total debts outstanding of any state should not exceed the real net revenue. As shown in Table 7.1-2, the ratio of the total debts to the real net revenue in the State of Para has been declining from 0.67 in 2002 to 0.39 in 2009. Accordingly, the margin left for additional borrowings from money market reached R$4,500 million in 2008. It appears unlikely that the state government would fail to get the STN approval on the Japan's ODA loan application.

Table 7.1-2 Real Net Revenue and Margin Left for New Borrowings (2002 – 2008)

(R$ million)

	2002	2003	2004	2005	2006	2007	2008
1. Total Debts Outstanding	2,471	2,434	2,755	2,615	2,768	2,679	2,860
2. Real Net Revenue (RLR)	3,688	3,579	4,174	4,670	5,427	6,089	7,312
3. Ratio of Debts to RLR (1/2)	0.67	0.68	0.66	0.56	0.51	0.44	0.39
4. Margin Left for New Borrowings	1,217	1,145	1,419	2,055	2,659	3,410	4,452

Source: *Ibid.*

(2) Ceiling on Repayments on Foreign Loans

The Program of Reconstruction and Fiscal Adjustment stipulates that the total annual repayments on foreign loans should not exceed 11.50% of the real net revenue. Table 7.1-3 shows the annual loan repayments and the remaining borrowing capacity of the State of Para during 2002 – 2009. The surplus borrowing capacity has been increasing in response to the declining trend in the annual total of amortizations and interest payments. The surplus capacity amounted to R$537 million in FY2008.

Table 7.1-3 Annual Repayments on Foreign Loans and Surplus Capacity

(R$ million)

	2002	2003	2004	2005	2006	2007	2008
1. Total Repayments	166	155	228	207	226	269	304
2. Real Net Revenue (RLR)	3,688	3,579	4,174	4,670	5,427	6,089	7,312
3. Available Maximum Capacity for Repayment (ratio of 1/2)	4.50	4.33	5.46	4.44	4.17	4.41	4.16
4. Amount of Repayable Ceiling : 11.5% of RLR	424	412	480	537	624	700	841
5. Surplus Borrowing Capacity	258	257	252	330	398	432	537

Source: *Ibid.*

As evidenced in the foregoing argument, the State Government of Para is sufficiently capable of repaying a new foreign loan without losing its fiscal balance.

7.2. TRUNK BUS OPERATION AND MANAGEMENT

7.2.1. PUBLIC CONSORTIUM

(1) Background

The efficiency of a given public transport system depends on (i) the adequacy of available road infrastructure for bus services, (ii) the effectiveness of the traffic control system, (iii) the appropriateness of the public transport operating system and (iv) the effectiveness of coordination and collaboration between the organizations established to participate in providing and supporting public transport.

The transportation of passengers and freight is one of the basic pillars that support variegated activities going on in a given society. Therefore, it must be operated under a mechanism that adjusts and coordinates in an integrated manner the activities of planning, implementation, operation and financing regarding the respective components mentioned above.

In any metropolitan area which comprises a collection of municipalities, it is requisite to institutionalize an integrative mechanism for the transport-related agencies and departments of varying capacity and capability that represent the different administrative levels (federal, state and municipal). However, it is often the case that the metropolitan transportation lacks such an institutional mechanism and metropolitan Belem is no exception in this respect. The problems stemming from this institutional inadequacy have been nearing a critical level. The inefficiencies of the public transport system in metropolitan Belem are summarized below, indicating the urgent need of effective inter-municipal coordination and cooperation.

1) Intra- and inter-city bus services have been expanding regardless of the effective transport demand. This largely uncontrolled growth, including services without proper licenses, is creating disorder and confusion in the public transport system.

2) The efforts of the state government have so far fallen short of establishing a mechanism for integrating inter-city bus services. As a result, the metropolitan municipalities have been trying to cope with the situation by means of ad hoc mutual agreements on technical collaboration that are *de jure* inadmissible on the jurisdictional level of municipal administration.

3) The system of tender does not exist for the transfer and the licensing of public transport services.

It will be crucial for the successful implementation of the Metropolis Action Plan to introduce an effective public transport management system which functions across the municipal jurisdictions. In other words, the proposed introduction of the trunk bus system does not end by the completion of required constructions. It will neither solve the mounting problem nor upgrade the public transport services unless it is operated effectively in the metropolitan frame of urban transportation. Along this line of reasoning, the state government created the State Secretariat of Strategic Projects (SEPE) with the mandate that includes, among others, the management of public transport operation in metropolitan Belem.

The primary issue in the mandate is how to realize the institutional aspect of transport development so as to provide bus services of satisfying quality for the metropolitan population. More specifically, the issue concerns, on the one hand, the creation of a public consortium capable of integrating and coordinating the administrative functions separately held by the state and the respective municipal governments, and on the other hand, the establishment of an management system of public transport serving the metropolitan area of Belem as a whole. The scope for this institutional development is defined as follows.

- It covers all of the currently operating bus lines and the new trunk and the feeder bus system.
- It excludes the other modes of public transport, i.e. taxi, school bus, ferry and other means of water transport.

(2) Organizational Model of the Public Consortium

The proposed model for Belem takes after the similarly conceived public consortium in metropolitan Recife, for the following reasons, considering the particularities of each metropolitan area.

1) The said public consortium was the first of its kind ever established for metropolitan transportation in Brazil.

2) No other institutional model is available in Brazil for metropolitan transport management.

3) The said public consortium was organized in the situation similar to Belem: the metropolitan area of Recife comprises three entities of Pernambuco State, Olinda and Recife municipal districts.

Under the leadership of NGTM of SEPE, a consulting firm that had participated in the public consortium formulation in Recife was contracted to develop a model suitable for metropolitan Belem. What has been made clear so far by their efforts (the proposal on the Terms of Agreement) is summarized as follows.

1) *Legal Bases*

The agreement to be signed and ratified by the consortium participants is based on Article 241 of the National Constitution and the Federal Statute No. 6017 issued on April 6th, 2005. The legal base on the state level is provided by the State Statute No. 6017 of Jan. 17th, 2007 and the State Decree No. 1117 of Jan. 16th, 2008 that establishes the detailed rules pursuant to the statute.

2) *Purpose*

The proposed public consortium manages the metropolitan public transport on behalf of the participating organizations and municipalities for the purpose of providing comfortable, safe and quick services for passengers.

3) *Legal Status*

The public consortium is an official administrative organization that functions as the arm of the respective state and the municipal governments which sign and ratify the agreement.

4) *Scope of Mandate*

The public consortium offers public transport services of satisfactory quality on the network of the federal, the state and the municipal roads in the metropolitan area of Belem.

1) The consortium manages those inter-city bus services reaching beyond the boundary of any one municipality or travelling across two or more municipalities.
2) The consortium manages intra-city bus services within the respective participating municipalities.

5) *Period of Mandate*

The period of the mandate is 25 years, to be extended if approved by the general meeting of the consortium.

6) *Participants*

The public consortium is to be participated by the following administrative bodies.

1) State Government of Para
2) Municipality of Belem
3) Municipality of Ananindeua
4) Municipality of Marituba
5) Municipality of Benevides
6) Municipality of Santa Barbara do Para

7) *Mandated Functions*

1) The consortium plans the trunk bus system with the aim of integrating the public transport means with other modes of travel.
2) Availing itself of the mandate legally transferred from the state and the municipal authorities, the consortium sets down the rules and the procedure of the new tender system for licensing the operations of bus services. The consortium approves and issues licenses to bus service operators and also stipulates the necessary administrative regulations and procedure over license contracts.

3) As required by the statutes and regulations currently in force, the consortium determines, and regularly reviews, the fare rate for trunk bus services.

4) As required by the statutes and regulations currently in force and the stipulations by the license contracts, the consortium reviews the fare rate and the license contracts to ascertain the economic and financial viability of licensed bus companies.

5) The consortium organizes the trunk bus system by effectively combining regular and express services and determines the quality and the schedule of service. It monitors and supervises the trunk bus operation and intervenes in cases of operational troubles.

6) The consortium coordinates the provision of trunk bus services with other means of public transport available in the respective jurisdictions of the state and the municipal authorities.

7) The consortium controls the services of the trunk bus system and to this end monitors closely and regularly the adequacy of the trunk bus services.

8) If deemed necessary to complement the current statutes and ordinances, the consortium draws up service standards and operating rules of the trunk bus system, punishable for infractions.

9) The consortium keeps surveillance over violations of the rules and standards and disciplines them by fines.

10) As required by the statutes and ordinances in force, the consortium intervenes in the faltering bus companies. In cases of need, the consortium either arranges a temporary or concessional transfer of the operation to another bus company, or devises appropriate measures to normalize the operation by utilizing the facilities and assets of the faltered company.

11) In accordance with the statutes, the stipulations in the contracts and the administrative rulings, the consortium can cancel the trunk bus license and other concessions.

12) The consortium levies a certain proportion of the fare revenue and imposes contributions from the licensed trunk bus company to meet the cost of its administration over the trunk bus system.

13) The consortium pays regular attention to the sustainability of the trunk bus system as a whole, by undertaking occasional economic analyses and field surveys and adjusting the fare rate accordingly.

14) The consortium plans and manages, directly and indirectly, advance sales of trunk and conventional bus tickets, season tickets and other service charges.

15) The consortium establishes and manages an income sharing system to allocate the trunk bus fare revenue in fair proportion to the different routes operated by the licensed consortium of bus companies.

16) The consortium identifies development projects of trunk bus related infrastructure (e. g., terminals, stations, bus stops, depots, and designs thereof) and directly implements, or commissions consultants or contractors to implement, the proposed project activities. It also carries out the monitoring of how the facilities are utilized.

17) The consortium follows up on the physical conditions of trunk bus exclusive roads, exclusive and priority lanes and the respective levels of their utilization, and prompts the relevant entities to initiate maintenance activities necessary for the efficient running of the trunk bus system.

18) The consortium contacts, and consults closely with, those municipal bodies in charge of bus transport and traffic regulation with the aim of sustaining the operational consistency

between the proposed trunk bus system and the existing conventional bus services over the use of available road transport infrastructure.

19) The consortium proposes and promotes programs of technical and managerial training for the personnel who would directly participate in or indirectly contribute to the trunk bus operation, thereby buttressing the sustainability of the licensed bus company.

20) The consortium engaged in effective PR and advertising activities, partly to appeal the favorable image of trunk bus services widely among passengers and partly to ensure thereby the increase in fare revenue, contributing to the improvement of metropolitan public transport as a whole.

21) The consortium actively engages in public relations to provide the inhabitants in general and the bus users in particular with necessary and important information on the alternatives available for travelling in the metropolitan area of Belem.

22) The consortium endeavors in the provision of quality services at all time, by responding readily to the claims and complaints from users and identifying and dealing with causes of the complaints. The consortium is to notify the complainants of what has been done to solve the problem within 30 days.

23) The consortium investigates commercial busing services unauthorized by any license, permit, approval issued by the relevant administrative authorities in the metropolitan area. The consortium is to take appropriate punitive or disciplinary measures in accordance with the statutes and regulations in force.

24) The consortium acts as the representative of the participating state and municipal governments and initiates appropriate actions in case of need vis-a-vis the other governmental organizations, by following the requirements of the statutes, resolutions and its own terms of agreement.

25) The consortium puts into action all those tasks and responsibilities that are stated in the relevant statutes, resolutions and its own terms of agreement regarding the trunk bus system.

8) Decision Making Structure

The consortium has the following executive structure.

1) General meeting
2) Board meeting
3) Auditing

9) Legal Representation

The legal representation of the public consortium is exercised by the incumbent mayor or governor who is to be the head of the participating administrative body holding the largest number of votes in the general meeting.

10) Personnel

The personnel of the consortium are hired in adherence to the General Labor Code (CLT). They are to be recruited in the following manners.

1) Officials and clerks transferred from the participating administrative bodies
2) Those that are formally hired as public servants by the consortium at the first public employment exam

3) Those that are hired at occasional public exams to fill in the posts that require special qualifications

4) Those that are formally appointed by the consortium

11) Future Plan

The following actions will be taken over the period from September 2009 to March 2010 toward the establishment of the public consortium.

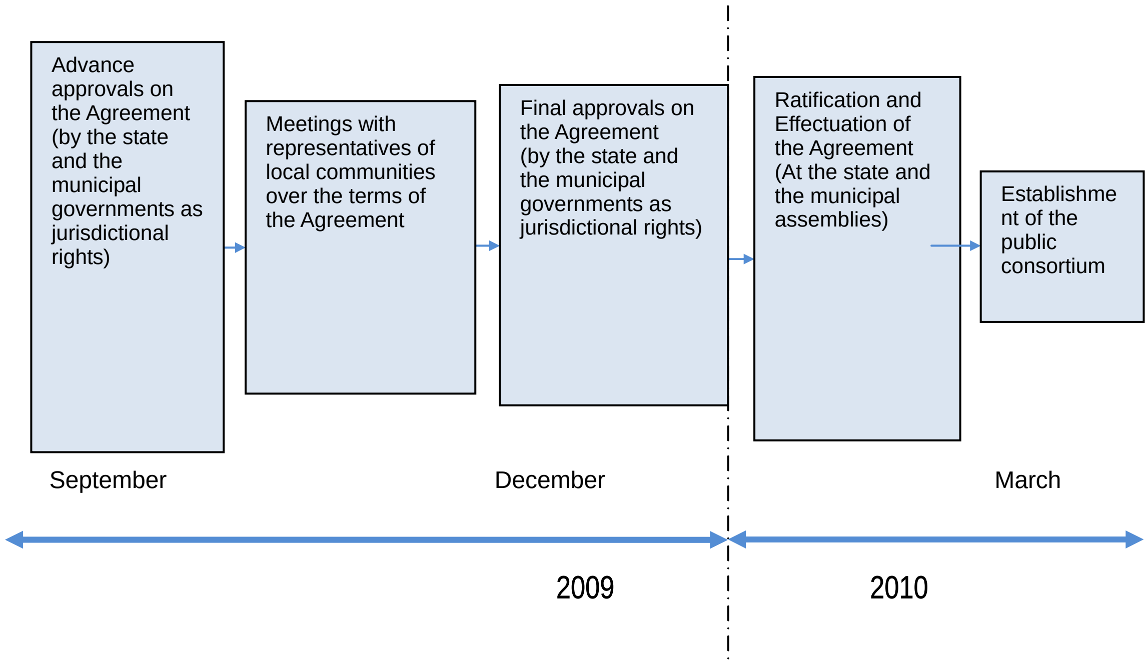


Figure 7.2-1 Planned Activities through March 2010

(3) Consortium Participants and Interrelationships

1) Consortium Participation

Figure 7.2-2 shows the positioning of the consortium in relation to the participating administrative bodies, bus users and bus operating companies. If any of the metropolitan municipalities should fail to decide its participation before the formal establishment of the consortium, it could join later on with the proviso that it should have ratified at the municipal assembly. The newly participating municipality would have to satisfy all the technical and operational requirements stipulated in the terms of agreement. The participating municipalities must contribute to the capitalization of the consortium according to the respective percentage shares pledged in their protocols of intentions. A non-participating municipality is expected to manage public transport in the usual manner.

Marituba has not yet decided on the participation, while one of the trunk bus terminals is proposed for the city. However, the municipal government did announce its intentions to cooperate with the Metropolis Action Plan, agreeing to the land acquisition by the state government to construct the proposed bus terminal. Moreover, Marituba has no intra-city bus service and no public organization, like CTBel in Belem City, which manages public transport. The city has made it clear to cooperate in the operation of the trunk and feeder bus services.

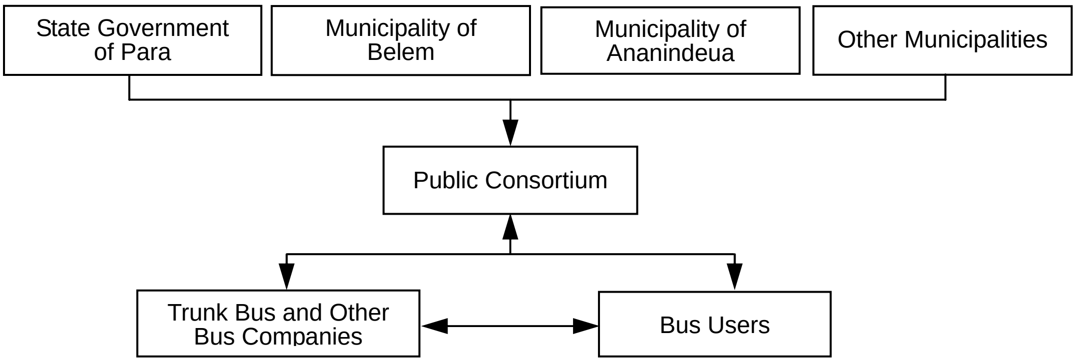


Figure 7.2-2 Consortium Participants and Interrelationships

2) *Organization of Consortium*

The consortium headed by the president and director consists of four departments, respectively responsible for planning, operation and management, community relationship, and general management and finance. The total number of personnel would be around 465 for public servants and 51 for persons formally appointed by the consortium.

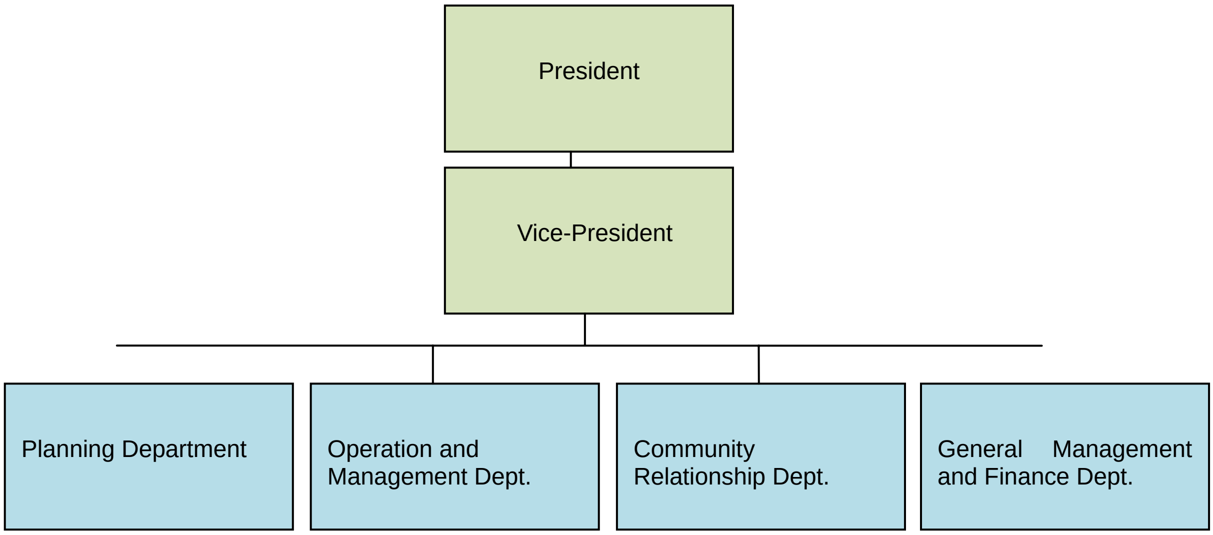


Figure 7.2-3 Organization of Public Consortium

3) *Interrelationships with Existing Public Transport Authorities*

As mentioned earlier, the public consortium is to manage the metropolitan public transport consisting of trunk, feeder and conventional buses. The administration of conventional bus lines controlled by the respective municipal authorities will be wholly controlled by the consortium. The present administration of municipal public transport is presented in Figure 7.2-4. CTBel of Belem and DEMUTRAN of Ananindeua would lose their authority over bus services but continue the administration of taxi, school bus and water transport. The respective municipal authorities agreed to the transfer. In other words, the public consortium will be in the position to decide how and how many existing conventional bus lines should be discontinued along with the start of the trunk bus system. The licenses previously issued to the existing bus lines all expired in 1992 and have not been renewed. Therefore, the consortium will be legally free to undertake bus line closures and consolidations as it deems it necessary.

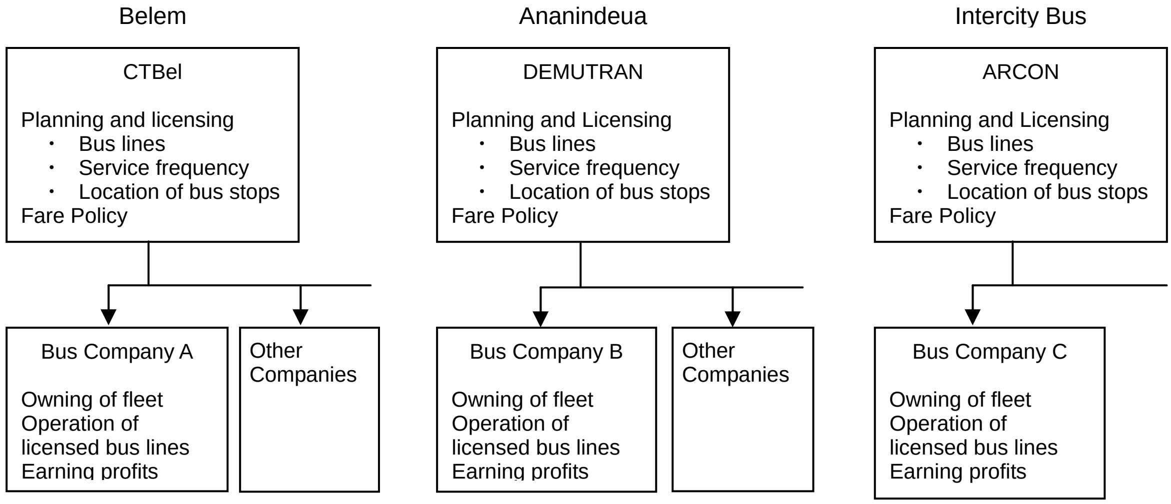


Figure 7.2-4 Administration and Operation of Existing Conventional Buses

7.2.2. CONSTRUCTION, OPERATION AND MANAGEMENT OF TRUNK BUS SYSTEM

The State Government of Para takes charge of construction works needed for the trunk bus system, the public consortium manages the bus operation and maintenance, and a bus company is licensed to run actual bus services. Table 7.2-1 shows the entities responsible for construction, maintenance and operation by facility component. The maintenance management includes protective maintenance, inspection and repair of the facilities concerned. The operation management checks and supervises how bus services are being provided, regarding the use of trunk bus exclusive roads and lanes, terminals, stations, ticket offices and so on.

The licensed trunk bus company is to construct bus depots on the sites acquired and provided by the state government, similar to the practice in Bogota. The practice in Brazil varies somewhat, as described below, but the formula proposed for Belem is becoming common. If the land should be privately owned, it would be easily usable for some other business purpose later on. It is increasingly felt necessary for the public sector to own the land for public transport facilities. When a licensed bus company should decide to pull out, the state government would buy up the buildings at the assessed price.

1) Curitiba: land acquired and facilities built by the private sector
2) Sao Paulo: land acquired and facilities constructed by the state government regarding one of the corridors
3) Recife: Land acquired by the state government and facilities built by the private sector

The formula of publicly owned land and privately owned facilities is the basis for specifying details of trunk bus operation and management, and estimating the costs thereof, in 7.3. The cost estimates in this chapter are used in the economic and financial analyses of the trunk bus system project in Chapter 9.

Table 7.2-1 Responsibilities for Construction, Maintenance and Operation by Facility Component

Facility	Construction	Maintenance and Management	Operation Management
Trunk bus exclusive roads and Lanes	State Govt. of Para	National Agency of Transport Infrastructure/ State and Municipal Governments[1]	Public Consortium
Terminals	State Govt. of Para	Public Consortium	Public Consortium
Stations	State Govt. of Para	Public Consortium	Public Consortium
Bus Stops	State Govt. of Para	Public Consortium	Public Consortium
Bus Depots	Bus Company	Bus Company	Bus Company

Note: 1) The state government is responsible for the maintenance on Av. Mario Covas and Av. Independencia. Elsewhere, the responsibility falls to the respective municipalities where the trunk bus routes are located.

7.2.3. SCHEDULED ACTIVITIES DURING 2010 - 2013

The consortium goes into action when its establishment is legally concluded in March 2010. It is necessary to prepare a schedule of activities over the period from March 2010 to June 2013 when the trunk bus system of the phase I is to complete the construction in June 2013. Table 7.2-2 shows a proposed schedule of activities for the public consortium, the State Government of Para, the public consortium and the bus company to be licensed for bus operation.

Table 7.2-2 Schedule of Activities during 2010 - 2013

Activity	2010	2011	2012	2013	2014
1) Public Consortium					
Organizational Development					
Personnel recruitment					
Procedures of employment exams					
Establishment of Transport Council					
Formulation of Rules and Regulations					
Procedures of Tenders from Private Bus Companies					
Preparation and posting of invitation					
Selection of a company and the signing of the licensing contract					
2) Private Bus Company					
Purchase of fleets					
Construction of bus depots					
Planning, design and construction (10 mos.)					
Start of trunk bus services					
3) State Government of Para					
Land Acquisition					
Start of procedures					
Acquisition of land					
4) NGTM Preparation for Trunk Bus System					
Selection by tender of consultants for D/Ds					
Selection of consultants and signing of contracts					
Preparation of D/Ds and planning of bus lines					
Construction of roads for trunk bus services					
Selection of contractors by tender and signing of contracts					
Construction works					

1) 2010

The president assigned by the representatives of the consortium is approved by the general meeting which is put highest on the consortium during the early half of the year. The director(s) of the consortium is/are assigned by the president and is/are approved by the general meeting. The members are employed according to the personnel planned by the consortium. It is possible to newly recruit by the approval of the general meeting. The members of NGTM are to be recruited together with officials and clerks transferred from the participating administrative bodies.

During the latter half of the year, the Public Transport Council which is organization of decision is established in the consortium. The Council authorizes biding procedure of the trunk bus operation company, and general rules and regulations of the consortium.

During the latter half of 2010, the consortium together with SEPE starts the procedures of tender regarding consultants who work on D/Ds and the procedures of land acquisition regarding trunk bus facilities such as terminals, stations and bus yards.

2) 2011

The consortium starts the procedures of employment exams during the early half of 2011 and completes the staff recruitment by the end of the year. The activities of D/Ds and planning bus lines by consultants will be completed during the early half of 2011. The tender procedures on the trunk bus road components for the selection of contractors will be completed by next year.

3) 2012

- In the beginning of 2012, the consortium starts the procedures of tender on the trunk and the feeder bus lines, and completes the selection of a bus company (or a consortium of bus companies) and the signing of the licensing contract therewith by the end of the year.
- After the signing of contracts, NGTM supervises and backs up the on-going construction works on BR-316, Av. Almirante Barroso, and the Centros of Belem. It also supervises the construction of terminals, stations, bus stops and other facilities of the trunk bus system.

4) 2013

- During the early half of the year, the consortium follows up the purchase of articulated buses by the licensed bus company.
- It also follows up on the on-going construction of bus depots by the bus company.
- The construction works of trunk bus exclusive roads and lanes continue through mid 2013.
- The operation of trunk bus services begins during the latter half of the year.

7.3. MANAGEMENT OF TRUNK BUS OPERATION AND MAINTENANCE

7.3.1. MANAGEMENT OF TRUNK BUS OPERATION

(1) Organizational Structure of Trunk Bus Operation

In consultation with relevant organizations, NGTM of the state government has been working on the organizational structure and policy of the public consortium. Figure 7.3-1 shows the image of the emerging proposal. The basic assumptions are as follows.

1) The State Government of Para and the participating municipalities jointly set up a public consortium, as already mentioned in Section 7.2.1.
2) The state government invests in the construction of infrastructure and facilities necessary to run the trunk bus services.
3) The public consortium formulates the plan of trunk bus operation.
4) A private bus company is licensed to run the trunk bus services.

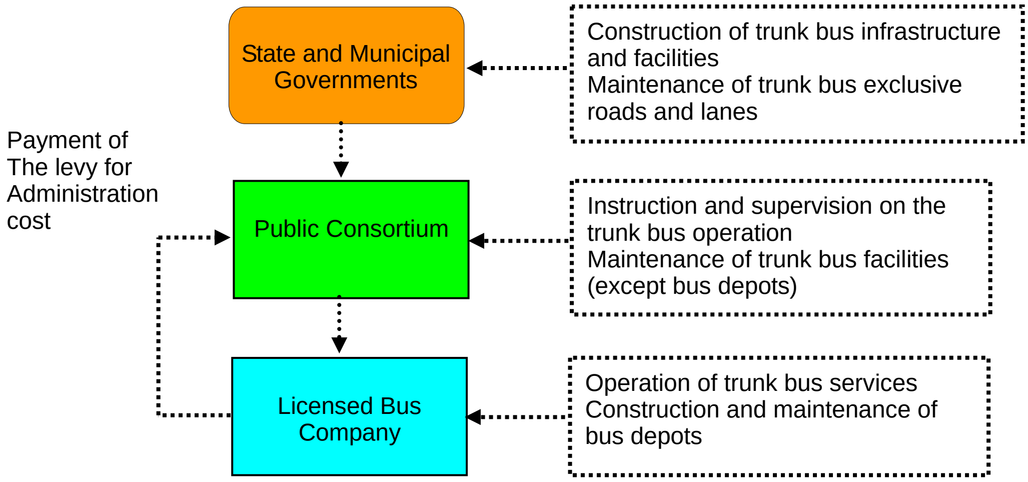


Figure 7.3-1 Organizational Structure for Trunk Bus Operation

(2) Functional Roles of State and Municipal Governments

The state and the municipal governments take the following measures.

1) The state government and participating municipalities establish the public consortium to operate and manage the trunk bus system.

2) The state government constructs the facilities for the trunk bus system (bus exclusive roads and lanes, terminals, stations, bus stops, etc.). The construction of bus depots is the responsibility of the bus company.

3) The respective government authorities (federal, state and municipal) carry out the maintenance of trunk bus exclusive roads, exclusive and priority lanes which are located within their administrative jurisdictions. The maintenance of bus depots is the responsibility of the bus company.

4) The municipal governments participating in the public consortium can state their opinions and argue their interests in the general meeting, the highest decision making level of the consortium. The participants are required to contribute to the capitalization of the consortium.

(3) Functional Roles of Licensed Bus Company

1) Functional Roles of Bus Company

A private bus company is to run trunk bus services. It must win the license by the tender procedures administered by the public consortium.

When the licensee is a single company, no problem is anticipated. If the licensee is a joint consortium of two or more private companies, which is more likely to happen, the question of how to share the fare revenue will emerge as one big, complicated issue to solve. For, the fare revenue would differ significantly among the planned trunk bus lines reaching different destinations in the suburbs or exurbs. The role of the bus company consists of the following functions.

1) The bus company constructs bus depots and operates and maintains their facilities. The land for construction is provided by the state government.

2) The bus company purchases its fleet of trunk buses (articulated types with capacity of 160 passengers) and feeder buses (conventional types with capacity of 40-60) and carries out the operation and maintenance of the fleet.

3) The operation of bus services uses terminals, stations, bus stops and other facilities that are provided by the state government. The public consortium manages the maintenance of these facilities.

4) The operation of the bus company covers i) dispatching of buses to terminals, stations and elsewhere, ii) inspection and management of the service schedule, iii) maintenance of buses, and iv) ticket sales at terminals, stations and elsewhere and the collection thereof.

5) The bus company is levied by the public consortium a fixed percentage of its fare revenue for the cost of operation management incurred by the latter.

2) *Trunk Bus Operation by Bus Company*

As shown in Figure 7.3-2, the bus company constructs a number of bus depots as hubs for managing trunk bus services. Each depot functions as the focal center of trunk bus operation by the bus company. The operation system consists of the following procedures.

1) The bus company constructs bus depots and carries out all the necessary operation and maintenance activities. Each depot is used as the control center of bus services.

2) The bus company establishes a management center at each depot to control the fleet operation. The center will house the following functional sections.

    a) The section which controls and manages the logistic allocation of buses to terminals and stations

    b) The section which inspects and checks out the actual running of services vis-à-vis the schedule

    c) The section which manages ticket sales at terminals, stations and elsewhere and collects the fare receipts. It will be inefficient if the public consortium should directly handle and manage ticket sales.

    d) The section which decides and coordinates the schedule of bus drivers and conductors

    e) The section which takes charge of performing washing, inspection, refueling and oiling, repair and other maintenance activities on returned vehicles

    f) The section which keeps accounts of fare receipts and operational expenses and issues tickets.

    g) The section which manages general affairs and handles legal matters.

3) Passengers on feeder services have to pay their fare on the bus. The collected fares are handed over to a designated terminal or station three to four times a day.

4) The fares pooled at terminals and stations are collected three to four times a day by the agents of the accounting section. Trunk bus passengers have to buy tickets before they enter a terminal, station or bus stop to get a ride.

5) At the end of the day, buses return to the depot to get washing, checkup and refueling and are parked overnight ready for the next day’s operation.

6) The feeder bus is operated by a driver and a conductor. The trunk bus is operated by a driver alone, because passengers buy their tickets before they enter terminals, stations or bus stops.

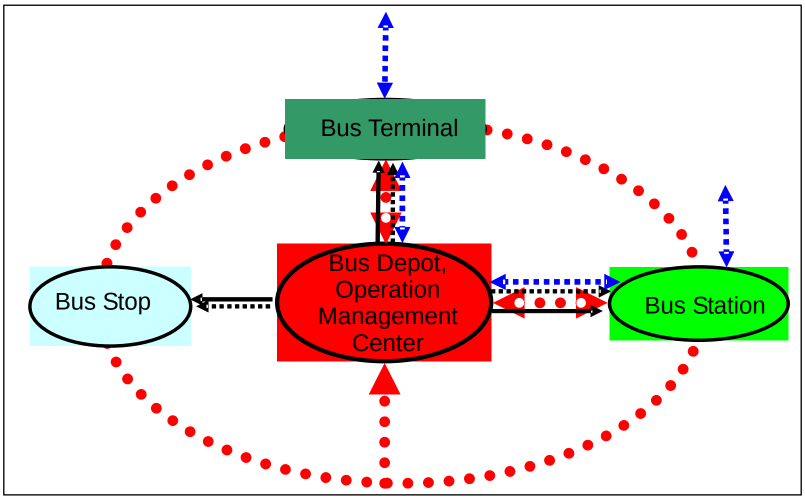


Figure 7.3-2 Operation System of Trunk Bus Services

3) Organizational Structure of Management Centers

As mentioned already, the trunk bus system that comprises trunk and feeder bus services is operated through the respective management centers set up at bus depots. The present Study proposes four such depots, and their respective scopes of operational management are shown in Table 7.3-1. The organizational chart suggested for management centers is shown in Figure 7.3-3.

Table 7.3-1 Four Proposed Depots and Operational Functions

Depot Location	Scope of Operational Management
(1) Icoaraci	1) Icoaraci Bus Terminal 2) Tapana Bus Station 3) Bus Stops on Av. Augusto Montenegro 4) Bus Stops inside Icoaraci City
(2) Marituba	1) Marituba Bus Terminal 2) Agua Lindas Bus Station 3) Bus Stops on BR-316 4) Bus Stops on Av. Almirante Barroso 5) Bus Stops inside Belem City
(3) Cidade Nova	1) Cidade Nova Bus Terminal 2) Bus Stops on Av. Independencia 3) Mangueira Bus Station
(4) Coqueiro	1) Coqueiro Bus Terminal

Note: During Phase I, the bus station at Mangueira is placed under the management of the Icoaraci depot center.

To perform the operational functions described above, each management center needs the organizational structure shown in Figure 7.3-3. The center is headed by a managing director. A department manager below him controls three sections of general affairs, accounting and operational management. The fare collection unit is placed under the accounting section, while the operational management section includes three units of fleet logistics, inspection and maintenance. The required number of personnel is indicated in the figure.

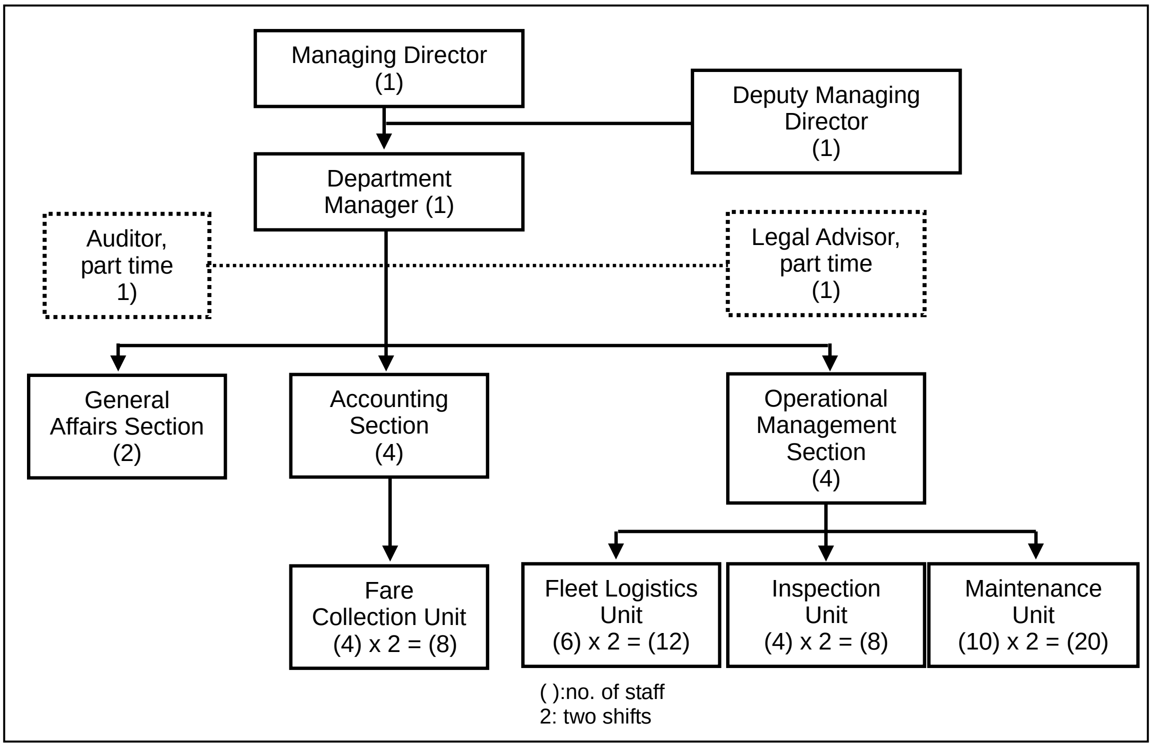


Figure 7.3-3 Organization and Personnel of Center Depot

4) Cost of Operation and Management by Bus Company

The cost of operation and maintenance to the bus company comes from i) salaries for the center personnel, ii) sundry expenses, iii) operation of cars needed for performing various tasks, and iv) fuels and oils, tires for replacement, salaries for bus drivers, conductors and other front-line employees. All these expenses have to be met by the fare revenue. The details of the cost item iv) will be discussed in the financial analysis in Chapter 9.

The present Study proposes four depots to operate the trunk bus system. The respective depots are located close to the four trunk bus terminals. The cost of operation and maintenance is estimated per depot, assuming the organization and the personnel describe above. The results of estimation are shown in Table 7.3-2. Two depot centers are expected to come into service at the start of the trunk bus operation in 2013. The annual cost of operation and maintenance would amount to R$8 million during Phase I (2013 –). The cost would rise to R$16 million during Phase II (2015 and after) when two more depot centers are expected to come into service.

Table 7.3-2 Annual Operation and Maintenance Cost per Depot

(R$1,000)

Cost Item	Job Category	Specification	Persons or Units per Depot	Cost per Month	Total Annual Cost
1. Salaries and Wages	Managing Director		1	7.0	84
	Deputy M. D.		1	5.0	60
	Dept. Manager		1	5.0	60
	Legal Advisor	Shared by four depots	0.25	7.0	21
	Auditor	Shared by four depots	0.25	7.0	21
	General Affairs Sec.		2	3.0	72
	Accounting Sec.		4	3.0	144
	Fare Collection Unit	Working in 2 shifts	8	1.5	144
	Ticket Sellers	Working in 2 shifts	96	0.7	806
	Operation Mng. Unit		4	3.0	144
	Fleet Logistics Unit	Working in 2 shifts	12	1.5	216
	Inspection Unit	Working in 2 shifts	8	1.5	144
	Maintenance Unit	Working in 2 shifts	20	1.5	360

	Subtotal				2,276
2. Depot Center Expenses	Equipment	30% of salaries and wages			441
	Supplies	20% of salaries and wages			294
	Utilities	20% of salaries and wages			294
	Miscellaneous	20% of salaries and wages			294
	Subtotal				1,323
3. Vehicles	Sedans	5 units	7 units	5.0	300
	Pickups	2 units	4 units	4.0	96
	Subtotal				396
Annual Cost of Operation and Maintenance per Depot					3,995
Annual Cost of Operation and Maintenance during Phase I : 2013 – 2014 (two depots in service)					7,990
Annual Cost of Operation and Maintenance during Phase II: after 2015 (four depots in service)					15,980

7.3.2. MAINTENANCE OF TRUNK BUS FACILITIES

(1) Facilities Needing Maintenance

Trunk bus facilities that require regular maintenance consist of 8 categories, as shown below.

1) Trunk bus exclusive roads
2) Trunk bus exclusive lanes
3) Trunk bus priority lanes
4) Trunk bus terminals
5) Trunk bus stops
6) Trunk bus stations
7) Trunk bus operation and maintenance facilities (depots)
8) Road development for trunk bus routes

(2) Organizations in Charge of Maintenance

Considering the system of management so far suggested for the trunk bus system and in consultation with the counterpart team of the state government, the present Study proposes that the maintenance of the respective trunk bus facilities be shared in the manner shown in Table 7.3-3.

Table 7.3-3 Maintenance of Trunk Bus Facilities

Trunk Bus Facility	Outline of Maintenance	Organization in Charge
Exclusive Roads	The State Govt. of Para is the executing entity that constructs bus exclusive roads. The bus company uses them for bus services and the public consortium carries out the necessary maintenance.	Public Consortium
Exclusive Lanes	The State Govt. of Para is the executing entity that constructs exclusive lanes. The bus company uses them and the public consortium carries out the necessary maintenance.	Public Consortium
Priority Lanes	The State Govt. of Para is the executing entity that constructs priority lanes. The bus company uses them and the public consortium carries out the necessary maintenance.	Public Consortium
Terminals	The State Govt. of Para is the executing entity that acquires land and constructs terminal facilities. The bus company pays the rent to use them and the public consortium carries out the necessary maintenance.	Public Consortium
Bus Stops	The State Govt. of Para is the executing entity that acquires land and constructs bus stop facilities. The bus company pays the rent to use them and the public consortium carries out the necessary maintenance.	Public Consortium
Stations	The State Govt. of Para is the executing entity that acquires land and constructs station facilities. The bus company pays the rent to use them and the public consortium carries out the necessary maintenance.	Public Consortium
Depots	The State government of Para acquires land for the sites. The bus company constructs and maintains depot facilities.	Private Bus Company
Road Development for trunk bus routes	The State Government of Para acquires land and develops roadways for trunk bus services.	State Govt. of Para

(3) Necessary Maintenance Activities

Table 7.3-4 suggests the necessary maintenance activities for the respective trunk bus facilities.

Table 7.3-4 Necessary Maintenance Activities

Trunk Bus Facility	Main Structures for Maintenance	Major Maintenance Activities
Exclusive Roads	Concrete surface pavement, concrete dividers from the roadway, road signs, lane marks, traffic signals, etc.	1) Because of the durability of concrete surface, the maintenance mostly consists of regular inspection and repairs of cracks and peel-offs. 2) Regular inspection and repairs on various structures of the exclusive roads
Exclusive Lanes	Concrete surface pavement, dividers of chatter bars from frontage road, road signs, lane marks, traffic signals, etc.	1) Because of the durability of concrete surface, the maintenance mostly consists of regular inspection and repairs of cracks and peel-offs. 2) Regular inspection and repairs on various structures on the exclusive lanes
Priority Lanes	Concrete surface pavement, road signs, lane marks, traffic signals, etc.	1) Because of the durability of concrete surface, the maintenance mostly consists of regular inspection and repairs of cracks and peel-offs. 2) Regular inspection and repairs on various structures on the priority lanes
Terminals	Office building, boarding gates, ticket offices, bus bays, platforms, bus passageways, waiting lounges, shops, lavatories, open spaces, etc.	1) Maintenance of buildings 2) Maintenance of water supply and drainage structures 3) Repairs on cracks and peel-offs of concrete structures of platforms 4) Inspection and repairs of machinery and equipment
Bus Stops	Boarding gates, ticket booths, bus bays, platforms, ramps, signals, notice boards, etc.	1) Maintenance of buildings at bus stops 2) Inspection and repairs on ramps and other structures 3) Repairs on cracks and peel-offs of concrete structures of platforms 4) Inspection and repairs of machinery and equipment
Stations	Boarding gates, ticket offices, bus bays, platforms, waiting lounges, shops, lavatories, stairs, escalators, pedestrian bridges, open spaces, etc.	1) Maintenance of buildings at bus stations 2) Inspection and repairs of elevators 3) Repairs on cracks and peel-offs of concrete structures of platforms 4) Inspection and repairs of machinery and equipment 5) Inspection and repairs of pedestrian bridges
Depots	Office buildings, operation control offices, maintenance management offices, car washes, repair workshops, bus yards, fuel pumps, open spaces, etc.	1) Maintenance of buildings at depots 2) Inspection and repairs of car wash structures 3) Inspection and repairs of workshops 4) Inspection and repairs of equipment for repairing vehicles 5) Inspection and repairs of bus yards
Road development for trunk bus routes	Asphalt pavement, slope face structures, roadway, drainage structures, sidewalks, traffic signals, lane marks, shelters, etc.	1) Regular inspection and repairs 2) Inspection and repairs of slope faces and road surfaces 3) Inspection and repairs of related structures

(4) Annual Maintenance Cost of Trunk Bus Facilities

The annual maintenance cost of trunk bus facilities is estimated by applying certain percentages to the respective construction costs of facility components. The percentage is determined by noting the varying importance and frequency of required maintenance per facility component, additionally drawing from the experiences in Belem on maintenance requirements.

1) Trunk bus exclusive roads: 2.0% of the construction cost thereof
2) Exclusive trunk bus lanes: 2.0% of the construction cost thereof
3) Priority trunk bus lanes: 2.0% of the construction cost thereof
4) Trunk bus terminals: 5.0% of the construction cost thereof
5) Trunk bus stops: 5.0% of the construction cost thereof
6) Trunk bus stations: 7.0% of the construction cost thereof
7) Trunk bus depots: 7.0% of the construction cost thereof
8) Road development for trunk bus routes: 5.0% of the construction cost thereof

Table 7.3-5 summarizes the estimation of the annual maintenance cost per facility component. The maintenance cost to the private bus company would amount to R$1.6 million during Phase I beginning in 2013 and increase to R$3.2 million during Phase II beginning in 2015.

Table 7.3-5 Annual Maintenance Cost of Trunk Bus Facilities

(R$1,000)

Trunk Bus Facility	Construction Cost by 2013	Construction Cost by 2015	Percent to Construction Cost	Annual Maintenance Cost during Phase I	Annual Maintenance Cost during Phase II
Exclusive roads (maintained by Belem / Ananindeua municipalities	266,929	0	2.0%	5.339	5.339
Exclusive Lanes (maintained by the state govt.	63,507	0	2.0%	1,270	1,270
Priority Lanes (maintained by the state govt.)	78,172	75,616	2.0%	1,563	3,076
Terminals (maintained by the pub. consortium)	48,238	33,490	5.0%	2,412	4,086
Bus Stops (maintained by the pub. consortium)	27,309	9,076	5.0%	1,365	1,819
Bus Stations (maintained by the pub. consortium)	29,262	0	7.0%	2,048	2,048
Bus Depots (maintained by the bus company)	22,631	20,416	7.0%	1,584	3,013
Subtotal				15,581 (2 depots)	20,651 (4 depots)
Road Development (maintained by the state govt.)	0	240,592	5.0%	0	12,030
Total				15,581	32,681

CHAPTER 8
Environmental And Social Consideration

8. ENVIRONMENTAL AND SOCIAL CONSIDERATION

8.1. PROJECTS UNDER STUDY AND PROJECTS FOR JAPAN'S ODA LOAN

The present Study carried out preliminary environmental assessment on those trunk bus projects selected for updating and Japan' ODA Loan application. The assessment took into consideration the findings of the 2003 F/S Study and followed the JBIC Guideline for Environmental Consideration of 2002. The trunk bus system proposed in the present Study is to be operated on the existing arterial roads. In this respect, it is arguably suggested that the system will be unlikely to add some adverse impact of appreciable magnitude upon the present roadside environment. The State Secretariat of Environmental Management (SEMA) is aware that the proposed system will bring only a minor impact on the roadside environment. While the present Study was on going, the secretariat in fact decided to apply the PCA (Environmental Control Plan) procedures for environmental licensing (LI: Installation License), which is less complicated than the EIA (environment impact assessment) procedures.

The preliminary environment assessment was done on the entire projects selected for updating and then more selectively on those projects considered applicable to the Yen Credit Facility in order to ascertain their environmental acceptability.

Table 8.1-1 Applied Check Lists of Environmental Assessment

Check List	Refer to:	Projects under Present Study	Projects for Yen Credit Application
Environmental and Social Consideration	Tables 8.2-1	○	
Environmental Scoping	Tables 8.2-3	○	
Measures for Avoiding or Mitigating Impacts	Table 8.2-4	○	
Magnitude of Relocating Local Inhabitants and Compensations	Tables 8.3-1 and 8.3-2	○	○ (Shown by color in the two tables)
Application of JBIC Guideline	Tables 8.5-1	○	○ (Shown by shading off the rest of the projects in the table)

8.2. SUMMARY OF FINDINGS

8.2.1. GENERAL

During the study visit to Belem in May 2009, the environmental and social consideration scoping (see Table 8.2-3) was carried out over the entire network proposed for the trunk bus system (total extension of about 73km), both by observation and interview. The present natural and social conditions along the proposed routes were noted down to ascertain the range of environmental and social consideration issues that might arise during the implementation of trunk bus projects. Table 8.2-1 sums up the results of the summary of findings.

Table 8.2-1 Summary Results of Environmental and Social Consideration

Environmental Impact	Summary Findings by the Preliminary Environmental Study
Air quality	1. The environmental administration of Brazil over air quality conditions is specified in CONAMA (Resolution 003 of 1990), which establishes the standards concerning dust, CO, NOX and other airborne pollutants. 2. Regarding the environmental study findings in the past, the 2003 F/S Study on the trunk bus system conducted a field investigation on the roadside air quality conditions along the major arterial roads in the metropolitan area of Belem. It was reported at the time that the measured and analyzed air quality conditions did not satisfy the CONAMA standards. The environmental study conducted by the State Government of Para regarding the construction of Av. Independencia did not include the field measurement, because the said road project followed the PCA procedures of environmental licensing. 3. The findings of the preliminary environmental study conducted as part of the present Study was as follows. Although the traffic volume would increase temporarily during the construction period, the air quality conditions will improve substantially after the trunk bus system comes into service. By the introduction of the articulated bus fleet, the CO_2 emissions are estimated to decrease by 62% over the ten-year period of the trunk bus operation. The emissions of methane (CH_4) and nitrous oxide (N_2O) are converted to CO_2 in the estimation.
Soils and Deposits	1. The environmental administration of Brazil does not provide the regulation specific to the contaminated area. The statues regulating environmental conservation and rehabilitation are variously applied to the issue of contaminated areas. In addition, the Federal Decree No. 6935 requires the project executing entity to pay for rehabilitation works and provide compensations for the affected in cases of contamination and pollution (Clause 7 of Article 4 and Clause 5 of Article 14). The Federal Decree No. 6766/79 (transfers of land within the urbanized areas) bans the sale of contaminated land. 2.The environmental study findings in the past and the 2003 F/S Study did not investigate the problem of soil contamination. 3. The conclusion of the present preliminary study concerning the proposed site for the Icoaraci trunk bus terminal is as follows. The former occupant was a wholesaler of cement, not a cement manufacturer. The site was used for commercial purpose. Accordingly, it is arguable that the soils of the site are not contaminated. - The former occupant of the site for the Marituba trunk bus terminal was a ceramic manufacturer (ceramic tiles, drainage pipes, etc.) who went out of business in June 1999. The site is now largely an open space with a few iron bars remaining from the former factory structure. - The conclusion of the present preliminary study is as follows. Although the possibility of contamination is judged slight, it would be necessary to carry out an investigation in accordance with the TOR issued by the State Secretariat of Environment, when the D/D is completed after the signing of the yen loan agreement.
Debris	1. The environmental study findings in the past and the 2003 F/S Study investigated the availability and capacity of dumping grounds in the vicinity of Belem City. 2. The conclusion of the present preliminary study is as follows. The proposed trunk busways and exclusive and priority lanes will have concrete surface pavement, requiring the extensive removal of the present asphalt surface. The debris will be of sizable bulk and necessitate suitable handling. - There are two lawful dumping grounds for asphalt debris and contaminated soils in Belem. No problem is anticipated regarding the debris from the trunk bus projects. One of the dumping grounds is located along BR-316, with a total area of $5.5km^2$, and the other is found near Marituba with an area of $2.2km^2$.
Noise and Vibration	1. The environmental administration of Brazil defines the regulation over noise and vibration by the Federal Decree ABNT (NBR-10151). 2. Regarding the environmental study findings in the past, the 2003 F/S Study carried out a field investigation on roadside noise and vibration along the arterial roads. The results of measurement and analysis and the subsequent forecast of the possible impact from the trunk bus implementation found that the situations did not satisfy the ABNT regulations. The environmental study conducted by the state government regarding the construction of Av. Independencia did not include the field measurement of noise and vibration, because the said road project followed the PCA procedures of environmental licensing. 3. The conclusion of the present preliminary study is as follows. The closure of some lanes during the construction period would intensify the problem of congestion, but the analysis of the demand forecast indicates that the spread of the resultant traffic congestion would be limited to certain locations. The construction proposed on BR-316 will affect a relatively wide area, but the detour by Av. Joao Paulo II proposed for 2011 in the plan of the state government is expected to disperse the localized

	traffic congestions. Although the level of total congestion will rise during construction, its concentration will be evened out by the state government proposal. The roadside noise level will certainly rise during construction, but it is judged as being of minor nuisance level. - When the construction works are completed, the trunk bus system will improve the flows of metropolitan traffic. The total vehicle kilometers inclusive of passenger cars in the metropolitan area will be lower by 3% compared to the “without” situation. The total bus kilometers will be lower by 40%. In addition, the introduced articulated bus fleet will make much less noise than the currently operated ordinary buses. Accordingly, the roadside noise level will be significantly lower with the trunk bus system than without. - The 2003 F/S Study carried out the noise level forecast and found that the roadside noise level would be reduced with the trunk bus system because of the drop in total vehicle kilometers and the location of trunk busways and lanes in the median part of the arterial roads. - The vibration from motorized traffic will be reduced by the concrete surface pavement of trunk busways, exclusive and priority lanes.
Stink	1. The environmental administration of Brazil does not specify the regulation on stink. 2. The environmental study findings in the past and the 2003 F/S Study did not specifically investigate the issue of stink, but found during the interview survey that the stench from long undrained surface water after flooding was public nuisance in some locations. 3. The present preliminary study agrees that the stench of rotten vegetable matters in the long undrained surface water could become a public nuisance. The problem lies in the inadequate drainage capacity and / or the inadequate maintenance thereof. - The proposed trunk busways and lanes will be provided with structures to drain surface water during flooding. The possibility of stink problems will be effectively contained.
Water Quality	1. The environmental administration of Brazil defines the regulation on water quality by the Federal Decree No. 1469 of 2000. 2. Regarding the past study findings, the 2003F/S Study carried out the water quality tests at 21 locations including rivers and wells in the vicinities of the proposed construction sites. It was found that the water quality had been deteriorating in some test locations by the discharged household sewage. The environmental study conducted by the state government regarding the construction of Av. Independencia did not include the water quality measurement, because the said road project followed the PCA procedures. 3. The present preliminary study expects that the discharges of used water and sewage at such facilities as construction yards (presently under construction), bus terminals and stations and bus depots require effective drainage structures. - The currently operated two bus terminals are provided with a simplified sewage and drainage system. The trunk bus terminals and bus depots are expected to be provided with similar drainage structures.
Topography and Geology	1. The present preliminary study considers as follows. The proposed trunk bus routes are to be developed on the existing arterial roads, and do not require any civil engineering that would involve sizable disturbances to the local drainage pipes and underground aquifers. It was reported, however, that the problem of surface water drainage would occur in some parts of the routes during the rainy season, primarily because the drainage facilities are inadequately provided. - The proposed trunk busways and lanes will be provided with structures to drain surface water during flooding. The surface water drainage will be more effectively dealt with by these structures in the future.
Involuntary Resettlement	1. The legal requirements regarding involuntary resettlement and land acquisition are mainly specified in the National Constitution and the Federal Statute 3365/41. 2. Regarding the past study findings over the issue, the state government so far implemented public sector projects that involved sizable involuntary resettlement for land acquisition with provision of compensations and resettlement (e.g., construction of the protective walls at APA Belem, road development on Av. Joao Paulo II). The construction of Av. Independencia, which the state government has been implementing on force account, involved the resettlement of 245 households. 3. The conclusion of the present preliminary study is as follows. Because the development of trunk bus routes is proposed on the existing roads, the implementation does not call for sizable land acquisition and resettlement of local inhabitants. However, the land acquisition at some sites for bus terminals and stations, bus depots and the interchange will require small-scale resettlement.
Local Economy (employment, livelihood, etc.)	1. There is no statute in Brazil that specifies the standards and regulations regarding this issue. 2. Regarding the past study findings, the 2003 F/S Study examined the impact of project implementation on local unemployment. It was estimated that the trunk bus system would employ 62,300 persons per month during its construction stage. 3. The present preliminary study expects that the introduction of trunk bus services will

	adversely affect the present operators and their employees of ordinary buses and minibuses. - The start of trunk bus operation will necessitate the discontinuance and consolidation of the existing bus lines. The specific planning on the future network of bus lines will be done in the later stage. - The preliminary analysis suggests that 20% of 160 bus lines now operating in the metropolitan area will be discontinued. - The state and the municipal governments intend to absorb the employees of bus companies as many as possible into the new trunk bus system. Bus drivers could get the same positions in the trunk and feeder bus fleets. Though trunk bus tickets are not sold on the bus, conductors could work as ticket sales clerks at terminals, stations and elsewhere. - The placement of these employees will have to be examined in detail in the later stage.
Cultural Heritage, Landscape and Minorities	1. The protection and conservation of cultural heritages are administered on the federal (IPHAN), the state (DPHAC) and the municipal (FUNBEL) levels. 2. Regarding the past study findings, the 2003 F/S Study compiled an inventory of cultural heritages in the metropolitan area of Belem on the basis of the information at IPHAN, DPHAC and FUNBEL. 3. The conclusion of the present preliminary study is as follows. Some sections of roadside plantings (mango and kapok) and sidewalks inside Belem and Ananindeua and the historic buildings in Belem are designated as important cultural assets. It is necessary to take sufficient care when the construction sites are near them. - Because there are no explicit regulations over the issue, exact steps to be taken during construction will have to be worked out in consultation with relevant administrative bodies.

8.2.2. ENVIRONMENTAL AND SOCIAL CONDITIONS OF PROJECT SITES

Table 8.2-2 includes the site descriptions (SD) that serve as the check list for environmental and social screening and scoping.

Table 8.2-2 Description of Project Sites

Item	Remarks
Social Environment:	
Local Communities (inhabitants, indigenous minorities, opinions on the trunk bus system, etc.)	- The existence of slums and indigenous minorities is not reported along the routes proposed for the trunk bus system. - Daily commuting trips by bus from Marituba, Ananindeua and other suburbs to the CBD of Belem suffer chronic traffic congestions along the way and take too long. Suburban residents largely welcome the introduction of the trunk bus services.
Land Use (urban and rural, historic sites, scenic spots, hospitals, etc.)	- No sizable concentrations of squatters are sighted on the present roadside spaces of BR-316, Av. Augusto Montenegro and Av. Almirante Barroso. - Roadside areas are mostly occupied by office buildings, shops, restaurants, gas stations, hospitals, churches and residences. No farms are found next to the bus routes. - A number of places and buildings are designated as important cultural assets within the cities of Belem and Ananindeua, namely, roadside plantings of mango trees and kapoks in both of the cities and historic buildings in Belem. Because trunk bus routes are to be provided in the median space of the existing arterial roads, their development is not likely to have adverse effects upon these assets.
Economy / Transportation (commerce, agriculture and fisheries, industrial estates, bus terminals, etc.)	- Commercial and service establishments of mostly small scale, i.e. markets, shops and restaurants, are found often intermixed with residential houses along the routes. Factories and storage facilities are often found along BR-316. Street venders and similar providers of informal services are found almost everywhere. - Bus transport is the most important public transport means in the metropolitan area of Belem (accounting for 75% of the total passengers). Taxis pick up and drop off their fares at major bus stops and terminals. - Two bus terminals are currently in operation, one at Sao Braz and the other in Cidade Nova. The Sao Braz terminal accommodates intra-city circular buses and inter-state long distance buses. The Cidade Nova terminal functions as the hub of bus services for Ananindeua City and one of the proposed trunk bus terminals is to be constructed in the same premise. - The site proposed for the trunk bus terminal in Icoaraci is currently occupied by a storehouse of a cement wholesaler.
Natural Environment:	

Topography / Geology (sharp gradients, soft grounds, swampy lowlands, escarpments, etc.)	- The proposed trunk bus routes are located on the low flat terraces (50m or less above sea level) of the Amazon. During the rainy season, some low-lying roadside areas in the metropolitan area of Belem are flooded due to inadequate drainage.
Rare Wild Life Species (wild life sanctuaries, habitats of protected species, etc.)	- The western section of Av. Independencia, now under construction by the state government to be completed in May 2010 (priority trunk bus lanes are proposed in the present Study), passes close to a nature conservation area (Presidente Medici II). - The state government has already acquired the environmental license on the road development.
Environmental Hazards:	
Complaints Lodged or Voiced (subjects for frequent complaints, etc.)	Chronic traffic congestions Inadequate local drainage
Institutional Responses (remedial measures taken by the public sector, compensations, etc.)	No particular incidence is known.
Other Issues of note	No particular incidence is known.

8.2.3. Environmental Scoping

Based on the JBIC Guideline for Environmental Consideration of 2002 to examine the environmental and social consideration, the present Study conducted a preliminary study on environment. The environmental and social consideration scoping presented below is based on the findings of the preliminary study.

Table 8.2-3 summarizes the results of environmental scoping. The conclusion at this stage is that the implementation of the trunk bus system will bring impacts of some adverse import on the environment but that the impacts will be of the kinds effectively actionable by appropriate measures. Such measures are suggested in Table 8.2-4.

Table 8.2-3 (1) Findings for Scoping of Environmental and Social Consideration

Adverse Impact	Rating*	Remarks
1. Atmosphere	B	- The traffic volume will increase temporarily during the implementation. Once the trunk bus system comes into operation with its fleet of articulated buses, the emissions converted to CO^2 are estimated to decrease by 62% over ten years.
2. Water Quality	B	- Four terminals and four bus depots proposed for the trunk bus system discharge variously used water and sewage. Two existing bus terminals are adequately equipped with simplified drainage and treatment facilities. - The proposed terminals and depots will be equipped with similar facilities.
3. Soils and Deposits	B	- The trunk bus terminal in Marituba is proposed on the former site of a ceramic factory closed down in June 1999. The site is largely an open space, with only a few remaining bars of the former iron frame. - The possibility of soil contamination appears to be low. However, after the yen loan agreement is signed and the detailed design is finalized, it will be necessary to conduct a study on soil contamination in the manner directed by the State Secretariat of Environmental Management.
4. Debris	B	- The construction debris, especially of asphalt pavement origin, will be enormous. The state government has the dumping ground properly licensed under the prevailing environmental regulations. The debris can be transported to this dumping site. - In order to control noises and dusts of debris transportation, it is necessary to establish a logistics plan. The logistics planning would not be very complicated because the dumping ground is in short distance from the road construction sites. - It appears unnecessary to prepare a plan of final disposal farther than the available dumping ground.
5. Noise/ Vibration	B	- The increased traffic volume during project implementation will raise the noise level around construction sites and the vicinities, but the decibel increase is likely to be of minor magnitude. - The roadside noise level will be substantially reduced in the end by the trunk bus system which serves to reduce the service frequency of the existing fleet of ordinary buses with its use of more efficient articulated buses. - The vibration hazards caused by the traffic will be of minor consequence,

		because the trunk bus routes are proposed in the median part of the arterial roads.
6. Ground Subsidence	D	- None
7. Stink	B	- It is feared in some places that the stench of rotten vegetable matters might arise from undrained surface water after occasional flooding (caused by the inadequacy of drainage structures or lack of proper maintenance thereof). - The proposed development of trunk bus routes includes structures to drain surface water and thus the present drainage capacity of the arterial roads will be improved greatly by the project implementation.
8. Topography/ Geology	B	- Some sections of the arterial roads where trunk bus routes will be developed suffer from occasional flooding and inadequate drainage during the rainy season. - The drainage capacity of the roads will be upgraded by the development of trunk bus routes which includes new structures to drain surface water.
9. River Beds / Sediments	D	None
10. Fauna and Flora	D	None
11. Water Use	D	None
12. Accidents	D	None
13. Global Warming	C	- Since the 2003 F/S Study, the technology of engines fueled by ethanol-gasoline mixtures has advanced greatly in Brazil. - The present Study carried out the estimation of CO^2 emissions with and without the trunk bus system (cf. Chapter 10). The results of the estimation indicate that the emissions would be reduced by 62% over 10 years. The trunk bus system will contribute to the curtailment of global warming.

* Grade A: Grave adverse impacts expected Grade B: Some adverse impacts expected
Grade C: Not ascertained (the situation would call for further study in the later stage, unless otherwise indicated by new findings)
Grade D: Negligible impacts, requiring neither IEE nor EIA procedures

Table 8.2-3(2) Findings for Scoping of Environmental and Social Consideration

Adverse Impact	Rating	Remarks
14. Involuntary Resettlement	B	- The trunk busways and lanes are developed on the existing arterial roads, neither requiring substantial resettlement of local inhabitants nor sizable land acquisition. The construction of terminals, stations, depots and the interchange requires land acquisition (see 8.3 of this chapter).
15. Local Economy (employment and livelihood)	D	- The introduction of the trunk bus services will adversely affect ordinary bus and minibus operators, forcing some of them out of business. The state and the municipal governments intend to absorb their employees to the trunk bus system as many as possible. The issue will have to be examined more closely during the stage of D/D drafting. - The site proposed for the Cidade Nova trunk bus terminal is presently occupied by one shop. The relocation of the shop is unlikely to affect the local customers because of the market nearby. The municipal government of Ananindeua is planning to move the shop in question to an open space available next to the site. Therefore, the proposed terminal is unlikely to affect local economic activities.
16. Use of Local Land and Other Natural Resources	D	- None
17. Social Overhead Capital and Social Institutions (e.g. decision making bodies)	D	- None
18. Present Social Infrastructure and Services	B	- Temporary increases of motorized traffic are expected in the vicinities of the project sites during implementation. The situation might temporarily affect the delivery of social services in such localities.
19. Poverty, Ethnic and Indigenous Minorities	D	- None
20. Unequal Distribution of	D	- None

Benefits and Adverse Effects		
21. Local Conflicts of Interests	D	- None
22. Gender Issues	D	- None
23. Rights of Children	D	- None
24. Cultural Heritage	C	- Some parts of the roadside plantings of mango trees and kapoks in Belem and Ananindeua and the roadside buildings in Belem are designated as important cultural heritage. It is necessary to take due caution during the development of priority lanes nearby. The adverse effect on these heritage sites are of minor import because the construction works are proposed on the median part of the roads. - The designs for terminals and bus stops will be required to take into account the local ambience. The buildings and structures are expected to fit adequately with the surroundings and contribute to the landscape improvement.
25. HIV/AIDs and Other Contagious Diseases	D	- None

* Grade A: Grave adverse impacts expected Grade B: Some adverse impacts expected
Grade C: Not ascertained (the situation would call for further study in the later stage, unless otherwise indicated by new findings)
Grade D: Negligible impacts, requiring neither IEE nor EIA procedures

Table 8.2-4 Basic Policy for Environmental Management Planning

Environmental Hazard	Rating	Measures to Avoid or Alleviate Adverse Impacts	Environmental Monitoring
1. Air quality	B	- Vehicles transporting construction materials and equipment should be careful to cover up the cargo with tarpaulin in order not to scatter dusts along the way. Mixing equipment should be adequately walled up not to let the dust fly out.	- Air quality measurement is regularly conducted in the vicinity of construction sites
3. Soils and Deposits	B	- The construction of the Marituba terminal requires an environmental license, and it is reasonable to suppose that no untoward violation would occur at the site. The ceramic factory in question was closed down more than 10 years ago and no apparent trace of illegally committed soil contamination was found during the present Study (cf. 8.3.4 of the text) - After the D/D is completed, it would be necessary to carry out soil analysis according to the terms of reference provided by the State Secretariat of Environmental Management (SEMA).	- Patrolling in the vicinity of construction sites are increased during the rainy season, checking and detecting the presence of exceptional deposits in ditches and river streams as early as possible.
4. Debris	B	- The construction debris of asphalt pavement will be transported to the dumping ground which the state government established properly with the environmental license. - During the drafting of D/Ds, it is necessary to prepare a logistics plan for debris transportation, although the proximity of the dumping ground to the project sites will make it a relatively simple task.	- Constant surveillance to prevent unlawful debris transportation and dumping during construction
5. Noise/ Vibration	B	- In adherence to the noise level standards of Brazil, construction machinery and heavy vehicles must be properly operated and maintained to lower the noise as much as possible. The overloading of vehicles must be strictly controlled. - When the project implementation is over, the trunk bus operation is expected to improve the traffic flow considerably, because it	- Noise level measurement is regularly conducted in the vicinity of construction sites. Vibration is regularly measured near the cultural heritages.

		would reduce the number of ordinary buses in operation. The articulated bus type produces less noise than the existing buses. It is estimated that the roadside noise level would be appreciably lower with the trunk bus operation than the "without" situation. Therefore, it is judged unnecessary at this stage to take any special countermeasure. - The vibration caused by the motorized traffic would be reduced significantly because the trunk busways, exclusive and priority lanes would be provided with concrete pavement. Therefore, it is judged unnecessary to take any countermeasure.	
7. Stink	B	- The trunk bus system includes new structures to drain road surface water for busways, exclusive and priority lanes. The system would greatly upgrade the drainage capacity of the arterial roads. The roadside areas would be freed from the recurrent drainage problems during and after the project implementation.	- Not applicable
8. Topography/ Geology	B	- During the D/D drafting, it is necessary to put together a plan for draining the locations likely to collect water during the construction.	-
14. Involuntary Resettlement	B	- The trunk bus system needs no involuntary resettlement of inhabitants, but requires the acquisition of land totaling 197,000 m^2. - Adequate compensations should be paid for land acquisition. Details are described in 8.3 of the text.	- To be described in land acquisition plan
15. Local Economy (employment and livelihood)	B	- During the construction, the transportation of materials, equipment and debris will cause traffic congestions in some locations. In order to contain the excess of interferences to local economic activities, it is necessary to draw up a logistics plan for construction related transportation with provision of appropriate detours. - During the construction on BR-316, Av. Joao Paulo II would be used as a detour for the motorized traffic, thereby avoiding the excessive concentration on Av. Almirante Barroso. - According to the simulation analysis, the construction works on the other roads would cause congestions of limited scale and spread compared with BR-316. The information on construction logistics and the availability of appropriate detours must be examined in advance in order to put the plan into effect. The issue must be analyzed in more precision at the stage of D/D drafting. - The trunk bus system will adversely affect the present ordinary bus and minibus operators. The state and the municipal governments are considering the option of absorbing their employees as many as possible into the trunk bus system. The details will have to be examined during the stage of D/D drafting.	- Not applicable
18. Present Social Infrastructure and Services	B	- Ditto	- Not applicable

* Grade A: Grave adverse impacts expected Grade B: Some adverse impacts expected
Grade C: Not ascertained (the situation would call for further study during the later stage, unless otherwise indicated by new findings)
Grade D: Negligible impacts, requiring neither IEE nor EIA procedures

8.3. SOCIAL CONSIDERATION

8.3.1. LEGISLATIONS ON RESETTLEMENT OF INHABITANT IN BRAZIL

This section describes the relevant legal requirements on land acquisition and compensation for resettlement.

(1) National Constitution of the Federal Republic of Brazil Regarding Resettlement

The national constitution of the federal republic is the ultimate source for the legislations regarding land acquisition. The following is a brief description of the relevant clauses and articles of the constitution.

1) Section I "Rights of Individuals and Collectives", from Chapter II "Fundamental Rights and Guaranties"

In Clause XXIII of Article 5, it is stated that the concept of ownership must carry its due social function. According to Clause XXIV of Article 5, the procedures of the land acquisition by public necessity or public use (necessidade ou utilidade publica) through just and previous monetary compensation acquisition that serves social interest (interesse social) must be legislated and enforced to uphold the constitutional declarations.

2) Section II "Urban Administration", from Chapter VII "Economic and Finance Order"

In Article 182, it is acknowledged that a municipal government (poder publico municipal) has the authority to appropriate urban real estate within its jurisdiction to expedite the development of urban social functions of the municipality and to guarantee social welfare for the inhabitants. Clause 3 of the article states that monetary compensation must be paid for the acquisition of real estate, while the detailed rules in Clause 4 state that the compensation can be paid in public bonds redeemable in equal annual installments over ten years with prior approval by the federal government.

In Article 183, it is stated that those who occupy the land lot of up to 250m2 consecutively for five or more years and do not own real estate or agricultural land elsewhere within the city limit are granted the ownership of the land as long as they themselves or their families actually live there, provided that there are no other claimants to the land. The article corresponds to the particular social conditions in Brazil. It aims to give relief to those who use or occupy a given piece of real estate in the urban built-up area for a long period of time and yet are unable to acquire the ownership over the ground they use or occupy. Such occupants can have their ownerships acknowledged at the judicial court to claim due compensation at the time of land acquisition. The judicial proceedings are called the usucaption by positive prescription, which requires, among others, the testimonies by neighbors that the occupant in question has kept the land in his possession openly and continuously for five or more years. The court proceedings start when the case is filed by a lawyer representing the occupant and normally take five to six years to conclude.

The Federal Statue No. 10257 of June 10, 2001 defines the detailed rules pursuant to the article above. In Clause 5 of Article 10 of the federal statute, it is stated that those low-income families who share the same dwelling on the land lot of up to 250m2 consecutively for five or more years with no explicit understanding of their respective shares in the property are granted the collective ownership of the land, unless there are other claimants to the land and unless they own real estate or agricultural land elsewhere within the city limit. Clause 2 of the same article states that the court adjudication would determine the division of the respective shares between the family units in the same dwelling and that the families can rely on the adjudication when they formally enter their ownership shares in the official land registry. The legislation provides the practicable legal approach to land acquisition regarding urban squatter settlements.

3) Section III "Agriculture Livestock, and Large Land Holdings Policy, and Agrarian Reform Policy", from Chapter VII "Economic and Finance Order"

Article 184 of Section III in Chapter IV defines the acquisition of real estate in the agricultural area that does not carry due social function. The article states that the land acquisition that serves social interest must be compensated in agrarian bonds (titulos da divida agraria) redeemable over the period not exceeding 20 years. Clause 1 of the said article states that the buildings found on the appropriated land must be paid monetary compensation.

(2) Decree Law (Decreto-Lei) on Land Acquisition

1) Land Acquisition for Public Necessity or Public Use

The legal base is provided by the Federal Decree-Law (Decreto-Lei) No. 3365/41 on July 18, 1941 that defines the land acquisition for public necessity or public use. The said statute declares that it legitimizes all cases of land acquisition in the country that are carried out in adherence to its stipulations. In Articles 1 and 2, it is stated that all types of real estate can be made subject to acquisition when the governing bodies on the federal, the state or the municipal administrative level and of the territories under direct federal control officially declare their intent of acquisition for public necessity or use. In other words, the private and the corporate ownerships of land, buildings, peripheral outdoor structures and trees planted within the premises must yield to the acquisition when the jurisdictional government publicly posts its intention. The basic principle of compensation is monetary payment, as described later in 1) of (1) of 8.3.1. The recipients of compensation must be the holders of ownerships. The procedures of land acquisition are explained in more detail in (5) of 8.3.1.

Article 15 of the said federal decree-law defines the range of public necessity or public use as follows.

1) National security
2) National defense
3) Relief provision in case of disasters
4) Public health
5) Construction or improvement of community centers and public assistance to the needy
6) Industrial utilization of mines, mineral deposits, water resources, hydropower generation, etc.
7) Construction of facilities for social welfare, sanitation, landscape conservation, hospitals and clinics, hot springs and spas
8) Maintenance and improvement of public roads
9) Land adjustment for economic betterment, hygienic improvement and public health (regardless of the presence or absence of buildings) and expansion of industrial estates
10) Operation of public transport
11) Conservation of artistic or historic heritages in the remote regions and urban areas, including the measures of conservation thereof, and preservation of special landscapes
12) Safekeeping of books and documents of historic and artistic value
13) Construction of public buildings, monuments and public cemeteries
14) Construction of stadiums, airports and airport runways
15) Reprinting or printing of scientific, artistic and literary works

16) Other items specifically required by legislation

2) Land Acquisition for Social Interest

The legal base is provided by the General Federal Law No. 4132/62 on September 10, 1962, consisting of 6 articles that define the land acquisition for social interest and the procedural requirements thereof. Article 1 declares that the land acquisition must be publicly posted for the explicit social interest of promoting equitable distribution of ownerships. Article 2 defines the range of social interest as follows.

1) Utilization of land areas with extremely low productivity, or land areas which are inhabitable by people who aspire to better their economic standings, or land areas which promise no possibility of better life
2) Installation or intentification of cultivations in the areas in which do not conform to the agricultural land use
3) Establishment and management of new agricultural land (colonias) or producers' cooperatives for dislocated farmers and their agricultural work.
4) Maintenance of occupants (posseiros) living in the clusters of ten or more family units in the urbanized areas who require some form of legal settlement with the legitimate landowners
5) Construction of housing units for low-income families
6) Areas and water with susceptive valorization estimated by conclusion of public works, such as to provide electricity, water reservoirs, irrigation facilities and so on, however, that were no used by social-minded.
7) Utilization of the areas, locations or assets which offer the possibility of tourism expansion by their characteristics

3) Land Acquisition for Urban Administration

Pursuant to Section II (urban administration) of Chapter IV in the national constitution, the Federal Law No. 10257 was promulgated on June 10, 2001. The legislation is derived from Articles 182 and 183 of the constitution and consists of 52 articles. The general rules and special stipulations on urban administration in the said statute define the overall jurisdictional authority of the municipal government. The statute is popularly known as the City Statute (Estatuto da Cidade). Section IV on the land acquisition with compensation in public bonds and Section VIII on the precedence granted to the municipal government define detailed procedures of land acquisition.

(3) Authority of Land *Acquisition*

1) Authority of Legislation on Land Acquisition

At present, the authority of legislation is defined by 25 clauses in Article 22 "Prerogative of Legislation", Section II "Federal Government", of Chapter III "Federal Organization" of the national constitution. Clause 2 explicitly concerns land acquisition and declares that the legislation over land acquisition is the sole prerogative of the federal government. However, the special stipulation is given in the same Article 22 to the effect that it is possible under special circumstances to grant the authority of legislation on land acquisition to the state government by a special federal decree. It is possible for the state government to obtain a certain legislative authority over land acquisition.

2) *Authority of Administration on Land Acquisition*

In adherence to the federal statues already mentioned in (1) above, the federal, the state and the municipal governments have their respective jurisdictional authorities of administration over land acquisition. In addition, varying degrees of administrative authority are granted to a number of federal agencies, for example, the National Agency of Electric Energy (ANEEL/ Agencia Nacional de Energia Eletrica) under the Federal Ministry of Mine and Energy (MME/Minsterio de Minas e Energia), and to some state subsidiary organizations, such as public corporations of water supply and sewage.

(4) Issues Related to the JBIC Guideline on Environmental Consideration

1) *Does the project implementation necessitate the involuntary resettlement of inhabitants? If it does, are there appropriate statutes and regulations that minimize the adversity to the affected?*

The Federal Decree-Law (Decreto-Lei) 3365/41 obligates the land expropriator to pay “monetary compensation” to the affected but does not go to the extent of requiring relocation/resettlement. However, the federal statute on environment defines that the social impact is a component of the environmental impacts. The statutory procedures of environmental licensing often require a detailed documentation on the environmental impact assessment (EIA/RIMA). The documentation is expected to examine and forecast the impact on social environment and to draft a plan, or a proposal, of resettlement and other alleviating measures for those who are affected by the project implementation.

2) *Are the involuntarily affected people adequately informed of the land acquisition and resettlement compensation well ahead of the project implementation?*

When the filing of EIA/RIMA documents is required as part of the procedures of environmental licensing, the project executing entity is legally obliged to hold a public hearing. The scope and the agenda of the hearing are specified in detail. Other than the public hearing, however, there is no legal requirement to contact and inform the affected communities. It has been understood between the government bodies in charge of environmental license screening and the project executing entities that the environmental scoping should include the minutes of presentation meetings with local communities as part of the EIA/RIMA documentation.

3) *Are there special considerations for women, children, the elderly, the poor, ethnic minorities and the other socially disadvantaged among the affected people?*

The relevant statute defines the compensation strictly in monetary terms, denying even the payment in public bonds. It is also clearly defined that the statutory recipients of compensations are those who own or lawfully occupy the land. Illegal occupants and squatters, who are often very poor and socially disadvantaged, are not guaranteed any statutory relief or aid. However, there are three institutional channels that function as safety net for these dwellers. First, the project executing entities are asked to include a specific proposal for relief in the environmental scoping for impact assessment or the environmental scoping for monitoring as part of the required EIA/RIMA documentation. Second, the Regional Public Prosecutor’s Office (Ministerio Publico) under the Ministry of Justice (MJ/Ministerio da Justica) increasingly intervenes under similar circumstances and persuades local administrative authorities to set up a mechanism for relief. Third, the state and the municipal governments in Brazil have the social relief sections to aid the disadvantaged, while churches have their own long-established channels of providing reliefs to the needy. One of the exemplary cases of administrative decisions, as distinct from the statutory requirement, is found in the State of Para. The housing development project by the State Corporation of Housing (COHAB) addresses the issue of squatter settlements (called "favela") and its approach to the land acquisition for road development offers a practicable pointer for other projects involving acquisition of squatted land.

The approach of the State Housing Corporation of Para (COHAB/Compania de Habitacao do Estado do Para) can be summarized as follows. Firstly, it is understood that illegal occupants and squatters have no recourse to the judicial process to get compensations because they have no rights to the dwellings they live in and to the land their dwellings are built on. Secondly, however, those who built their dwellings on their own and live there are paid due compensations by assessing the ground space occupied and the quality of construction. Thirdly, when the squatting dwellers desire to move to lawful dwellings on lawful ground elsewhere, they are relocated at no cost to them to the 100% lawful apartment units in the housing estates built by COHAB for low-income people. If they do not wish resettlement, they receive monetary compensations. Fourthly, when those living in the same dwelling consist of any combination of unmarried women, single mothers and the elderly, they are relocated to separate units as per family ties in the COHAB housing estates.

Although the present study team was unable to visit, there are cases in other states which involved acquisition of squatted or illegally occupied land. One of them concerned the squatter settlements within an environmental conservation area (APA: Area de Preservacao Ambiental). At the intervention by the regional prosecutor's office, administrative authorities in charge of community affairs and environmental monitoring, land owners and the project executing entity organized a joint committee to discuss the matter. After signing the Terms of Livelihood Adjustment (TAC: Termos de Ajustamento de Conduta) that stipulated the respective responsibilities and cost sharing in legal terms, they launched the resettlement of squatters in the manner similar to COHAB's.

(5) Procedures of Land *Acquisition*

1) Procedures of Land Acquisition by the State Government

The procedures of the state government are as follows.

(1) Posting of the land acquisition for public use by the project executing entity

(2) Land survey by the executing entity: i) characteristics (local land use, available urban infrastructure, attributes and area size of the proposed site, etc.), ii) existing buildings in the site (sizes, structures and finishes of the buildings, years after construction, etc.) and iii) purposes of the buildings (residential, commercial, etc.)

(3) The value of land, building, and business establishment in the planned site is estimated at current market price by the executing entity and documented in the set forms (for compensation estimation).

(4) The start of land acquisition procedures (direct negotiations with owners of land and buildings, residents, etc.)

(5) When agreement is reached over the amount of compensation and other conditions, the contract of sale is formally signed.

(6) When agreement is not forthcoming, the negotiations are taken up to the judicial arbitration at the court.

(7) When the judicial arbitration is successful, the contract of sale is signed in the presence of the judge.

(8) When the judicial arbitration falls through, the executing entity places the deposit worth the estimated compensation in the court and files a lawsuit for court adjudication.

(9) The interim court decision is issued on land acquisition (the interim decision is usually obtainable in a relatively short while).

(10) The executing entity starts the project implementation on the site, while continuing the court proceedings concerning the lawsuit over compensation.

2) Procedural Requirements

The executing entity prepares the document of site evaluation as close as possible to market price by the following procedures.

(1) Land: Records of five or more sales at similar economic and environmental locations are consulted to arrive at the current market price for the land in question.

(2) Buildings: Monthly issues of the magazines specializing in prices of buildings are consulted to determine the amount of compensation apropos of the structure, the finish and other characteristics of the buildings in question.

(3) Value of business establishment: Sales of similar business category are consulted to determine the value of the business establishment in question.

The amount of compensation estimated by the procedures would not be far removed from market transactions. However, few parties agree to the initially offered amounts of compensation and many in fact resort to the disputation at the judicial court.

The Federal Decree-Law (Decreto-Lei) 3365/41 specifies the legal requirements of land acquisition for public use. According to Article 9 of the statute, the presiding judge has the authority to acknowledge the legitimacy of the procedures taken for land acquisition and the jurisdictional right of the executing entity to start the procedures. He does not have the authority to adjudicate on whether the selection of a particular site for public acquisition is rightfully conducted and on whether the dispute itself is justified as a case for court adjudication.

The Prosecutor General of the State of Para (PGA: Procurador Geral do Estado) answered in the interview as follows. (i) The court procedures would take about 20 days from the placement of the deposit in the court to the issuance of an interim decision. After the dispute is adjudicated in favor of the official side, (ii) it would take about two years to transfer the ownership documentation to the state government.

3) Procedures of Land Acquisition for Illegal Occupants

The State Housing Corporation of Para (COHAB) takes the following procedures of land acquisition regarding illegal occupants.

(1) Ground plans of the dwelling units of illegal occupants are drawn up by using the design maps prepared for the road development and the aerial photographs of the area of settlement in question.

(2) Each dwelling unit is visited with the ground plan and the residents are interviewed according to the set questionnaire on how many live in the dwelling and how they earn their livelihood as well as the physical make and layout of the dwelling. The findings of the interview survey are used to estimate the values of the respective dwellings visited and the values of the businesses (e.g. retailing) the dwellers engage in at their dwellings.

(3) On the basis of the information obtained by the survey, the COHAB enters into negotiations with the dwellers, offering either the resettlement at no cost to the dwellers to apartment units in the COHAB housing estates or cash compensations. If two or more family units reside in the same dwelling, they will be offered separate units in the housing estates. The cash compensations are paid as soon as possible to the demand of the dwellers.

(4) If the apartment units are in short supply, COHAB finds some appropriate dwellings elsewhere and subsidizes the rents until the dislocated dwellers can be moved to the COHAB units.

8.3.2. CONSERVATION OF HISTORIC AND CULTURAL HERITAGE AND LANDSCAPE

The conservation of historic and cultural heritages and landscapes falls under the jurisdictions of different administrative levels: namely, the Federal Institute of Historic and Cultural Heritages and National Artistic (IHPAN/Instituto do Patrimonio Historico e Artistico Nacional) under the Federal Ministry of Culture (MinC/Ministerio da Cultula), the State Secretariat of Culture, Sport and Tourism (SECULT/Secretaria de Estado de Cultura, Desportos e Turismo) and its Department of Cultural Historic Heritage, Autistics and Cultural (DEPHAC/Departamento de Patrimonio Historico, Artistico e Cultural) in the State of Para, and the Cultural Foundation of Cultural Heritage of Belem (FUBEL/Fundacao do Patrimonio Cultural de Belem) in the Belem Municipality. The latest registry of the State Secretariat of Culture shows that five more buildings and three cultural assets were added after the 2003 F/S Study. Most notable assets in the registry are certain groves of mango (mangueiras) and kapok (samaumeiras) found along the roadsides and in the parks in the metropolitan area, which were registered as cultural assets for conservation on May 18th, 1982.

8.3.3. RESETTLEMENT OF LOCAL INHABITANTS AND COMPENSATIONS

(1) Estimation of Resettlement Requirements and Compensations

Table 8.3-1 shows the number of dwelling units and the ground areas of buildings to be expropriated for the development of trunk bus facilities. The table also indicates some salient site conditions, the timing of removal by construction phase and the evaluation of risks involved. The phase distinction is meant to distinguish the components for the yen loan application.

The components for the yen loan application do not involve any resettlement of dwelling units, requiring no resettlement of inhabitants. However, their Phase 1 implementation would require the land acquisition totaling about 112,000m2. The ground areas of the buildings for removal, including outer peripheral walls, add up to 6,742m2. The building currently in use for business is only 1) a storehouse of about 1,800m2, found within the site for the trunk bus terminal of Icoaraci. Since it is judged that the wholesaler will be able to continue its business in the site, only compensation of building needs. Equally, the Phase 2 development does not involve the resettlement of inhabitants. The land acquisition totals about 85,000m2, of which the ground areas of the buildings account for 3,480m2. The buildings currently in use for business purposes comprise 2) a shop of construction materials (about 180m2) in the site for the terminal of Coqueiro, 3) a gas station with a repair workshop (about 725m2) within the site for the right ramp of the interchange, and 4) a building of public function (a public market place of about 1,500m2) within the site for the terminal of Cidade Nova. A total of four buildings are to be expropriated for the project implementation.

The components for the yen loan application will require the estimated amount of R$9.14 million for compensation payments. The compensations required for the Phase 2 development will amount to R$7.61 million. Table 8.3-2 shows the details of estimation by facility component.

Table 8.3-1 Removal Requirements of Buildings for Trunk Bus Facilities

No.	Facility and Location	Dwelling Unit	Area of Acquisition (m^2)		Phase of Acquisition	Site Condition	Risk or Obstacle
			Premise	Building			
1. Interchange Ramps for Trunk Bus Routes							
1.1	Right Ramp	0	11,340	725	Phase 2	Open space & commercial use	None
1.2	Left Ramp	0	780	0	Phase 2	Commercial use	None
Subtotal		0	12,120	725			
2. Trunk Bus Terminals							
2.1	Icoaraci	0	15,449	2,232	[Y-Left]	Commercial use	None
2.2	Coqueiro	0	14,266	180	Phase 2	Open space &	None

						commercial use	
2.3	Marituba	0	22,080	0	[I]	Open space	None
2.4	Cidade Nova	0	0	1,500	Phase 2	Public function	None
Subtotal		0	51,795	3,912			
3. Trunk Bus Depots							
3.1	Icoaraci	0	22,032	0	[Y-Left]	Open space	None
3.2	Coqueiro	0	24,375	0	Phase 2	Open space	None
3.3	Marituba	0	46,400	1,235	[I]	Open space	None
3.4	Cidade Nova	0	34,127	1,071	Phase 2	Open space	None
Subtotal		0	126,934	2,306			
4. Trunk Bus Stations							
4.1	Tapana	0	3,245	1,260	[Y-Left]	Public function, residential, commercial & other uses	None
4.2	Mangueirao	0	None	690	[Y-Left]	Public function	None
4.3	Aguas Lindas	0	3,290	1,325	[I]	Public function & commercial use	None
Subtotal		0	6,535	3,275			
Grand Total			197,384	10,218			

Notes: 1) The area of a building is the sum of the ground area of the building and the ground area of the outer peripheral walls.

Table 8.3-2 Estimated Compensations for Land Acquisition and Removal of Buildings

(R$1,000)

No.	Facility and Location	Land Acquisition	Compensation for Building	Compensation for Business	Total Compensations
1. Interchange Ramps for Trunk Bus Routes					
1.1	Right Ramp	635.04	688.75	700.00	2,023.79
1.2	Left Ramp	43.68	0.00	0.00	43.68
Subtotal		678.72	688.75	700.00	2,067.47
2. Trunk Bus Terminals					
2.1	Icoaraci	865.14	1,283.40	0.00	2,148.54
2.2	Coqueiro	798.90	119.70	132.00	1,050.60
2.3	Marituba	1236.48	0.00	0.00	1,236.48
2.4	Cidade Nova	0.00	997.50	0.00	997.50
Subtotal		2,900.52	2,400.60	132.00	5,433.12
3. Trunk Bus Depots					
3.1	Icoaraci	1,233.79	0.00	0.00	1,233.79
3.2	Coqueiro	1,365.00	0.00	0.00	1,365.00
3.3	Marituba	2,598.40	821.28	0.00	3,419.68
3.4	Cidade Nova	1,911.11	214.20	0.00	2,125.31
Subtotal		7,108.30	1,035.48	0.00	8,143.78
4. Trunk Bus Stations					
4.1	Tapana	181.72	252.00	0.00	433.72
4.2	Mangueirao	0.00	205.50	0.00	205.50
4.3	Aguas Lingas	184.24	306.85	0.00	491.09
Subtotal		365.96	764.35	0.00	1,130.31
Grand Total		11,053.50	4,889.18	832.00	16,774.68

Notes: 1) The compensation for a building is the payment for both the building and the outer peripheral walls.
2) The evaluation uses the report, dated April 7th, 2009, prepared by the State Secretariat of Public Works on the prices paid for acquisition regarding road development projects.

(2) Monitoring during Land Acquisition and Handling of Complaints

The State Secretariat of Public Works (SEOP/Secretaria de Estado de Obras Publicas) is directly in charge of the land acquisition procedures. The Planning and Management Unit of the NGTM in the State Secretariat of Strategic Projects (SEPE) monitors the progress of land acquisition. The

Resettlement Action Plan (RAP) to be prepared during in the D/D drafting stage includes the specification of subjects for monitoring (progress of land acquisition at project sites, issues and complaints raised by the other side of negotiation, etc.) and the decision over the frequency of progress reports from SEOP to the NGTM and other matters. As mentioned in 2) of (5) in 8.3.1, the acquisition is hardly agreed upon during the early stages of direct negotiations and subsequent court arbitration. Many disputes have to be adjudicated as lawsuits at the judicial court. During the stage of direct negotiations between SEOP and land owners or residents, as referred to in 5) below, SEOP itself handles complaints. In order to avoid unnecessary personal enmities, the procedures of land acquisition from direct negotiations to court arbitration and lawsuits are normally conducted by the lawyers representing each side of the disputation.

(3) Outline Schedule for Land Acquisition (see Table 6.2-1: Implementation Plan of the Project Financed by Japan's ODA Loan in Chapter 6)

1) Site profiling (location, land area, physical attributes, etc.): 1 month (from July 2010)
2) Posting of land acquisition for public use: 1 month (from August 2010)
3) Site survey on land and buildings: 2 months (from September 2010)
4) Current price evaluation on land and buildings: 2 months (from November 2010)
5) Direct negotiation on land acquisition: 3 months (from January 2011)
6) Court arbitration: 1 month (from April 2011)
7) Placement of the deposit worth the offered compensation in the court at the failure of court arbitration: 1 month (from May 2011)
8) Issuance of the interim court decision acknowledging the project implementation on the disputed site: 1 month (from June 2011)
9) Start of construction works, amidst the continuing lawsuit: 6 months (from July 2011)

The compensation is paid at the time of contract signing after the agreement is reached by direct negation or court arbitration. If the dispute is taken to the court, the compensation is paid out of the court deposit after adjudication.

8.3.4. MONITORING AFTER LAND ACQUISITION

As mentioned earlier in 8.2.3, the projects for the trunk bus system do not involve any resettlement of inhabitants, but require the acquisition of three privately owned business buildings and one public building (a small market place owned by the Marituba Municipality). The need of monitoring after land acquisition is described separately by construction lot-cum-phase.

(1) Phase 1-1, Lot [I]

The acquisition concerns two buildings in this phase. One is a building of reinforced concrete found in the site for the Marituba trunk bus terminal. It has been long abandoned and now completely unoccupied, with no need of subsequent monitoring. The other is a gas station in the site for the trunk bus station in Aguas Lingas. The removal concerns only a small part of the iron framed roof of the station. The site visit ascertained that the said removal would not adversely affect the business in any way. The rest of the sites are all considered "empty", with some remains, if any, of outer peripheral walls of the long-gone buildings. The monitoring after land acquisition is judged unnecessary during this phase

(2) Phase 1-2, Lot [Y-Left]

The acquisition concerns two buildings during this phase. One is found in the site for the Icoaraci bus terminal. The removal concerns a storehouse of a cement wholesaler and part of the ground premise. As there is an unused lot kept available for continuing water transport, it is judged that the wholesaler will be able to continue its business satisfactorily after land acquisition. The compensation will be paid on land and building, not on business. The monitoring is judged unnecessary at this site. The other is found in the site for the Mangueirao bus station in Cidade Nova. The acquisition concerns a small gatekeeper's post that belongs to the nearby public building of the state government. The proposed compensation includes the cost of new construction. Because land is sufficiently available for project implementation, the monitoring after land acquisition is judged unnecessary at this site.

(3) Phase 2

The most important acquisition in Phase 2 concerns a small public market found in the site for the trunk bus terminal in Cidade Nova. The ground and the facilities are owned and managed by the Marituba Municipality. After acquisition of land and buildings, it will be necessary to monitor the livelihood of small shopkeepers who now rent spaces in the market. The market place in question is visibly antiquated, with no traces of adequate maintenance and repairs. Most of the shops are either temporarily or permanently closed down. The proposed compensation for the buildings would pay for the construction of a new market place of equivalent scale. In close consultation with the municipal government, it will be possible to set up an effective monitoring system for the tenants currently in business, including the possibility of arranging new tenancies elsewhere or of offering preferential tenancies in the terminal premise. The other buildings to be expropriated during Phase 2 are the gas station and the repair workshop found in the site for the right ramp of the interchange and the shop of construction materials found in the site for the trunk bus terminal in Coqueiro. The monitoring needed for these sites will be desirable to carry out by following the procedures of the Surveillance Commission (Comissao de Fiscalizacao) mentioned in Section 8.4.2.

8.4. PUBLICATION OF INFORMATION AND COMMUNITY PARTICIPATION

8.4.1. PUBLICATION OF INFORMATION

The State Secretariat of Strategic Projects (SEPE/Secretaria de Estado de Projetos Estrategicos) hosted five stakeholders' meetings from April 6th to May 14th in 2009, and explained the Action Plan for the Metropolitan Area (Projeto Acao Metropole) and presented the proposal of the trunk bus system. The participation exceeded 300 attendees including the members of the present study team. It was reported that the questions and answers are exchanged regarding well over 40 topics, and reported that there was nobody present who raised an objection to the trunk bus system. Table 8.4-1 summarizes the nature of each stakeholders' meeting.

Table 8.4-1 Outlines of Stakeholders' Meetings

1st Stakeholders Meeting: Presentation of the Inception Report

1.	Date	14:00 – 17:00, April 8 (Wed), 2009
2.	Host	State Secretariat of Strategic Projects (SEPE)
3.	Participants	83 attendees

2nd Stakeholders Meeting: Presentation to local inhabitants, shopkeepers and business establishments

1.	Date	18:30 – 21:00, April 16(Thu), 2009
2.	Host	State Secretariat of Strategic Projects (SEPE)
3.	Participants	33 attendees

3rd Stakeholders Meeting: Presentation to local inhabitants, shopkeepers and business establishments

1.	Date	15:00 – 18:00, April 23 (Thu), 2009
2.	Host	State Secretariat of Strategic Projects (SEPE)
3.	Participants	24 attendees

4th Stakeholders Meeting: UNAMA seminar at Amazonia University[1]

1.	Date	19:30 – 20:30, May 5 (Tue), 2009
2.	Host	UNAMA, Amazonia University
3.	Participants	approx. 150 attendees (no record kept)

5th Stakeholders Meeting: Presentation to the members of the Para Chapter of CREA[2]

1.	Date	18:30 – 21:00, May 14 (Thu), 2009
2.	Host	SEPE and CREA-PA
3.	Participants	33 attendees

Notes: 1) The meeting was hosted by Amazonia University as one of the seminars of the Program of the Academic Week for Construction Engineering. Attendees were students and faculty members at the university and other educational institutions. The agenda consisted of the presentation of the proposed trunk bus system and the session of questions and answers.
2) CREA (Conselho Regional de Engenharia, Arquitectura e Agronomia) is the council organized nationally by civil engineers, architects, urban planners and agricultural engineers. The membership registration at the council formally accredits technical qualifications for designing and supervising construction works. The council members often give specialist advices and conduct researches on urban policies and public infrastructure development. The meeting was held for the members of the Para chapter of the council.

8.4.2. COMMUNITY PARTICIPATION

The State Secretariat of Strategic Projects institutionalized the Surveillance Commission (Comissao de Fiscalizacao) in order to let local inhabitants watch over social and environmental impacts of the on-going public works on road upgrading and rehabilitation. The operational support and coordination of the commission activities is given by the Local Community Affairs Team of NGTM.

To facilitate swift and fair handling of complaints, demands and protests from local communities, SEPE drew up for internal use the stipulations regarding the commission, detailing its establishment, purpose, membership, mandate and term of appointment.1 The executive members of the commission keep the minutes of the deliberations at the meetings and hand them over to the Local Community Affairs Team. NGTM reviews the minutes and decides what to do and swiftly notifies the decisions to the contractor or the supervising consultant concerned.

Regarding the proposed trunk bus system, a participatory surveillance commission will be established for each construction lot by appointing local inhabitants.

8.5. ENVIRONMENTAL CHECK LIST OF JBIC GUIDELINE

The State Secretariat of Environmental Management (SEMA) decided to apply the PCA procedures to the proposed trunk bus projects, pursuant to Clause 1 of Article 12 in the CONAMA Resolution No. 247 (Dec. 19, 1997). It is now possible to apply for the construction license (LI) by omitting the preliminary license (LP) documentation.

From the foregoing review on the environmental impact of the trunk bus projects, it is judged that the scoping of natural environment is now adequately done. NGTM of the state government is currently preparing the PCA documentation and expects to get the construction license in December of 2009. Therefore, the next step will be the stage of D/D drafting when some environmental issues pointed out in this preliminary study will be examined closely and necessary steps will be proposed.

The environmental check list is written up in accordance with the JBIC Guideline on Environmental Consideration in preparation for the yen credit application.

[1] The commission is organized by 12 appointees, with equal number of alternates, selected from the local private organizations in the area affected by any given construction works and a representative from the Public Prosecutor's Office (Ministerio Publico). One third of the commission membership is retained for the leaders of local community organizations and cooperatives. The SEPA stipulations define the criteria for appointment, the election by mutual vote of the executive members within the commission, the responsibility and the authority of the executive members and the general commission members and the term of appointment.

Table 8.5-1 Environmental Check List of JBIC Guideline

Category and Issue	Main Questions	Available Study Findings
1. License, Permit and Presentation		
1.1 Environmental Impact Assessment (EIA) and Environmental License	1. Was the EIA report completed? 2. Were the EIA report and other relevant documents approved officially by the government? 3. Was the said approval unconditional? If conditional, is it possible to clear the conditions? 4. In addition to the official approval mentioned above, were the necessary approvals from other relevant authorities obtained?	1. – 4. The EIA report was not prepared. The project requires the environmental license (LI) for implementation, and the following steps have been and are being taken to get the license. On May 12, 2009, the project brief was submitted to the State Secretariat of Environmental Management (SEMA). Then, based on both joint field survey and presentation held on May 14, 2009, decision was made that only PCA is required for the environmental license application for this proposed project. Note that PCA is simplified procedure, compared with full-scale EIA/RIMA and application of LP can be skipped but LI application is mandatory.
1.2 Presentation to Local Communities	1. Is the executing entity well prepared to provide appropriate information on the project and its likely impacts to local inhabitants and the public in general? 2. Is the executing entity ready to answer any question and comment from other government agencies and local inhabitants?	- 1. Five stakeholders' meeting were held from April 6 to May 14, 2009. At these meetings, presentation was made regarding the Action Plan for Project Implementation toward a Comprehensive Transport System in the Metropolitan Area of Belem and the proposed trunk bus system which derives from the plan. The participation totaled over 300 attendees and more than 40 questions and comments were raised and duly explained. In the meetings, it was not reported that the project is opposed. -2. Comments and opinions of the public can be gleaned from the traditional institution of town meetings in Brazil It is desirable to monitor the discussions at these meetings and take appropriate actions. As for the implementation of road projects by Para state, since the Surveillance Commission (Comissao de Fiscalizacao) supported by NGTM controls road projects, complaints, demands and protests from local communities are fair handled.
2. Measures for Pollution		
2.1 Air quality	1. Are the estimated emissions from motorized traffic expected to affect the air quality conditions? Do the estimated emissions satisfy the official standards in the country? 2. If there is an industrial belt emitting airborne pollutants along the proposed route, is the project expected to aggravate the pollution?	-1. The 2003 F/S Study conducted the field survey along the major arterials, measuring the roadside air quality conditions. The study reported that the conditions did not satisfy the national environmental standards. -2. N/A
2.2 Water Quality	1. Is the soil spillage from the exposed surfaces of banking and cutting expected to flow into nearby streams and degrade the water quality downstream? 2. Is the drainage of road surface water expected to contaminate the underground aquifers? 3. Do the expected drainages from stations, parking lots or highway service areas satisfy the official standards of the country? Are the drainages expected to worsen the water quality of any particular watershed to the level inadmissible by the official standards?	-1 and 2. The proposed projects concern the improvement on the existing arterial roads. They do not necessitate any sizable civil engineering works that would change the terrain, while there are neither major rivers nor water catchment areas in the vicinities of the project sites. -The risk of large-scale soil spillage is thus judged small. It might happen that the oil spillage from the wrecked cars in traffic accidents seep into underground aquifers, but there are no major underground water layers or conservation catchments along the proposed trunk bus routes. -3. However, the drainage of used water and sewage at the construction yard (under

		construction), terminals, stations and bus depots require proper treatment. The existing bus terminals are equipped with simplified drainage facilities. The trunk bus terminals will be equipped with the same facility. The state government considers that the drainage plans will be included in the Terms of Reference for the subsequent D/Ds.
2.3 Noise and Vibration	1. Do the estimated noise and vibration levels by the traffic expected to satisfy the official standards of the country?	-1. The 2003 F/S Study conducted the field survey along the major arterials, measuring the roadside noise and vibration levels and estimating what would happen by the project implementation. The study reported that the conditions did not satisfy the national environmental standards. -The project implementation is expected to lower the roadside noise and vibration levels by improving the flows of motorized traffic (the metropolitan total vehicle kilometers in 2018 is forecasted to be lower by 3% compared with the situation "without" the project implementation). The articulated buses to be introduced for the trunk bus system make less noise than the existing ordinary buses. -Trunk busways, exclusive and priority lanes are to be provided in the median part of the arterial roads with concrete surfacing. The roadside vibration will be thus appreciably reduced. - Accordingly, it is judged unnecessary to undertake additional investigation during the later stage of D/D drafting.
3. Natural Environment		
3.1 Nature Conservation	1. Is the project located near any nature conservation area protected by the national statute of the country or by the international treaty? Does the project give adverse impacts to the protected areas?	-1. The western section of Av. Independencia passes close to a nature conservation area (Presidente Medici II). -The state government already obtained the environmental license (LI), and the construction works are underway to be completed in May 2010 (the avenue is to be provided with trunk bus priority lanes when the construction is completed). So, it can be said that there would be no significant negative impact, regarding this environmental factor.
3.2 Natural Habitats	1. Does the project site include virgin forests, tropical forests, or any ecologically important ecosystems (coral reefs, mangrove forests, tidal flats, etc.)? 2. Does the project site include habitats of rare species protected by the national statute or by the international treaty? 3. If the project is expected to have the adverse impacts, is the executing entity prepared to propose and implement effective measures to mitigate the impacts? 4. Is the executing entity prepared to take appropriate actions regarding the road crossing by wild life and livestock, the separation of natural habitats by the project, or the occurrence of traffic accidents involving wild life or livestock? 5. Is the implementation of the project expected to cause deforestation, intensified poaching, desertification, or drying up of marshland? Is the project expected to introduce foreign species and pests nonexistent in the area before and thereby disturb the	-1. and 2. The presence of rare species of fauna and flora is not reported along the proposed routes. As mentioned immediately above, however, the western section of Av. Independencia passes a nature conservation area. -3. The state government already possesses the environmental license and stipulates the appropriate environmental measures in the project implementation (e.g. establishment of workshops for environmental education and a visitor center). -4. 5. and 6. N/A So, it can be said that there would be no significant negative impact, regarding this environmental factor.

	local ecosystems? 6. If the road project is in an undeveloped region, is the ensuing regional development expected to destroy the natural environmental balance?	
3.3 Hydrology	1. Are modifications of topographic features and constructions of tunnels and other large-scale structures expected to alter adversely the flows of surface and underground water?	-1. The proposed projects concern the improvement on the existing arterial roads. They do not necessitate any sizable civil engineering works that would change the terrain. -It has been reported, however, that certain locations on the proposed routes are subject to water-logging during the rainy season due to inadequate drainage of surface water. -The proposed trunk bus routes are to be provided with structures for surface water drainage and catchment facility. The drainage conditions on road surface will be greatly improved by the project implementation. -It is necessary that the subsequent D/Ds include the suitable drainage plans.
3.4 Topography and Geology	1. Are there any places along the route where landslides or land collapses are expected to occur? Is any appropriate construction method available and applied to prevent such dangers? 2. Are the banking and cutting works needed for the project expected to cause landslides or land collapses? Are appropriate measures taken to prevent such risks? 3. Are the exposed surfaces of banking and cutting, debris dumping grounds, or gravel harvesting pits expected to cause soil spillage? Are appropriate measures taken to prevent such risks?	-1. Places and slopes at risk of land slide or collapse are not found along the proposed routes. -2, and 3. The proposed projects do not involve any sizable banking and cutting works and are thus considered unlikely to cause such damages. -It is judged unnecessary to consider the issue in the later stage of D/D drafting.
4. Social Environment		
4.1 Resettlement of Local Inhabitants	1. Does the project involve any involuntary dislocation of local inhabitants? If it does, is the executing entity prepared to take actions to minimize the impact of dislocation? 2. Does the executing entity intend to explain fully the issue of dislocation and compensation to the affected people? 3. Does the executing entity conduct the study on the affected area and the inhabitants therein and draw up an effective plan of compensation and resettlement, and guarantee the swift recovery of livelihood after resettlement for the affected people? 4. Does the plan of compensation and resettlement pay special attention to the socially disadvantaged groups of people, such as women, children, the elderly, the poor, and ethnic or indigenous minorities? 5. Is it possible to secure the agreement from the affected people before the start of project implementation? 6. Is the executing entity able to establish a mechanism for handling the problems involved in the resettlement? Does the entity possess the adequate capability and	1. The proposed trunk bus projects do not necessitate the resettlement of local inhabitants. However, the land acquisition is required at the following sites. 1. Grade separated interchange on Av. Independencia and Av. Augusto Montenegro (12,120m^2) 2. Icoaraci trunk bus terminal and bus depot (37,481m^2) 3. Coqueiro trunk bus terminal and bus depot (38,641m^2) 4. Marituba trunk bus terminal and bus depot (68,480m^2) 5. Cidade Nova trunk bus terminal and bus depot (34,127m^2) 6. Tapana trunk bus station (3,245m^2) 7. Aguas Lingas trunk bus station (3,290m^2) 2. The public posting is required prior to land acquisition for public purposes. 3. Land, building and business establishment are evaluated for compensation. Compensation is paid in cash, usually after the arbitration or adjudication at the judicial court. 4. Because no dislocation of local inhabitants is required for the projects, it is not necessary to formulate a plan for resettlement. 5. The agreement on compensation is usually reached at the arbitration or adjudication by

	fund to handle the problems of resettlement? 7. Is there a plan to monitor the lives of the affected people after resettlement?	the judicial court. 6. Based on the plan prepared by NGTM of the State Secretariat of Strategic Projects, the State Secretariat of Public Works undertakes the land acquisition. The expenditure on land acquisition procedures is allocated in the state budget. The prospective loan agreement will explicitly stipulate that the cost of land acquisition belongs to the domestic component of the project implementation cost. 7. In some cases, it will be necessary to plan a monitoring system over a certain period after the land acquisition is completed.
4.2 Life and Livelihood	1. If the project involves the new development of roads or railways, are the existing transport services and their employees affected adversely by the implementation? Does the project necessitate drastic changes in the present land use pattern and means of livelihood including unemployment? Is the executing entity prepared to take appropriate steps for alleviating such adverse impacts? 2. Does the project adversely affect the lives of people other than those mentioned above? Is the executing entity ready to take steps to alleviate their setbacks? 3. Does the project stimulate the inflow of people from elsewhere with risks of diseases (HIV and other contagious diseases) ? Is the executing entity ready to take steps to provide adequate public hygiene and sanitation? 4. Does the project adversely affect the flows of traffic in its vicinities (level and spread of congestion, frequency of traffic accidents, etc.)? 5.Does the development of roads or railways obstruct the movement of local inhabitants? 6. Do road structures (e.g. pedestrian bridges and other overhead structures) obstruct sun light or radio wave?	1. As mentioned earlier, the proposed projects concern the improvement on the existing arterial roads. Nine out of ten trunk bus facilities such as terminals and depots are proposed at the sites currently classified as industrial or mixed uses (the only exception is the site for the Cidade Nova terminal). Therefore, the project implementation is unlikely to change the local land use pattern. The introduction of the trunk bus system will adversely affect the current operators and employees of bus services. The adverse impact will be minimized because they will be provided with opportunities to transfer to the trunk bus operation. 2. The construction will unavoidably affect daily lives of local communities. It is necessary to prepare beforehand a plan for construction-related transportation (e.g. provision of detours). 3. The construction entails the inflow of workers to the project sites. The stipulations in the contracts will ensure that the appropriate hygienic and sanitary standards are maintained during construction. 4. It is impossible to entirely avoid the traffic congestion caused by on-going construction works. It is necessary to devise the implementation strategy carefully lest the construction works unduly disturb social and economic activities in the local communities. It is important to propose measures such as alternative routes with traffic sign and to publish its information to car drivers. The detailed planning is required at the stage of D/D drafting. 5. Implementation of the project will increase left-turn traffic and pedestrian's road crossing to access to bus stops. Proper measures such as signal installation should be taken to control them and the detailed planning is required at the D/D stage. 6. The possibility of sun light obstruction is unlikely to become a major issue in the ethos of local population. It might be necessary to consider measures such as cables under ground (not discussing with counterpart) against possible obstructions of radio wave by certain road structures. On the whole, it is judged that no serious obstruction of sunlight and radio wave would occur by the proposed trunk bus projects.
4.3 Cultural Heritage	1. Does the project harm the archeological sites, historic, cultural and religious heritages and relics? Is	- 1. Some roadside plantings of mango trees and a few buildings within the city limit of Belem are designated as important historic

	the project designed in accordance with the national regulations regarding such cultural assets?	and cultural heritages. (The inventory of historic and cultural heritages was compiled by the 2003 F/S Study.) Appropriate care need be taken when priority lanes are constructed near such heritages (e.g., integrated townscape coordination such as special design of bus stop facility on bus priority lane to be constructed nearby, and/or anti-vibration around important cultural heritages by concrete pavement). The planning is called for at the stage of D/D drafting.
4.4 Landscape	1. Does the project harm the landscapes of special importance? Are appropriate measures taken to protect such landscapes?	- 1. As mentioned immediately above, a number of historic and cultural assets are found near the construction sites (priority lanes) within the city limit of Belem. - Because the proposed projects concern the improvement on the existing roads, it is not expected that the construction works would cause any serious disturbance to such assets. Regarding the facilities such as terminals, stations and bus stops, care will be taken to give them the design befitting the respective local roadside landscapes.
4.5 Ethnic and Indigenous Minorities	1. If communities of ethnic or indigenous minorities are found along the project routes, does the executing entity take suitable measures to minimize the impacts on their culture and life styles? 2. Does the project design conform to the national regulations regarding ethnic or indigenous minorities?	- 1. No community of ethnic or indigenous minorities is found along the proposed route. - 2. N/A.
5. Others		
5.1 Impacts during Construction	1. Does the executing entity take appropriate measures to mitigate the adverse environmental impacts of the construction works (noise, vibration, water muddying, dust, gaseous emission, debris, etc.)? 2. Do the construction works of the project affect local natural environment (ecosystems)? Are appropriate steps taken to alleviate such risks? 3. Do the construction works affect local social environment? Are appropriate steps taken to mitigate the impacts? 4. Does the executing entity provide the opportunity of safety education for the staff and workers involved in the project implementation?	- 1.and 3. The PCA documentation now under preparation is expected to include necessary measures for mitigating the indicated impacts. 2. The 2003 F/S Study drafted a plan for mitigating measures. The impacts of the construction works on natural environment (ecosystems) are expected to be slight . - Based on the volume of debris estimated by the present Study, it is necessary to devise a plan for debris transportation during construction. In the State of Para, the planning on debris transportation is done during the stage of D/D preparation and drafting. - Regarding the issues of noise, vibration, water muddying, dust, gaseous emission, debris etc. during the construction phase, the present Study suggested to NGTM to prepare a comprehensive plan for environmental management, including the establishment of an effective system for monitoring. This can be done during the preparation for the LI application. - NGTM agreed in answer that it would have some officials seconded from SEMA and have them participate in the PCA documentation. - 4. Regarding the safety education for construction workers, the present Study suggested to NGTM to include appropriate actions in the PCA documentation.
5.2 Monitoring	1. Does the executing entity set up and operate the monitoring system concerning all the environmental issues mentioned above? 2. Is the planned monitoring system	- 1., 2. and 3. As mentioned elsewhere, NGTM is currently preparing the PCA documentation for the LI application. The present Study suggested to NGTM to prepare a plan for environmental

	judged suitable to the tasks? 3. Is the monitoring system adequately organized and staffed and funded (organizational structure, number of personnel, budget allocation, and their respective continuity)? 4. Does the executing entity establish the procedures of reporting to the relevant government branches (forms and intervals of reporting)?	monitoring and include it in the PCA documentation, describing the organizational structure, the procedures for monitoring and the reporting requirements. - NGTM stated in answer that it would have some officials seconded from SEMA for the purpose. - It is expected that NGTM would establish the channel of maintaining consultation and exchange of relevant information with SEMA through the seconded officials. - The 2003 F/S Study referred to the issue of environmental monitoring and suggested that the details should be worked out in close consultation with SECTAM during the preparation for the LI application. As of October 2009, PCA D/F is under preparation stage and those information shall be integrated within its documentation. - 4. no stipulation is made in Brazil.
6. Notes for Special Consideration		
Additional Environmental Check Lists	1. If the need is justified, it is advised to apply the environmental scoping to forests (when the project requires the removal of forest vegetation). 2. If the need is justified, the environmental scoping is advised to consider the possible impacts from the electric transmission and distribution lines (when the project involves the construction of facilities for electric transmission and distribution).	- 1. and 2. N/A. - The western section (Av. Augusto Montenegro – Julio Cesar) of Av. Independencia is currently under construction to be completed by May 2010. - The state government has the environmental license for the road project. - Regarding the sites proposed for trunk bus terminals in Marituba and Icoaraci, It is necessary to check whether the soils are contaminated by the previous users.
Coverage of Check Lists	1. If the need is justified, it is advised to extend the coverage of environmental scoping across the national borders (when debris dumping might cross the borders, or the project might aggravate the problems of acid rain, destruction of the ozone layer or global warming).	- 1. N/A.

8.6. APPLICATION TO ENVIRONMENTAL LICENSE

8.6.1. ENVIRONMENTAL LICENSE APPLICATION IN 2003 FEASIBILITY STUDY

The 2003 F/S Study on Transport System Improvement in the Metropolitan Area of Belem carried out the environmental impact assessment (EIA) for the projects it covered, including the present trunk bus system. The EIA working team was organized by the then JICA study team, COHAB (the then counterpart agency for the JICA study team) and a local EIA consultant firm. The team was to conduct studies, collect and review the relevant information, and attend the sessions with SECTAM (the former name of SEMA) over the application for the advance environmental license (LA). The JICA team offered technical and supervisory support to the environment impact assessment and took charge of the following tasks.

1) Drafting of the project brief
2) Participation in the consultative meetings over the EIA Terms of Reference
3) EIA tasks
4) Drafting of the EIA/RIMA draft final report

COHAB was responsible for the following tasks.

1) Administrative procedures needed to obtain the environmental license
2) Meetings with local inhabitants

It was initially hoped that the LA would be approved while the JICA study team was still in Brazil. If the necessary tasks could not be completed within the time limit, it was agreed that COHAB would take over the remaining tasks (e.g. revision and finalization of the draft final report) after the departure of the JICA team and complete the license application.

The final Terms of Reference on environmental impact assessment was agreed in July 2002 and the JICA team began the EIA study immediately. The EIA/RIMA draft final report was submitted to SECTAM at the end of February 2003 and officially accepted. The notice of the report for public perusal was posted in the Official Diary (Diario Oficial) dated March 31, 2003, and the report was presented to the public view for 45 days. At the same time, SECTAM appointed five teams for the evaluation of the draft final report.

The period of public presentation was duly over, with no demand filed by the local inhabitants to open a public hearing. According to the statues on environmental impact assessment in Brazil, if local inhabitants make no demand for a public hearing during the period of public presentation, it is admissible to omit public hearings from the EIA evaluation procedures. SECTAM cancelled the initially planned public hearing and entrusted the final evaluation of the report to the then State Council of Environmental Management (COEMA). It was expected at the time that the SECTAM examination of the report would be over during July 2003 and that the results of the examination would be submitted to COEMA for final approval. However, both SECTAM and COHAB apparently lost touch of the subsequent progress of the evaluation. There is no information available on what happened to the license application (as revealed at the meeting with NGTM in April 2009).

8.6.2. Schedule for Environmental Impact Assessment

(1) Background

The present Study was tasked to collect and review the relevant information, starting from the findings of the 2003 F/S study, which will be needed for the application to a yen loan. One basic issue is whether the environmental license (LI) for project implementation is already granted or likely to be granted.

In general, it is mandatory to apply LP (Preliminary License), LI (Installation License) and LO (Operation License) for infrastructure development projects in order to obtain the official permit of its implementation in Brazil.

The consultation with NGTM made it clear that the license was not issued yet. In order to facilitate the project implementation, NGTM had the meeting with the SEMA officials in charge of EIA on May 8, 2009, about environmental licensing procedures, including the LA application at the time of the 2003 F/S Study.

Throughout this consultation, it was ruled on May 25, 2009 by SEMA that only PCA is required for the official application process of the environmental license for this proposed project since the proposed project is implemented within the current road space and no large-scale acquisition will be required. Note that PCA (Environmental Control Plan) is more simplified and less time saving form, compared with EIA/RIMA. Also, the application of LP can be skipped and starts from LI for its environmental license application.

(2) Environmental License (LI) Application

The license application is for the Y-net trunk bus development on Av. August Montenegro, BR-316 and Av. Almirante Barroso and priority lanes in the city centers of Belem and Icoaraci (see Chapter 1 for more detailed descriptions of “Y-net” definition). The trunk bus projects are proposed on the existing arterial roads with little new road development and do not involve any sizable resettlement of local inhabitants. Accordingly, SEMA notified NGTM to apply to the PCA procedures of environmental licensing in May 25, 2009. As of October 2009, the environmental documentation is expected to proceed according to the schedule shown below. The drafting of the PCA documents must be done by a Brazilian EIA-specialized consulting firm officially registered at the Federal Ministry of Environment.

May 12, 2009:	The project brief submitted to SEMA
May 13, 2009:	Joint Field Survey by SEMA, NGTM and JICA study team
May 14, 2009:	Presentation of the project summary at SEMA
May 25, 2009:	Notification on the necessary environmental impact study and documentation (adoption of the PCA procedures)
August 16, 2009:	Posting of tender
End of August, 2009:	Selection of the consulting firm (NGTM), and the start of the environmental study and documentation
December, 2009:	Completion and submission of the PCA documents and the start of SEMA examination
December, 2009:	The license (LI) to be issued by SEMA

Table 8.6-1 shows the schedule for license application and approval.

Table 8.6-1 Schedule for License Application and Approval

	2009							
	5	6	7	8	9	10	11	12
1. Prior Consultations with SEMA	—	—						
2. Commissioning of the Consultant				—				
3. Drafting of Necessary Documents					—	—	—	—
4. Application to SEMA								☆
5. Examination by SEMA								—
6. Issuance of the License								☆

CHAPTER 9
Project Effects

9. PROJECT EFFECTS

9.1. FORECAST OF PROJECT EFFECTS

The study analyzes the following two cases for trunk bus passenger demand.

1) Analysis of effects of Introducing the study project: Phase I+II

2) Analysis of effects of Introducing the projects related to ODA loan, i.e., “Y” shape projects (Phase I)

9.1.1. EFFECTS OF INTRODUCING THE NEW TRUNK BUS SYSTEM

(1) Benefits to Travel Time and Distance in the Metropolitan Area of Belem

1) Development Effects of Phase I+II Project Plan

The effects of introducing the proposed trunk bus system upon the transportation in the Study area are analyzed regarding two indicators shown below. These indicators are used to evaluate the economic importance of the project.

1) Reduction of total travel time

2) Reduction of total travel distance

Table 9.1-1 shows the forecasts of total passenger hours for the years 2013, 2018 and 2025. “With” and “without” comparisons of the proposed trunk bus system are made regarding these years. Total daily travel time in 2013 will be reduced by a little over 142,000 passenger hours with the project compared to the situation without the project. The expected reduction is about 10%. For the years 2018 and 2025, the rate of reduction will be about 15 %.

The new trunk bus service is operated on the exclusive lane and will be unaffected by the traffic congestion on mixed traffic lanes. Available general lanes on Av. Almirante Barroso will be reduced by the construction of the exclusive lane, but the congestion of vehicle traffic on these lanes will worsen very little, because the trunk bus service will result in the reduced operation of conventional buses on the mixed lanes. For these reasons, the introduction of the trunk bus system will lead to a significant reduction of total travel time in the metropolitan area.

Table 9.1-1 “With” and “Without” Differences of Daily Travel Time (Phase I+II Project Plan)

Year	Vehicle Type	Without (A)	With (B)	Difference (B-A)	Rate (B/A)
2013 (Y Net)	Passenger Car	221,670	224,511	2,841	1.01
	Conventional Bus	1,206,445	924,087	-282,358	0.77
	Trunk Bus	-	137,241	137,241	-
	Total	1,428,115	1,285,839	-142,276	0.90
2018 (Full Net)	Passenger Car	287,783	287,333	-451	1.00
	Conventional Bus	1,369,508	856,497	-513,011	0.63
	Trunk Bus	-	272,186	272,186	-
	Total	1,657,291	1,416,015	-241,276	0.85
2025 (Full Net)	Passenger Car	421,890	424,456	2,566	1.01
	Conventional Bus	1,639,555	1,021,073	-618,482	0.62
	Trunk Bus	-	309,814	309,814	-
	Total	2,061,445	1,755,343	-306,102	0.85

Table 9.1-2 shows the forecasts of total daily travel distance for the years 2013, 2018 and 2025, comparing the “with” and “without” cases. In 2013, “with” total travel distance will be smaller by a little over 953,000 passenger kilometers, a reduction of 3%, compared to the “without” forecast.

The reduction expected in 2018 and 2025 are also around 3%. The reduction mostly pertains to conventional buses, with practically no difference for other vehicles.

Table 9.1-2 “With” and “Without” Differences of Daily Travel Distance (Phase I+II Project Plan)

Year	Vehicle Type	Without (A)	With (B)	Difference (B-A)	Rate (B/A)
2013 (Y Net)	Passenger Car	13,091	13,174	83	1.01
	Conventional Bus	21,093	16080	-5,013	0.76
	Trunk Bus	-	3,976	3,976	-
	Total	34,184	33,231	-953	0.97
2018 (Full Net)	Passenger Car	16,590	16,523	-67	1.00
	Conventional Bus	23,105	14,607	-8,498	0.63
	Trunk Bus	-	7,276	7276	-
	Total	39,695	38,406	-1,289	0.97
2025 (Full Net)	Passenger Car	22,792	22,807	15	1.00
	Conventional Bus	26,011	16,332	-9,679	0.63
	Trunk Bus	-	8,287	8,287	-
	Total	48.803	47,426	-1,377	0.97

2) Development Effects of Phase I Project Plan

Phase I project plan introduces the exclusive trunk busway only on three routes, namely, Av. Almirante Barroso, BR-316 and Av. Augusto Montenegro. The effects of this project implementation are analyzed regarding the same two indicators. The effects on total travel time and distance for the years 2018 and 2025 are shown in Table 9.1-3 and Table 9.1-4. Compared to Phase I+II project plan that includes the exclusive lane development on Av. Independencia, the reduction of total passenger hours is smaller by 5% in both 2018 and 2025. The expected reduction of total daily travel distance for 2018 and 2025 is respectively 258,000 and 286,000 passenger kilometers less than Phase I+II plan.

Table 9.1-3 “With” and “Without” Differences of Daily Travel Time (Phase I)

Year	Vehicle Type	Without (A)	With (B)	Difference (B-A)	Rate (B/A)
2013 (Y Net)	Passenger Car	221,670	224,511	2,841	1.01
	Conventional Bus	1,206,445	924,087	-282,358	0.77
	Trunk Bus	-	137,241	137,241	-
	Total	1,428,115	1,285,839	-142,276	0.90
2018 (Full Net)	Passenger Car	287,783	291,760	3,977	1.01
	Conventional Bus	1,369,508	1,040,596	-328,911	0.76
	Trunk Bus	-	152,534	152,534	-
	Total	1,657,291	1,484,890	-172,401	0.90
2025 (Full Net)	Passenger Car	421,890	428,346	6,456	1.02
	Conventional Bus	1,639,555	1,236,711	-402,845	0.75
	Trunk Bus	-	174,809	174,809	-
	Total	2,061,445	1,839,865	-221,580	0.89

Table 9.1-4 “With” and “Without” Differences of Daily Travel Distance (Phase I)

Year	Vehicle Type	Without (A)	With (B)	Difference (B-A)	Rate (B/A)
2013 (Y Net)	Passenger Car	13,091	13,174	83	1.01
	Conventional Bus	21,093	16,080	-5,013	0.76
	Trunk Bus	-	3,976	3,976	-
	Total	34,184	33,231	-953	0.97
2018 (Full Net)	Passenger Car	16,590	16,705	115	1.01
	Conventional Bus	23,105	17,540	-5,565	0.76
	Trunk Bus	-	4,420	4,420	-
	Total	39,695	38,665	-1,030	0.97
2025 (Full Net)	Passenger Car	22,792	23,000	208	1.01
	Conventional Bus	26,011	19,647	-6,364	0.76

	Trunk Bus	-	5,065	5,065	-
	Total	48,803	47,712	-1,091	0.98

(2) Reduction of Peak Hour Traffic Congestion in the Study Area

1) Effect of Phase I+II Project Plan

The reduction of total passenger hours would lead to the easing of traffic congestion. The effect of Phase I+II project plan on congestion is analyzed and the results of "with" and "without" comparisons are shown in Table 9.1-5 through Table 9.1-7. The peak hour congestion level is shown in three ranks (less than 1.0, from 1.0 to less than 1.5 and 1.5 and above).

For 2013, two congestion ranks of 1.0 to less than 1.5 and 1.5 and above are reduced by 2.2km and 0.9km respectively. The same reduction is 3.1km and 5.2km in 2018 and 2.7km and 6.8km in 2025. The expected impact of the trunk bus system is substantial on traffic congestion.

Table 9.1-5 Total Extension of Congestion by Rank (Phase I+II in 2013)

Congestion Rank	"Without" (A)		"With" (B)		Difference (B-A)	
	Extension (km)	% Share	Extension (km)	% Share	Extension (km)	% Difference (B/A)
Less than 1.0	646.0	85.6%	649.2	86.0%	3.2	0.4%
1.0 to less than 1.5	76.9	10.2%	74.7	9.9%	-2.2	-0.3%
1.5 and above	31.6	4.2%	30.7	4.1%	-0.9	-0.1%
Total	754.6	100.0%	754.6	100.0%	0.0	0.0%

Table 9.1-6 Total Extension of Congestion by Rank (Phase I+II in 2018)

Congestion Rank	"Without" (A)		"With" (B)		Difference (B-A)	
	Extension (km)	% Share	Extension (km)	% Share	Extension (km)	% Difference (B/A)
Less than 1.0	696.7	84.2%	705.1	85.2%	8.3	1.1%
1.0 to less than 1.5	78.1	9.4%	74.9	9.1%	-3.1	-0.4%
1.5 and above	52.8	6.4%	47.6	5.8%	-5.2	-0.7%
Total	827.6	100.0%	827.6	100.0%	0.0	0.0%

Table 9.1-7 Total Extension of Congestion by Rank (Phase I+II in 2025)

Congestion Rank	"Without" (A)		"With" (B)		Difference (B-A)	
	Extension (km)	% Share	Extension (km)	% Share	Extension (km)	% Difference (B/A)
Less than 1.0	645.4	78.0%	654.9	79.1%	9.5	1.3%
1.0 to less than 1.5	96.5	11.7%	93.8	11.3%	-2.7	-0.4%
1.5 and above	85.7	10.4%	78.9	9.5%	-6.8	-0.9%
Total	827.6	100.0%	827.6	100.0%	0.0	0.0%

2) Effect of Phase I Project Plan

Table 9.1-8 and Table 9.1-9 show the effect on congestion by Phase I project plan that does not implement the trunk busway development after 2018 on Av. Independencia. The expected congestion extension is shown in "with" and "without" comparison for the years 2018 and 2025.

Compared to the "with" situation in 2013 (Table 9.1-5), both Phase I+II and Phase I plans show an increase of the uncongested extension below 1.0 and a distinctly smaller increase of the congestion ranks of 1.0 and above in 2018, indicating the easing congestion by the completion of Av. Independencia. But the increase of the uncongested extension is smaller and that of the ranks 1.0 and above is significantly larger in Phase I development. The extension free of congestion is appreciably smaller in Phase I (698.7km) than in Phase I+II development (705.1km) in 2018.

From 2018 to 2025, both of the project plans show a decrease of the uncongested extension and the concomitant increase of the congestion ranks of 1.0 and above, an indication of worsening congestion. But the congestion extension of 1.0 and above in 2025 is larger in Phase I plan, namely, 177.6 km compared to 172.7km in Phase I+II development. This difference mostly comes from the congestion rank of 1.5 and above, with 85.2km for Phase I and 78.9km for Phase I+II net. The trunk busway development on newly completed Av. Independencia is more effective in controlling the worsening of congestion in 2025.

Table 9.1-8 Total Extension of Congestion by Rank (Phase I in 2018)

Congestion Rank	"Without" (A)		"With" (B)		Difference (B-A)	
	Extension (km)	% Share	Extension (km)	% Share	Extension (km)	% Difference (B/A)
Less than 1.0	696.7	84.2%	698.7	84.4%	1.9	0.3%
1.0 to less than 1.5	78.1	9.4%	76.6	9.3%	-1.5	-0.2%
1.5 and above	52.8	6.4%	52.4	6.3%	-0.4	-0.1%
Total	827.6	100.0%	827.6	100.0%	0.0	0.0%

Table 9.1-9 Total Extension of Congestion by Rank (Phase I in 2025)

Congestion Rank	"Without" (A)		"With" (B)		Difference (B-A)	
	Extension (km)	% Share	Extension (km)	% Share	Extension (km)	% Difference (B/A)
Less than 1.0	645.4	78.0%	650.1	78.5%	4.7	0.6%
1.0 to less than 1.5	96.5	11.7%	92.4	112%	-4.2	-0.5%
1.5 and above	85.7	10.4%	85.2	10.3%	-0.5	-0.1%
Total	827.6	100.0%	827.6	100.0%	0.0	0.0%

9.1.2. TRAFFIC CONGESTION UNDER CONSTRUCTION OF THE PROJECT

(1) Four Road Sections Chosen for Analysis

Presuming that the trunk bus system starts its operation in mid 2013, the estimation of traffic congestion under the construction is done by focusing on the traffic demand forecast for 2013, the completion year of construction works. Four sections where the project implementation will most seriously affect the traffic condition are chosen for demand forecast and congestion analysis. It is assumed that the one-way construction be carried out at any time.

The basic assumptions for demand forecast are as follows.

1) Morning peak hour demand in 2013
2) Operation of only conventional bus services
3) Four sections most likely to create serious bottlenecks:
   (1) Av. Almirante Barroso: two lanes out of the present four lanes in direction are available for traffic during construction
   (2) Av. Augusto Montenegro and BR-316: two lanes out of the present three lanes in direction are available for traffic, with the median used for construction
   (3) Centro area: two lanes out of the present three lanes in one way traffic are available for traffic during construction

Figure 9.1-1 shows the location of the four road sections selected for demand and congestion forecast. It is assumed that the construction at each section is carried out alone, i.e., that two or more sections are never brought under construction at the same time.

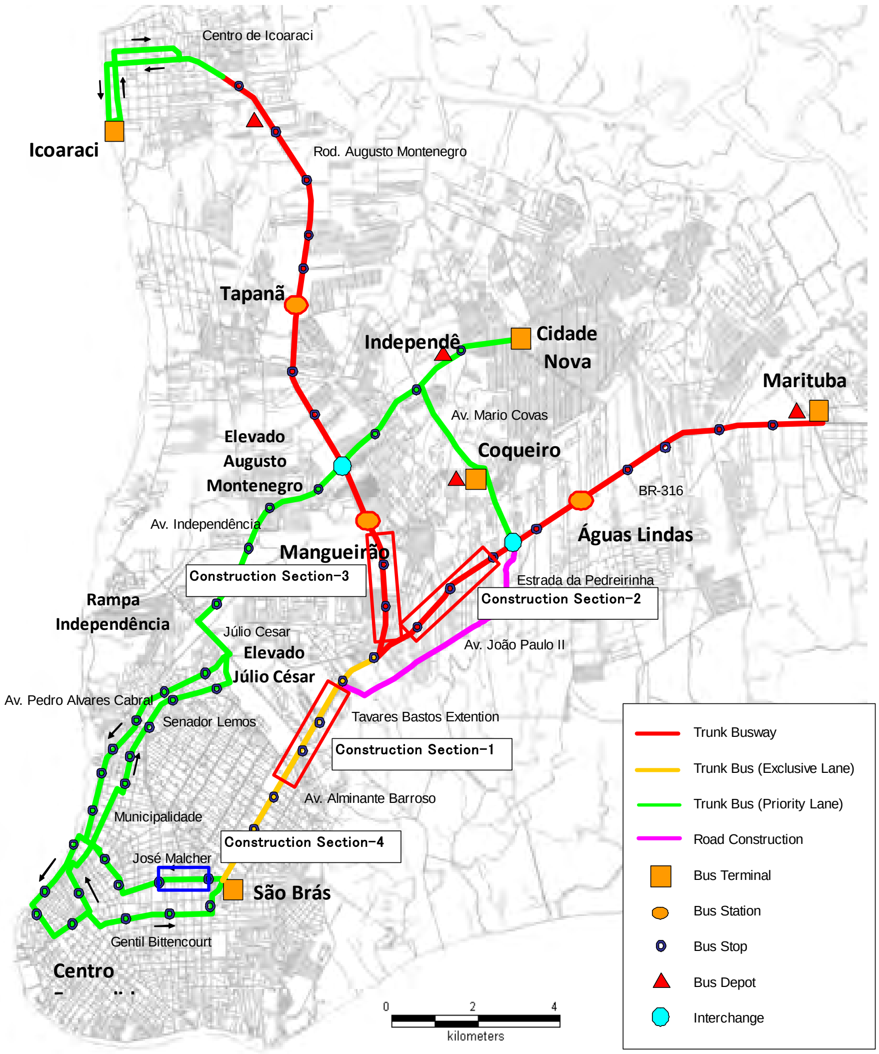


Figure 9.1-1 Four Road Sections Selected for Demand and Congestion Forecast

(2) Congestion Forecast at Four Road Sections

Table 9.1-10 through Table 9.1-13 indicate the traffic at four road sections in four congestion levels during construction, as compared to the base case situation without construction. Figure 9.1-2 through Figure 9.1-5 show the balance between the base case and the under-construction case. The decrease of traffic is shown in blue and the increase in red, while the width of the band reflects the traffic volume as forecast in PCUs per hour.

Table 9.1-10 shows the traffic assigned to Av. Almirante Barroso and its nearby roads during the trunk busway construction on the avenue. Compared to the base case, the congestion ranks of 1.5 and above (Ranks 3 and 4) are longer in extension and expand to the roads in the vicinity (Figure 9.1-2). As shown in Table 9.1-11 through Table 9.1-13 and Figure 9.1-3 through Figure 9.1-5, the situation is similar in the other road sections of BR-316, Av. Augusto Montenegro and the Centro area.

It must be noted that the construction on BR-316 will affect its interconnected roads more widely than the other sections. The construction in the Centro area will lead to the congestion on the other roads within its boundary, but do not affect the roads outside.

Table 9.1-10 Congestion during Construction on Av. Almirante Barroso

Congestion Rank		Extension (km) Base Case A	With Construction B	Difference (B-A)	Ratio (B/A)
1	Less than 1.0	526.95	528.77	1.82	1.00
2	1.0 to less than 1.5	66.97	60.48	-6.49	0.90
3	1.5 to less than 2.0	52.39	53.01	0.62	1.01
4	2.0 and above	108.25	112.30	4.05	1.04
Total		754.56	754.56	0.00	1.00

Table 9.1-11 Congestion during Construction on BR-316

Congestion Rank		Extension (km) Base Case A	With Construction B	Difference (B-A)	Ratio (B/A)
1	Less than 1.0	528.77	525.66	-3.11	0.99
2	1.0 to less than 1.5	60.48	6581	5.33	1.09
3	1.5 to less than 2.0	53.01	56.55	3.54	1.07
4	2.0 and above	112.30	106.54	-5.76	0.95
Total		754.56	754.56	0.00	1.00

Table 9.1-12 Congestion during Construction on Av. Augusto Montenegro

Congestion Rank		Extension (km) Base Case A	With Construction B	Difference (B-A)	Ratio (B/A)
1	Less than 1.0	525.66	529.17	3.51	1.01
2	1.0 to less than 1.5	65.81	61.54	-4.27	0.94
3	1.5 to less than 2.0	56.55	56.32	-0.23	1.00
4	2.0 and above	106.54	107.53	0.99	1.01
Total		764.56	754.56	0.00	1.00

Table 9.1-13 Congestion during Construction in the Centro

Congestion Rank		Extension (km) Base Case A	With Construction B	Difference (B-A)	Ratio (B/A)
1	Less than 1.0	529.17	526.89	-2.28	1.00
2	1.0 to less than 1.5	61.54	64.93	3.39	1.06
3	1.5 to less than 2.0	56.32	49.29	-7.03	0.88
4	2.0 and above	107.53	113.45	5.92	1.06
Total		754.56	754.56	0.00	1.00

Figure 9.1-2 Change in the Traffic Flow With and Without Construction: Av. Almirante Barroso

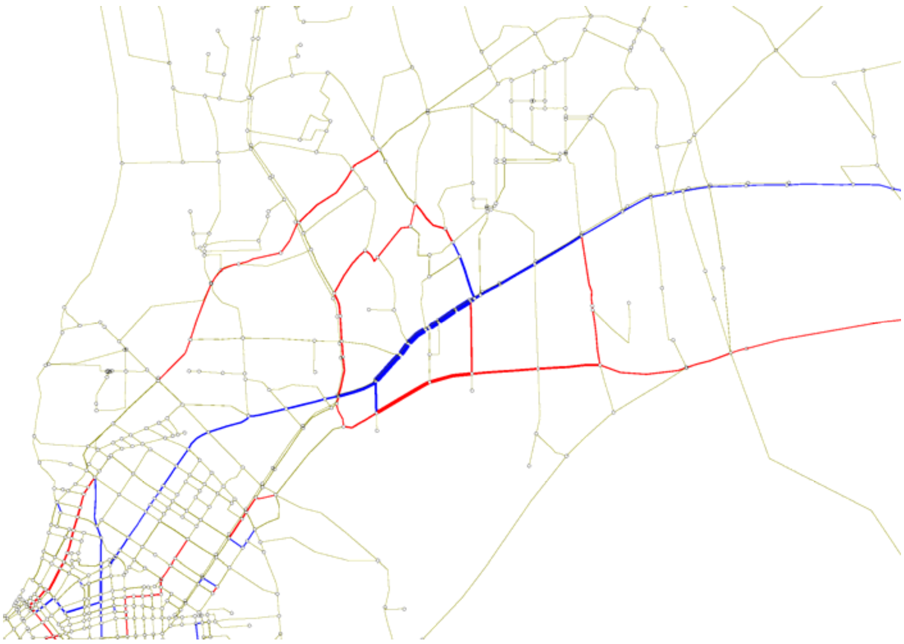


Figure 9.1-3 Change in the Traffic Flow With and Without Construction: Rod. BR-316

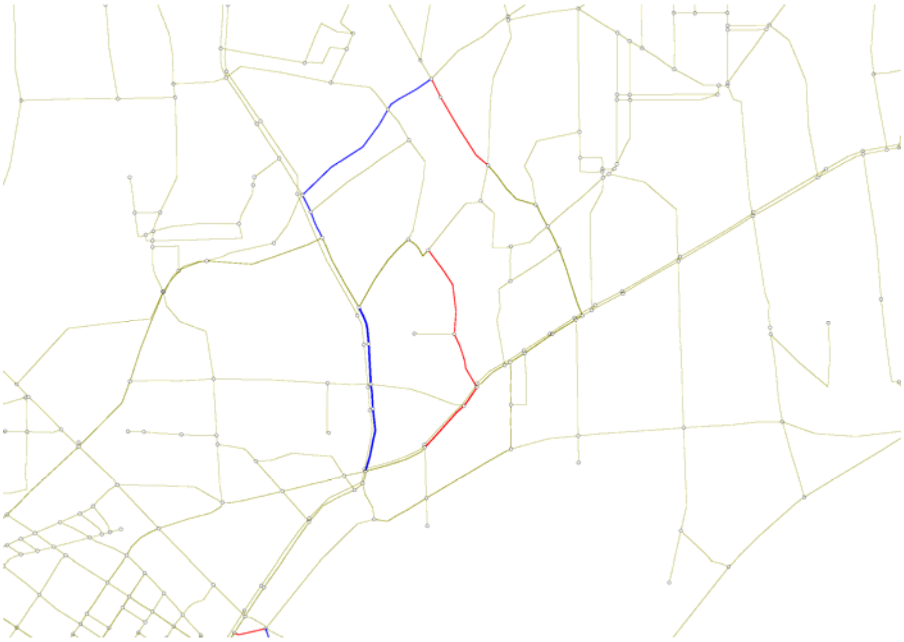


Figure 9.1-4 Change in the Traffic Flow With and Without Construction: Av. Augusto Montenegro

Figure 9.1-5 Change in the Traffic Flow With and Without Construction: the Centro

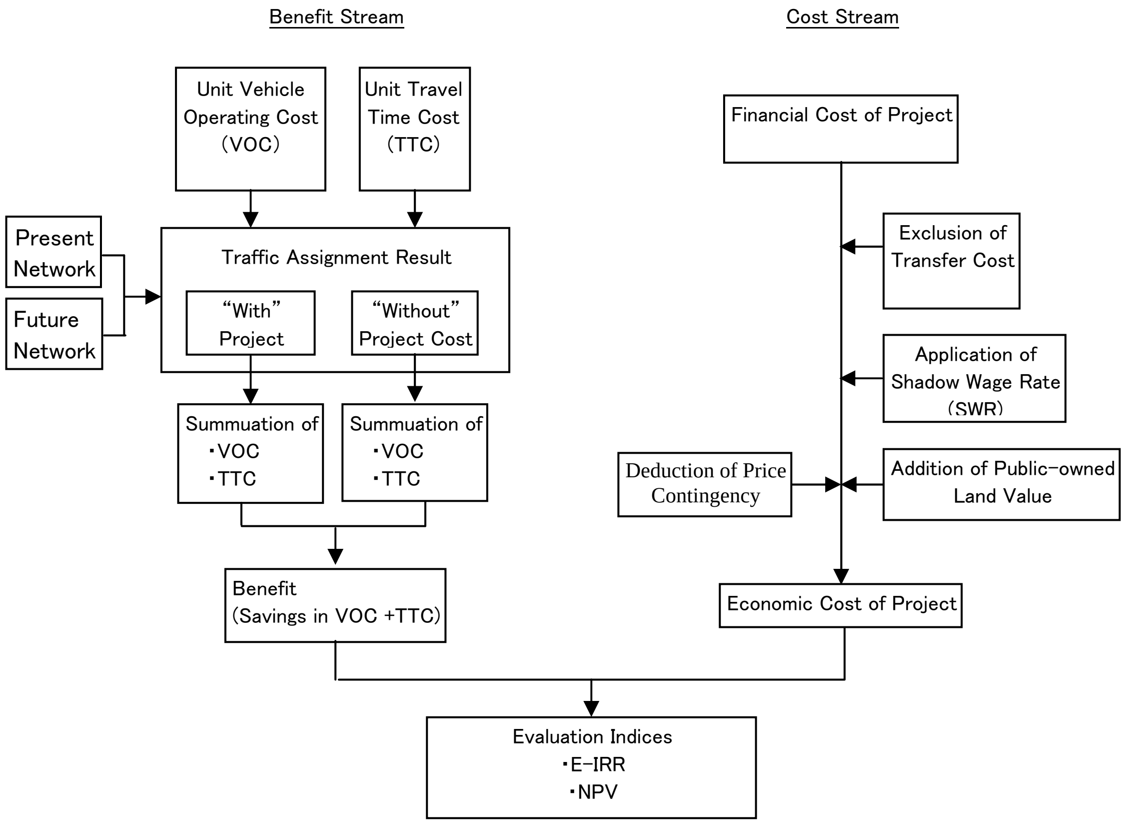
9.2. ECONOMIC AND FINANCIAL EVALUATION

9.2.1. ECONOMIC EVALUATION

(1) Approach

The cost and benefit analysis is applied to the proposed trunk bus project, following the steps indicated in the flow chart of Figure 9.2-1. The purpose of the analysis is to see if the project assures a sufficient benefit worth its cost from the viewpoint of the metropolitan economy of Belem. Therefore, the financially-priced cost of investment and operation (i.e., those goods and services that are used and consumed as inputs for investment and operation) must be adjusted to obtain the economic value of the project to the society at large. This process of adjustment, or the conversion of financial price to economic value, is shown by the cost stream in the flow chart. The components of the adjustment are as follows.

1) Adjustment for direct transfer payments (elimination of taxes and subsidies)
2) Application of shadow wage
3) Elimination of price escalation (elimination of inflation from financial pricing)
4) Evaluation of public land at market price



Source: JICA Team estimates

Figure 9.2-1 Flow Chart of Economic Evaluation

The reductions of the vehicle operating cost (VOC) and the travel time cost (TTC) are the most direct benefit measurable in money term with comparative ease. The analysis of project benefits focuses on these two types of reduction.

It might be noted that the proposed project would improve the level of traffic safety and promote the urban development at large. However, the available data is hardly adequate to analyze and prove the interrelationship between the project implementation and the decrease of traffic accidents. It is difficult to pinpoint the project contribution to the growth of the urban economy and society, the range of possibility in this direction being uncertain to define, to say the least. The economic analysis itself will lose its credibility if it has to devise some arbitrary measures and assumptions for evaluating these benefits.

The removal of traffic congestion by the proposed project is expected to reduce the polluting emissions from motorized vehicles. This aspect is examined in detail in Chapter 10 and discussed later in this chapter regarding the benefit evaluation.

VOC and TTC reductions are obtainable by comparing the “with” and “without” situations. The future OD trips are assigned to the present (“without”) and the future (“with”) transport network to obtain the total vehicle operating cost and the total travel time cost in the two alternative networks. The respective balances in terms of VOC and TTC between the “with” and “without” situations are the project benefits. Because the project aims to improve bus transport service, the future traffic demand is distributed by applying the transit assignment for public transport and the highway assignment for private vehicles.

The last stage of economic analysis is the calculation of project worth. As shown in the flow chart, the economic internal rate of return (E-IRR) and the net present value (NPV) are calculated to evaluate the proposed trunk bus project. The E-IRR is the rate of project efficiency in recovering the investment and operating costs by the incremental benefits and the NPV shows the present project worth in absolute value of the incremental net benefits. The NPV calculation uses the discount rate of 12% commonly used in Brazil.

- Internal Rate of Return:
  The rate (*r*) satisfies the equation: $$\sum \frac{B_n}{(1+r)^n} = \sum \frac{C_n}{(1+r)^n}$$
- Net Present Value (NPV) = $$\sum \frac{B_n - C_n}{(1+DR)^n}$$

The project life is 25 years. The duration is somewhat shorter than normal transport development projects, because bus systems require a much smaller component of infrastructure development than railway systems, with their system management is of greater relative importance compared to railways. In addition, the proposed bus system has its limit in transport capacity. It is judged necessary in the foreseeable future to introduce some mass transit railway system to meet the increasing traffic demand.

(2) Project Cost

1) Initial Investment

Chapter 6 identifies cost items for the project and values them in market prices to obtain the financial cost of the project. In this chapter, the financial project cost is converted to the economic cost by the following steps.

1) The estimated financial cost includes the national value added tax (VAT) of 17%. This national tax must be eliminated, because it is a transfer payment and not part of the project input of goods and services.

2) In the similar manner, the state transfer tax (ICMS) of 7% and the municipal service tax (SSS) of 5%, though not explicitly stated in the reference book of tax in the Para state, must be eliminated from the financial cost.

3) The financial cost assumes an annual inflation of 2.6% on the foreign exchange component and another as high as 13.3% on the domestic currency component. The cost due to price

escalation must be excluded because the economic cost is expressed in constant price (of 2009).

4) The financial costing of the project in Chapter 6 presumes the lending from Japan. It assumes a commission charge of 1.2% per annum for the Japanese loan and another of 0.1% for the unexpended part of the loan. These financial charges should not be included in the economic analysis to calculate the internal rate of return.

5) According to the home page of PNAD/IBG, the unemployment in the metropolitan area of Belem ranges from 10 to 12%. According to the formula proposed by J. Haveman, the economic value of the wage paid to unskilled labor under such a high employment rate is never as high as the wage determined in the market. The shadow wage of unskilled labor is usually from 65% to 75% of the legally stipulated minimum wage.

Shadow Wage = Market Wage × (1.25 – Unemployment Rate / 0.2)
= Market Wage × (0.65 ~ 0.75)

The financial cost of the project is subdivided into three parts of construction materials, machinery and labor. According to the informed judgment of the costing experts, the materials and the machinery should make up 60% and 30% of the total project cost. The share of labor is 10%. Supposing that 60% of the labor cost would be paid to unskilled workers, 6% (=10% x 60%) of the total financial cost of the project has the economic value of 65% ~ 75%. The shadow wage rate for unskilled labor is thus calculated as:

6% × (100 – 65% ~ 75%) = 1.5% ~ 2.1%

In other words, the application of the shadow wage rate (SWR) reduces the total financial project cost by about 2%.

6) The proposed project do not use public land provided free of compensation. Accordingly, it is not necessary to evaluate the cost of public land at market price and add it to the economic cost of the project.

Table 9.2-1 sums up Steps 1) through 5) mentioned above of converting the financial to the economic cost of the project. Normally speaking, the ratio of the economic to the financial costing (usually called Standard Conversion Factor, or SCF) ranges from 0.75 ~ 0.85. The proposed projects shows the low SCF of less than 70%, because of the high tax rate of nearly 30% and the cost of probable high inflation.

Table 9.2-1 Economic Cost of Annual Investment

(R$ million)

Year	Investment of Phases I & II		Investment of Phase I Only	
	Financial Price	Economic Price	Financial Price	Economic Price
2010	8.2	6.7	8.0	6.7
2011	29.6	23.8	29.6	23.8
2012	549.2	378.7	530.9	365.4
2013	500.2	314.9	417.1	264.3
2014	163.2	88.4	0.0	0.0
2015	45.7	24.2	0.0	0.0
Total	**1,296.2**	**836.6**	**985.7**	**660.2**
SCF	-	0.65	-	0.67

Source: JICA Team Estimates

2) Operation and Maintenance Cost

Once the service begins, the trunk bus system requires the annual expenditure on the following cost items (cf. Section 3 of Chapter 8 for details). In the economic project analysis, all of these expenses on goods and services needed for operation and maintenance must be taken into account, regardless of which entity pays them.

a) Purchase of the trunk bus fleet

b) Purchase of the feeder bus fleet

c) Trunk bus operating cost

d) Feeder bus operating cost

e) Management cost of trunk and feeder bus fleets (overhead cost)

f) Maintenance and management cost of the physical facilities for trunk and feeder bus services

g) Operation and maintenance cost of the public consortium that oversees the trunk bus system

As mentioned earlier, the project cost comprises the initial investment and the operation and maintenance cost ranging from the items a) through g). The project benefit is obtained by subtracting the total VOC and TTC with the project implementation from those without the project. However, the "with" value of VOC and TTC includes the total operational cost of the trunk bus system. In addition to fuels and repairs that make up the operation cost, some part of the fleet purchasing cost, i.e., the depreciation and the opportunity cost (interest) of the articulated vehicle fleet, is included in vehicle operating kilometers and vehicle travel hours, as will be mentioned later on. Therefore, to express the benefit of the proposed project as a reduction in the total VOC and TTC, the cost items a) and c) are already taken into account and only the remaining items b) and d) through g) need estimation.

a) <u>Purchase and Operation of Trunk and Feeder Bus Fleets</u>

The trunk bus system uses a fleet of articulated buses with 160-passenger capacity. The economic price is R$595,000 per vehicle. The feeder service uses large conventional buses at the economic purchase price of R$187,000 per vehicle. The economic cost of trunk and feeder bus fleets is obtained by multiplying the required sizes of the respective fleets mentioned in Chapter 5 by these prices, as shown in Table 9.2-2.

Table 9.2-2 Fleet Sizes and Economic Costs of Trunk and Feeder Bus Services

Requirement	Bus Service	Full Net (Phases I & II)			Y Net (Phase I Only)		
		2013	2018	2025	2013	2018	2025
Fleet Size (no. of vehicles)	Trunk	206	336	387	206	230	260
	Feeder	103	127	143	103	114	129
Purchase Cost (R$ million)	Trunk	104.8	170.9	196.8	104.8	116.9	132.5
	Feeder	16.5	20.3	22.9	16.5	18.1	20.7

Source: JICA Team estimates

The operational cost of the trunk bus service will be discussed in the next section. Assuming that the average daily operating distance of 200km and the average operating speed of 20km per hour for the feeder bus service, the economic price of the vehicle operating cost is R$1.16 per operating kilometer. The cost of annual feeder bus operation pertaining to the total operating distance (excluding the costs of depreciation, interest and management) is shown in Table 9.2-3.

Table 9.2-3 Annual Cost of Feeder Bus Operation (per Total Operating Distance)

(R$ million/year)

Year	Phases I & II	Phase I Only
2013	7.5	7.5
2018	9.2	8.3
2025	10.2	9.2

Source: JICA Team estimates

b) Operation and Management of the Trunk Bus Company

In addition to the direct operation cost, the trunk bus service requires the cost of operating bus terminals and workshops and the management (overhead) at the head office. The details are shown in Table 7.3-2 of Chapter 7. The annual expenditure amounts to R$8 million during the period from 2013 to March 2015 and doubles to R$16 million after March 2015. The expenditure in economic price is worth 85% of these estimates.

c) Management of Public Consortium

As mentioned in Chapter 7, the proposed trunk bus system services a number of municipalities, and its administration across municipal jurisdictions could be complicated. It is proposed therefore that the municipalities concerned organize Public Consortium under the aegis of the Para State Government. Because this administrative body is established for the purpose of operating the trunk bus system, its expenses must be considered as part of the economic cost of the project.

It is being planned that the said body would manage its affairs by taking a certain portion of the revenue of the trunk bus operation. The details are yet undecided, but following the examples in other cities (Recife and Manaus), 2.5% of the fare revenue is earmarked for the management of the public consortium. The proposed body is a non-profit government organization and thus pays no corporate tax. The management expenditure of the public consortium is shown in Table 9.2-4, as calculated from the estimated fare revenue discussed in the next section.

Table 9.2-4 Management Expenditure of the Public consortium

(R$ million/year)

	Phases I & II	Phase I Only
2013	1.3	1.3
2018	5.0	3.0
2025	5.8	3.4

Source: JICA Team estimates

d) Maintenance and Management of Physical Facilities

The cost of maintaining and managing various facilities for the trunk bus system is estimated in Table 7.3-5 of Chapter 7. The annual expenditure amounts to R$15.6 million during the period from 2013 to March 2015 and rises to R$20.7 million after March 2015. The expenditure in economic price is worth 85% of these estimates.

(3) Economic Benefit

1) Unit Values of Vehicle Operating Cost

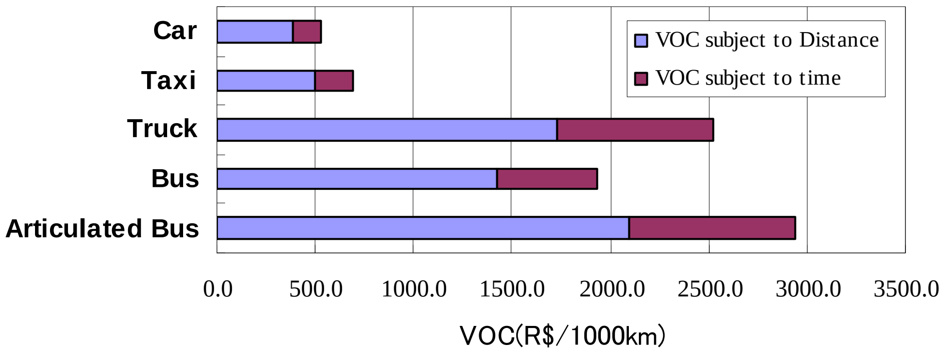
The feasibility study conducted in 2003 estimated the vehicle operating cost by vehicle type and operating speed. The study used the statistics made public by the Transport Company of Belem Municipality (CTBel). The unit values are updated for the year 2013 by using the latest available information on the prices of vehicles and fuels, tax rates and so on. The updated results are shown in detail in the appendix. The new unit values are shown in Table 9.2-5 and Figure 9.2-2.

Table 9.2-5 Unit Values of Vehicle Operating Cost

(R$/1000km)

Type of Costing	Operating Speed (km/hour)	Passenger Car	Taxi	Truck	Conventional Bus (70-passenger capacity)	Articulated Bus (200-passenger capacity)
Financial Cost (R$/1000km)	5	1,696.9	2,250.5	8,689.9	5,887.5	8,903.6
	10	1,010.0	1,324.2	5,160.0	3,547.5	5,401.4
	20	653.1	848.4	3,332.4	2,321.9	3,542.2
	30	532.0	687.7	2,519.5	1,937.6	2,944.1
	40	469.2	606.2	2,109.1	1,715.8	2,603.2
	50	438.0	568.9	1,894.6	1,668.4	2,500.6
	60	429.5	562.4	1,774.5	1,722.5	2,531.8
	70	433.4	572.1	1,745.9	1,839.4	2,653.3
	80	452.8	600.7	1,826.1	2,017.9	2,891.0
	90	484.4	646.4	1,966.2	2,192.1	3,144.6
Economic Cost (R$/1000km)	5	1,228.0	1,664.9	6,986.6	4,879.5	7,537.0
	10	732.3	978.5	4,157.0	2,949.4	4,572.1
	20	474.6	626.0	2,688.6	1,933.2	2,990.4
	30	387.0	506.8	2,030.2	1,611.4	2,474.9
	40	341.6	446.2	1,694.7	1,422.5	2,175.2
	50	319.1	418.3	1,516.5	1,376.3	2,072.9
	60	313.3	413.4	1,417.1	1,416.8	2,088.0
	70	316.5	420.5	1,392.6	1,510.1	2,180.6
	80	330.7	441.0	1,454.0	1,653.8	2,367.8
	90	353.7	474.1	1,561.6	1,792.8	2,565.5

Source: JICA Team estimates



Source: JICA Team estimates

Figure 9.2-2 Operating Cost by Vehicle Type (at 30km per hour)

2) *Unit Values of Travel Time Cost*

According to the household survey of 2000, the average monthly household income was R$822 in Belem municipality. Compared to the household income of R$1,960 among car owners, the non-motorized household income averaged only R$460. Assuming the monthly work hours of 150, the time value per work hour is R$13 among car owners and R$3 among non-motorized households.

Of the total daily person trips in the metropolitan area, business trips account for about 6%, "to work" trips 35% and "to home" trips 30%. By assigning 100% of the time value mentioned above to trips during work hours and 50% to the time spent for "to work" trips, it is reasonable to assume that the average time value during travel comes to 38% for the total person trips.

The time value is estimated for 2009 from the assumptions above, as shown in Table 9.2-6. The estimates for the future years are obtained by assuming the increase rate of 4.3% per annum which is equivalent to the growth of per capita GDP in the economic framework of the present study. The reduction of travel time is obtained for each mode from the traffic assignment, and the economic benefit is calculated by multiplying the total reduction by the time value. As indicated in the table below, the time value of motorized households is applied to those who travel by car and that of non-motorized households to bus riders.

Table 9.2-6 Time Value during Travel among Belem Citizens

(R$/hour)

annual Year	Motorized Households	Non-motorized Households
2009	6.50	1.56
2013	7.69	1.85
2018	9.49	2.28
2025	12.75	3.06

Source: JICA Team estimates

3) Economic Benefit

The traffic flow is assigned in the following manner. The first step is done by the transit assignment which distributes bus trips (public transport) to the trunk and conventional bus links in the road network. After preloading the public transport demand, passenger car trips are assigned to the network.

The vehicle operating cost and the travel time cost both vary according to the operating speed. The calculation of VOC and TTC is done for each link in the network (a link is a section between one intersection and the next of a bus line) and then added up. There are two types of link speed. One type is the speed level (called final speed) that corresponds to the total link traffic volume on the QV curve. The other is the average speed that corresponds to the center of the area formed by the QV curve, X and Y axes, and the line of the total link traffic volume on the X axis. The former link speed is always lower than the latter.

It is assumed that the final and the average speed respectively correspond to peak hours and off peak hours of traffic. One day for traffic assignment is set at 18 hours, excluding the period from midnight to 6 o'clock in the morning. Daily peak hours are set at 5 hours, 2 hours in the morning and 3 hours in the evening. The remaining 13 hours are off peak hours. The VOC and TTC are calculated at the final and the average speed per link and then averaged at the ratio of 5 to 13. The reductions of VOC and TTC per link between "with" and "without" situations are added up to obtain the economic benefit. Table 9.2-7 shows the annual economic benefit (the amount saved in terms of VOC and TTC reductions) of the trunk bus project.

The trunk bus system is managed on a public transport priority policy in which buses run on the exclusive busway. Private car users will not welcome the project implementation and in fact, the vehicular traffic other than bus will suffer increased congestion, or the increased VOC. However, the reduction in TTC among public transport users is large enough to ensure the substantial economic benefit after offsetting the VOC increase.

Table 9.2-7 Annual Economic Benefit of the Trunk Bus Project

(R$ million/year: 2009 price)

Year	Phases I & II			Phase I Only		
	VOC Reduction	TTC Reduction	Total	VOC Reduction	TTC Reduction	Total
2013	-8.9	81.6	72.8	-8.9	81.6	72.8
2018	0.5	211.1	211.5	-6.8	123.8	117.0
2025	-10.5	395.1	384.6	-10.3	214.4	204.1

Source: JICA Team estimates

If the system runs a hybrid bus fleet, the project could contribute to a decrease of exhaust emissions. As mentioned in 5.5 of Chapter 10, however, the economic effect (acquisition of CER) of such a fleet would total some US$11 million or R$20 million worth over 10 years. This gain in 10 years is, for example, a little less than 10% of the annual economic benefit in 2018 of the full net development. In other words, the gain per annum would be worth less than 1% of the annual benefit in VOC and TTC reductions, too small to affect the internal rate of return even if its benefit is taken into account in the calculation. The expected reduction in CO2 emissions by the use of hybrid buses is certainly environment-friendly and good public relations. The economic significance of such a decision is small considering the present market price for CER transactions.

(4) Results of Economic Evaluation

1) *Cash Flow of Benefit and Cost*

The cash flow of benefit and cost is shown separately for the full-net development (Phases I and II) and for the Y-net development (Phase I only) in Figure 9.2-3 and Figure 9.2-4 and Table 9.2-8 and Table 9.2-9. In 2038, the 25th year of the trunk bus operation, the cost of land acquisition and the residual value of the bus fleet purchased after 2028 are counted into the benefit stream.

It is evident that the Phase II construction will bring a large benefit with relatively small investment. The full-net development is clearly more economically efficient than the Y-net development of Phase I only.

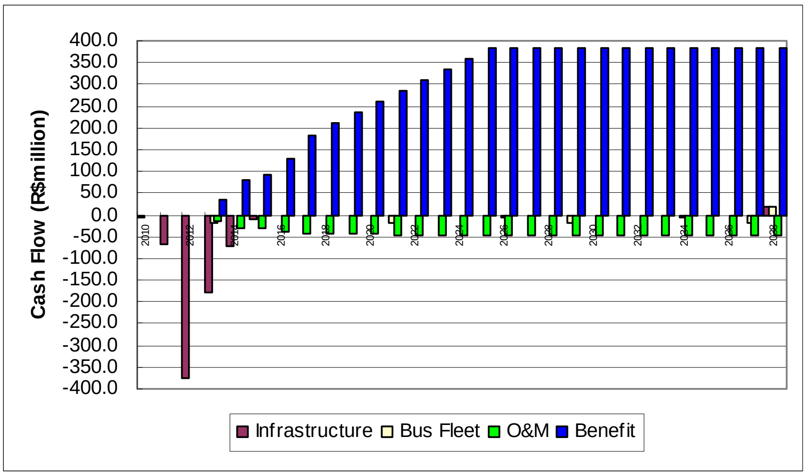


Figure 9.2-3 Cash Flow of Benefit and Cost (Phases I & II)

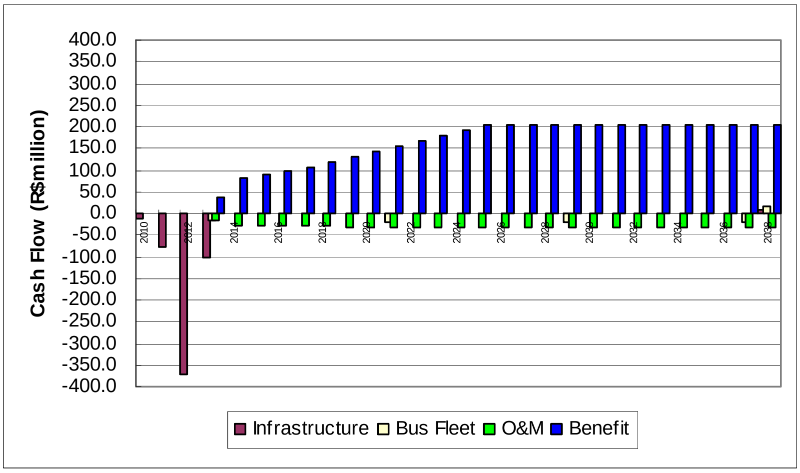


Figure 9.2-4 Cash Flow of Benefit and Cost (Phase I only)

2) *Implementation of Phases I and II*

When both Phases I and II are implemented according to the basic project plan, the economic internal rate of return is 18.9% and the net present value is R$451.4million. Even if the cost should balloon 1.8 times, or if the benefit should drop by 36%, the E-IRR would still be above 12%.

Table 9.2-8 Cash Flow of Benefit and Cost (Phases I & II)

(R$ million: 2009 price)

Year	Construc-tion Cost	Fleet Acquisition for Feeder	Operating Cost of Feeder	Terminal Operation Cost	Facility Maintenance Cost	Administ-ration Fee	Economic Benefit	Net Cash Flow	Discounted by 12%	
									Cost	Benefit
2010	6.7							-6.7	6.0	0.0
2011	23.8							-23.8	19.0	0.0
2012	378.7	0.0						-378.7	269.5	0.0
2013	314.9	19.3	3.7	3.4	6.6	1.3	36.4	-312.8	221.9	23.1
2014	88.4	1.8	8.0	6.8	13.2	2.7	81.6	-39.3	68.6	46.3
2015	24.2	0.9	8.4	12.5	16.8	4.5	146.8	79.5	34.1	74.4
2016		0.9	8.7	13.6	17.6	4.8	156.0	110.4	20.6	70.6
2017		0.9	9.0	13.6	17.6	4.9	183.8	137.7	18.6	74.2
2018		0.4	9.2	13.6	17.6	5.0	211.5	165.7	16.5	76.3
2019		0.4	9.4	13.6	17.6	5.2	236.2	190.2	14.8	76.1
2020		0.4	9.5	13.6	17.6	5.3	261.0	214.6	13.3	75.0
2021		19.7	9.7	13.6	17.6	5.4	285.7	219.8	16.9	73.3
2022		2.2	9.9	13.6	17.6	5.5	310.4	261.7	11.2	71.1
2023		1.3	10.0	13.6	17.6	5.6	335.1	287.1	9.8	68.6
2024		1.3	10.2	13.6	17.6	5.7	359.9	311.6	8.8	65.7
2025		0.9	10.2	13.6	17.6	5.8	384.6	336.6	7.8	62.7
2026		0.4	10.2	13.6	17.6	5.8	384.6	337.1	6.9	56.0
2027		0.4	10.2	13.6	17.6	5.8	384.6	337.1	6.2	50.0
2028		0.4	10.2	13.6	17.6	5.8	384.6	337.1	5.5	44.7
2029		19.7	10.2	13.6	17.6	5.8	384.6	317.8	6.9	39.9
2030		2.2	10.2	13.6	17.6	5.8	384.6	335.3	4.6	35.6
2031		1.3	10.2	13.6	17.6	5.8	384.6	336.2	4.0	31.8
2032		1.3	10.2	13.6	17.6	5.8	384.6	336.2	3.6	28.4
2033		0.9	10.2	13.6	17.6	5.8	384.6	336.6	3.2	25.3
2034		0.4	10.2	13.6	17.6	5.8	384.6	337.1	2.8	22.6
2035		0.4	10.2	13.6	17.6	5.8	384.6	337.1	2.5	20.2
2036		0.4	10.2	13.6	17.6	5.8	384.6	337.1	2.2	18.0
2037		19.7	10.2	13.6	17.6	5.8	384.6	317.8	2.8	16.1
2038	-17.6	-19.0	10.2	13.6	17.6	5.8	384.6	374.1	0.4	14.4
Total	819.0	79.2	248.2	335.0	440.4	136.6	7988.6	5930.1	809.1	1260.4

Source: JICA Team estimates

Table 9.2-9 Sensitivity Analysis of Phases I & II

(E-IRR: %)

Sensitivity Analysis		Change in Investment			
		Base Case	20% Increase	40% Increase	60% Increase
Change in Benefit	Base Case	18.9	16.6	14.8	13.3
	20% Decrease	15.3	13.3	11.7	10.4
	40% Decrease	11.1	9.4	8.1	7.0
	60% Decrease	5.7	4.4	3.4	2.5

Source: JICA Team Estimates

3) Implementation of Phase I Only

If the Phase II construction should be cancelled after the completion of Phase I, the economic internal rate of return would be 13.8%, appreciably higher than 12%. Even with the 18% cost hike, the project would be feasible at the E-IRR of 12.0%. The 12% reduction in benefit, however, would make the project unfeasible.

Table 9.2-10 Cash Flow of Benefit and Cost (Phase I only)

(R$ million: 2009 price)

Year	Construc-tion Cost	Fleet Acquisition for Feeder	Operating Cost of Feeder	Terminal Operation Cost	Facility Maintenance Cost	Administ-ration Fee	Economic Benefit	Net Cash Flow	Discounted by 12%	
									Cost	Benefit
2010	6.7							-6.7	6.0	0.0
2011	23.8							-23.8	19.0	0.0
2012	365.4	0.0						-365.4	260.1	0.0
2013	264.3	19.3	3.7	3.4	6.6	1.3	36.4	-262.2	189.7	23.1
2014	0.0	0.8	7.6	6.8	13.2	2.7	81.6	50.4	17.7	46.3
2015	0.0	0.4	7.8	6.8	13.2	2.8	90.5	59.5	15.7	45.8
2016		0.4	7.9	6.8	13.2	2.8	99.3	68.1	14.1	44.9
2017		0.4	8.1	6.8	13.2	2.9	108.1	76.7	12.7	43.7
2018		0.4	8.2	6.8	13.2	3.0	117.0	85.3	11.4	42.2
2019		0.4	8.4	6.8	13.2	3.0	129.4	97.5	10.3	41.7
2020		0.4	8.6	6.8	13.2	3.1	141.9	109.8	9.2	40.8
2021		19.7	8.7	6.8	13.2	3.2	154.3	102.7	13.2	39.6
2022		1.2	8.9	6.8	13.2	3.2	166.8	133.4	7.6	38.2
2023		0.8	9.0	6.8	13.2	3.3	179.2	146.0	6.8	36.7
2024		0.8	9.2	6.8	13.2	3.4	191.6	158.2	6.1	35.0
2025		0.4	9.2	6.8	13.2	3.4	204.1	171.0	5.4	33.3
2026		0.4	9.2	6.8	13.2	3.4	204.1	171.0	4.8	29.7
2027		0.4	9.2	6.8	13.2	3.4	204.1	171.0	4.3	26.5
2028		0.4	9.2	6.8	13.2	3.4	204.1	171.0	3.8	23.7
2029		19.7	9.2	6.8	13.2	3.4	204.1	151.7	5.4	21.2
2030		1.2	9.2	6.8	13.2	3.4	204.1	170.2	3.1	18.9
2031		0.8	9.2	6.8	13.2	3.4	204.1	170.6	2.8	16.9
2032		0.8	9.2	6.8	13.2	3.4	204.1	170.6	2.5	15.1
2033		0.4	9.2	6.8	13.2	3.4	204.1	171.0	2.2	13.4
2034		0.4	9.2	6.8	13.2	3.4	204.1	171.0	1.9	12.0
2035		0.4	9.2	6.8	13.2	3.4	204.1	171.0	1.7	10.7
2036		0.4	9.2	6.8	13.2	3.4	204.1	171.0	1.6	9.6
2037		19.7	9.2	6.8	13.2	3.4	204.1	151.7	2.2	8.5
2038	-9.6	-18.4	9.2	6.8	13.2	3.4	204.1	199.4	0.2	7.6
Total	650.6	72.2	225.1	173.2	337.7	82.7	4353.2	2811.8	641.7	725.1

Source: JICA Team estimates

Table 9.2-11 Sensitivity Analysis of Phase I Only

(E-IRR: %)

Sensitivity Analysis		Change in Investment			
		Base Case	10% Increase	20% Increase	30% Increase
Change in Benefit	Base Case	13.8	12.8	11.9	11.1
	10% Decrease	12.2	11.3	10.4	9.7
	20% Decrease	10.6	9.7	8.9	8.2
	30% Decrease	8.7	7.9	7.2	6.6

Source: JICA Team Estimates

9.2.2. FINANCIAL EVALUATION

(1) Methodology and Assumptions

1) Methodology

Financial analysis examines the profitability of a given project to see whether the project operating entity would be able to run the project on the financially sound basis. The basic methodology is the same as the regular corporate accounting that compares revenue and expenditure and thereby checks the profitability and the soundness of financing. The balance sheet examination is kept to minimum except for the cases where such factors as asset depreciation which affect the profitability through taxation must be analyzed.

Financial analysis uses both the constant price of 2009 and the current price that would reflect inflation. The constant price is used in the first half of this section in order to evaluate the project as a totality in the net terms and calculate the internal rate of return. The current price is used in the second half in order to examine the issue of actual financing.

The examination of revenue and expenditure must identify which entity earns the revenue from and bears expenses for project operation. The stakeholders in the proposed trunk bus system are the trunk bus operator (bus company), the government of the State of Para (or Public Consortium), external donors, lending institutions, conventional bus operators, users of the trunk bus service and so forth. In the present analysis, the most important stakeholder is the trunk bus operator, and therefore the issue of revenue and expenditure is examined chiefly in relation to the trunk bus company.

2) Assumptions

a) Period for Analysis

The period is the same as the economic analysis, i.e., 25 years from the start of project operation through 2038.

b) Payers of the Necessary Development Fund

As mentioned in Section 3 of Chapter 7, the Government of the State of Para (or Public Consortium) will invest in the construction of the exclusive busway, bus terminals, stations and stops and pays the maintenance and management cost of these facilities. The trunk bus company operates its service by using these facilities and submits 2.5% of its fare revenue to the state government (or Public Consortium). The government repays the external loan and takes the foreign exchange risks.

c) Sources of Finance

The foreign exchange component is to be financed by Japan’s ODA Loan. The conditions of lending are concessional because of the status of Brazil as one of the primary borrowers: namely, the interest rate of 1.2%, repayment in 25 years (with deferred payment of 7 years).

Regarding the domestic currency component, the Brazil Development Bank (BNDES) is expected to give a loan at the interest rate of 16.5% (the basic rate of 15% plus a spread of 1.5%) and the repayment of 10 years with no deferment. The equity capital is to account for 30% of the domestic currency component.

d) Inflation

The effect of inflation is added to the cost stream examined in the current price: namely, 2.6% per annum for the foreign exchange component and 13.3% for the domestic currency component. The interest rate of the domestic loan mentioned above will be 2.82% in real terms (= (1.165 ÷ 1.133) – 1).

e) Foreign Exchange Rate

The present exchange rate is BRL 1.0 = US$0.435 = JPY41.65. This rate is used in the project costing and economic analysis. By noting the wide inflationary gap between the foreign exchange and the domestic currency, the financial analysis of the project in current price applies the exchange rate for Yen by devaluing BRL at 10.43% per annum.

(2) Investment Schedule

The Government of the State of Para bears the cost of constructing the infrastructure for the trunk bus system and the related physical facilities such as terminals and stations, excluding the fleet depot for bus operation and management. The cost is not counted in the financial analysis for the trunk bus operator. Table 9.2-12 shows the investment schedule to give an overall picture of the initial investment. The total investment amounts to R$841.3 million in 2009 price. The figure excludes from the total project cost mentioned in Chapter 6 the fleet cost, the price escalation and the financial cost like interest payments and commission charges during construction but includes tax payments.

Table 9.2-12 Initial Investment

(excluding vehicle purchase, price escalation and financial charges)

(R$ million: 2009 price)

Year	Phase I+II	Phase I
2010	6.9	6.9
2011	25.0	25.0
2012	380.7	367.0
2013	316.0	265.1
2014	88.5	0.0
2015	24.3	0.0
Total	841.3	663.9

Source: JICA Team estimates

Of the total investment above, the trunk bus operator bears the cost of constructing the fleet depot for bus operation and management. The investment amount and schedule are shown in Table 9.2-13.

Table 9.2-13 Construction Cost of the Fleet depot (excluding price escalation and financial charges)

(R$ million: 2009 price)

Year	Phases I & II			Phase I		
	Total	Foreign Exchange	Domestic Currency	Total	Foreign Exchange	Domestic Currency
2010						
2011						
2012						
2013	22.6		22.6	22.6		22.6
2014	16.3		16.3			
2015	4.1		4.1			
2016						
Total	43.0		43.0	22.6		22.6

Source: JICA Team estimates

(3) Purchase of Trunk and Feeder Bus Fleets

The purchase of the trunk bus fleet is counted in the benefit stream in the economic analysis. The financial analysis examines the cost and the revenue (fare revenue and non-fare revenue) and must include the vehicle purchase in the cash flow. The state distribution tax (ICMS) of 12% and the municipal service tax (SSS) of 5% are added to the vehicle price. An articulated trunk bus of 160-passenger capacity costs R$696,150 and a conventional bus of 70-passenger capacity is priced at R$218,790. The required sizes of two fleets for three target years are shown in Table 9.2-14. The cash flow assumes that these vehicles are purchased prior to the respective target year.

Table 9.2-14 Required Bus Fleets and Vehicle Costs

(R$ million: 2009 price)

Fleet and Cost	Bus Line	Phases I & II			Phase I Only		
		2013	2018	2025	2013	2018	2025
Number of Vehicles	Trunk	206	336	387	206	230	260
	Feeder	103	127	143	103	114	129
Total Cost (R$ million)	Trunk	122.6	199.9	230.3	122.6	136.8	155.0
	Feeder	19.3	23.7	26.7	19.3	21.2	24.2

Source: JICA Team estimates

The service life is set at 10 years for the trunk bus and 8 years for the feeder bus, requiring the fleet renewal every 10 and 8 years respectively. The old vehicles written off at the time of such a renewal are valued zero. Those vehicles that are bought prior to 2038 and have some remaining service life are priced at their respective residual value.

(4) Operation, Maintenance and Management

This cost category consists of (1) fleet operation, (2) indirect cost (i.e., the overhead cost for fleet operation and the cost of operating bus terminals and other facilities), (3) trunk bus operation and maintenance facility (depot), and (4) operation and overhead of Public Consortium.

1) Fleet Operation Cost

The operation cost of the trunk bus service is mentioned in 9.2.1 with unit values in financial price per different operating speed (Table 9.2-5). The operating speed of public transport is fixed in transit assignment and the operating routes are also fixed per phase. Therefore, the operating distance varies by the frequency of service. The frequency rises in accordance to the growth of demand, calling for the increase in fleet size. Based on the results of transit assignment, the operating cost of the trunk bus service is estimated as shown in Table 9.2-15.

Table 9.2-15 Annual Cost of Trunk Bus Operation

(R$ million: 2009 price)

	Phases I & II	Phase I Only
2013	8.8	8.8
2018	34.0	22.7
2025	55.6	32.4

Source: JICA Team estimates

Assuming that the feeder bus fleet services 200km a day at the average speed of 20km, the vehicle operating cost per kilometer is R$1.16 in economic price. The annual operation cost, excluding the costs of depreciation, interest payments and overhead, is estimated in relation to the operated vehicle kilometers, as shown in Table 9.2-16. One year is assumed to be 307 days.

Table 9.2-16 Annual Cost of Feeder Bus Operation

(R$ million/year)

	Phases I & II	Phase I Only
2013	6.1	6.1
2018	15.8	14.2
2025	17.0	15.3

Source: JICA Team estimates

2) Operation and Management of the Bus Company

In addition to the direct cost of operating the trunk bus fleet, the bus company bears the cost of operating facilities such as terminals and workshops and the overhead cost of management. The details are shown in Table 7.3-2 of Chapter 7. The annual expenditure is estimated to be R$8 million during the period from 2013 through February 2015 and R$16 million after the start of the Phase II operation in March 2015.

3) Operation and Management of Public Consortium

As discussed in Chapter 7, the proposed trunk bus system covers a number of municipalities, and a certain degree of administrative complication is duly anticipated. It has been proposed that the municipal governments concerned establish public consortium with the official support from the Government of Para State. Because this organization is to be established for the operation of the trunk bus system, its expenditure must be counted in the economic cost of the project.

It has been suggested that the public consortium would levy a certain percentage of the trunk bus fare revenue to pay for the expenses of its own operation and management. The details are yet to be decided. The levy of 2.5% is assumed for analysis, by considering the examples in other cities (Recife and Manaus). The said body is a non-profit governmental organization and exempt from corporate taxes. The annual expenses are estimated from the fare revenue discussed later and shown in Table 9.2-17.

Table 9.2-17 Annual Expenditure of Public Consortium

(R$ million/year)

	Phases I & II	Phase I Only
2013	1.3	1.3
2018	5.0	3.0
2025	5.8	3.4

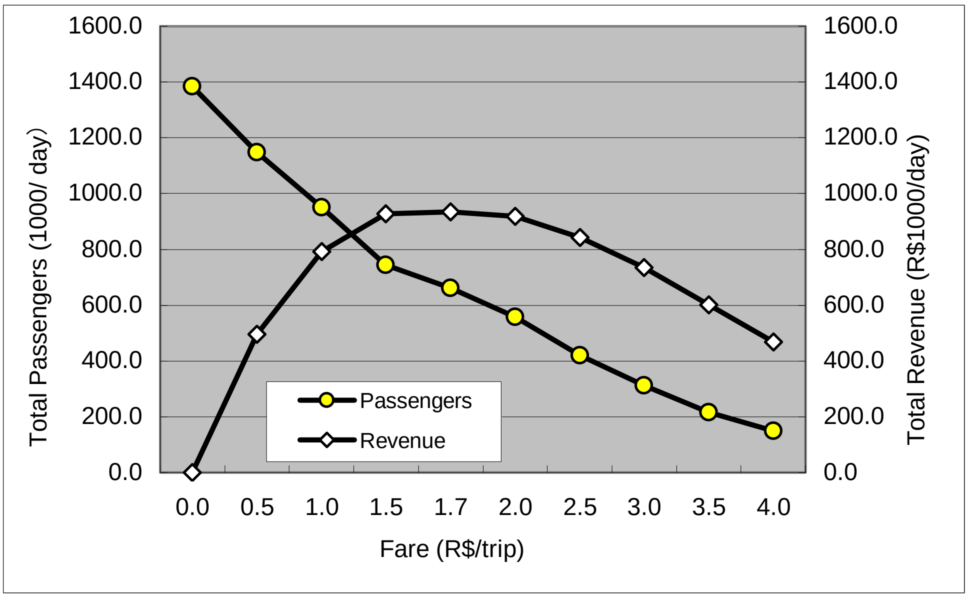
Source: JICA Team estimates

4) Maintenance and Management of Facilities for Trunk Bus System

The cost of maintaining and managing the facilities of the trunk bus system is shown in Table 7.3-5 of Chapter 7. The annual expenditure is estimated to be R$15.6 million during the period from 2013 through February 2015 and R$20.7 million after the start of the Phase II operation in March 2015.

(5) Fare Revenue and Other Income

The total fare revenue is obtained by multiplying the total number of passenger trips by the respective fare per trip, but the former would change according to the fare scale. Figure 9.2-5 shows the relationship between the revenue and the total number of trips. The present bus fare is R$1.7, and the total revenue is maximized in the figure. Therefore, uses the same fare is used in the financial analysis of the trunk bus project.



Source: JICA Team estimates

Figure 9.2-5 Relationship of Fare Rate, Total Passengers and Revenue

Another important factor that influences demand and revenue is the rationalization of the conventional bus lines. The more the conventional bus lines go out of service, the larger the passenger demand for the trunk bus system. Table 9.2-18 shows this relationship. If any conventional bus line with 70% or more of its distance overlapping the trunk bus route has to give up its service, the total extension of the bus lines will decrease by 23%. If the cut for discontinuance is 50% or more, the conventional bus lines will be rationalized by 52% in kilometers. This analysis assumes that the cut for discontinuance is 70% or more.

Table 9.2-18 Discontinuance of Conventional Bus Lines and Demand for Trunk Bus Service

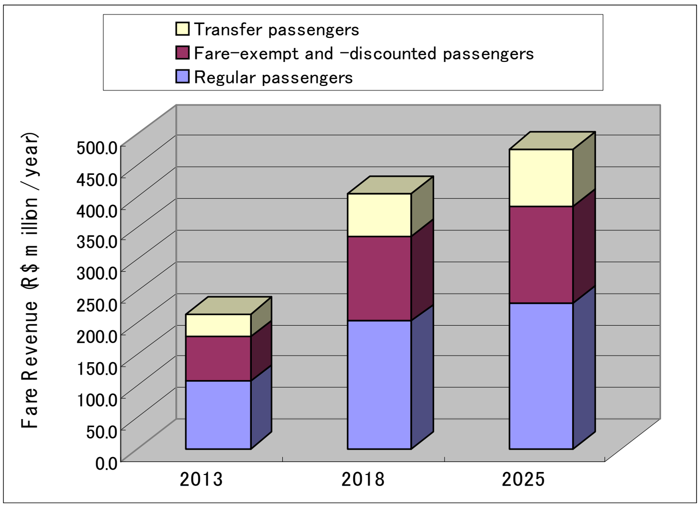
(passengers/day: R$/day)

Decrease of Bus Lines	Conventional Bus Service		Trunk Bus Service		Remark
	Passenger	Revenue	Passenger	Revenue	
0%	2,665,955	4,532,099	661,493	934,364	No discontinuance
23%	2,683,865	4,562,568	778,195	1,096,100	Bus lines competing in 70% or more of their distance are discontinued
52%	2,486,410	4,226,983	1,022,488	1,414,728	Bus lines competing in 50% or more of their distance are discontinued

Source: JICA Team estimates

The revenue indicated in the table above is 17% to 19% less than the amount obtainable from multiplying the total passengers by the fare of R$1.7. This is because passengers can transfer between trunk bus lines any number of times without extra charge.

In addition to the free transfer, the military personnel, government officials and the handicapped are fare-exempt on the present bus lines. For example, it has been reported that 23% of the bus passengers did not pay their fare in 2003. Students and school children get a discount of 50%. According to the information of CTBel, such fare-discounted passengers made up 36% of the total bus riders. If these concessions should be applied to the trunk bus system, the expected revenue would be 40% lower than the figure given in Table 9.2-18. The structure of fare revenue is graphically shown in Figure 9.2-6, in which the height of each column indicates the total revenue when every passenger pays up the fare of R$1.7. The red portion consists of fare-exempt and fare-discounted passengers and the yellow one transferred passengers. The actual revenue of the trunk bus system is the blue portion.



Source: JICA Team estimates

Figure 9.2-6 Effective Total Passengers and Potential Fare Revenue

The trunk bus company gets non-fare income such as advertisement fees and passenger services offered at bus terminals. It is assumed that such income is worth 2% of the fare revenue. The annual revenue of the trunk bus company is shown in Table 9.2-19. The start of bus operation is scheduled on July 1st of 2013, and the revenue for this year, R$53.2 million, is 50% of the annual estimate.

Table 9.2-19 Revenue of Trunk Bus Company

(R$ million: 2009 price)

Year	Phases I & II		Phase I Only	
	Fare	Non Fare	Fare	Non Fare
2013	53.2	1.1	53.2	1.1
2014	109.0	2.2	109.0	2.2
2015	179.6	3.6	111.5	2.2
2016	193.7	3.9	114.0	2.3
2017	197.8	4.0	116.4	2.3
2018	201.9	4.0	118.9	2.4
2019	206.0	4.1	121.5	2.4
2020	210.1	4.2	124.1	2.5
2021	214.2	4.3	126.6	2.5
2022	218.4	4.4	129.2	2.6
2023	222.5	4.4	131.7	2.6
2024	226.6	4.5	134.3	2.7
2025	230.7	4.6	136.9	2.7
2026	230.7	4.6	136.9	2.7
2027	230.7	4.6	136.9	2.7
2028	230.7	4.6	136.9	2.7
2029	230.7	4.6	136.9	2.7
2030	230.7	4.6	136.9	2.7
2031	230.7	4.6	136.9	2.7
2032	230.7	4.6	136.9	2.7
2033	230.7	4.6	136.9	2.7
2034	230.7	4.6	136.9	2.7
2035	230.7	4.6	136.9	2.7
2036	230.7	4.6	136.9	2.7
2037	230.7	4.6	136.9	2.7
2038	230.7	4.6	136.9	2.7

Source: JICA Team estimates

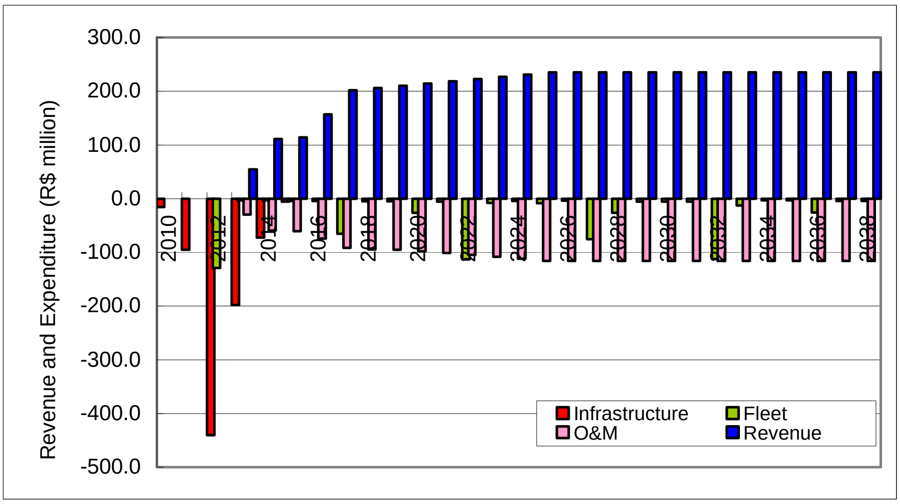
(6) Overall Evaluation of the Project

1) Profitability of the Total Project

As stated in the assumptions for analysis, the Government of Para State invests in the infrastructure for the trunk bus system, and the trunk bus company does not concern itself with the initial investment except the construction of the fleet depot. The financial analysis first evaluates the profitability of the project in its entirety including the initial investment.

The total cash flow of investment, current expenditure and revenue described in the preceding paragraphs is shown in Figure 9.2-7 and Table 9.2-20. The financial internal rate of return is 6.6%, and the net present value is minus R$253.5 million at the discount rate of 12%. If the entire project should be implemented by the private sector alone, the F-IRR of 6.6% would be too inadequate as a business venture. From the viewpoint of private investors, it would take too long, though not as long as some railway project, to recover the capital invested in infrastructure and fleet.

If the project is implemented as a public-private partnership scheme in which the public sector shoulders the infrastructure development and the private sector purchases and operates the fleet, the F-IRR of 6.6% will be judged more favorably. Moreover, the official development assistance committed to the government investment in infrastructure will possibly make the whole project financially feasible.



Source: JICA Team estimates

Figure 9.2-7 Financial Cash Flow of the Entire Project

Table 9.2-21 shows the results of sensitivity analysis on changes in the cash flow of revenue and expenditure. The financial internal rate of return is more sensitive to the decrease in revenue than the increase in cost. If the revenue drops by 20% or more, the F-IRR will turn negative.

Table 9.2-20 Cash Flow of the Entire Project

(R$ million: 2009 price)

Year	Infra. Dev.	Purchase of Bus Fleet		Maintenance of Infrastructure	Trunk Bus Operation	Feeder Bus Operation	Management of Bus Co.	Other Expenses	Management of Joint Adm. Body	Total Cost	Fare Revenue	Non Fare Revenue	Cash Flow
		Trunk	Feeder										
2010	6.9									-6.9			-6.9
2011	25.0									-25.0			-25.0
2012	380.7	0.0	0.0							-380.7			-380.7
2013	316.0	143.4	22.5	7.8	8.8	6.1	4.0	0.9	1.3	-510.9	53.2	1.1	-456.5
2014	88.5	36.2	2.1	15.6	18.5	14.1	8.0	2.0	2.7	-187.8	109.0	2.2	-76.6
2015	24.3	18.1	1.1	19.9	26.4	15.1	14.7	2.8	4.5	-126.7	179.6	3.6	56.5
2016		18.1	1.1	20.7	29.7	15.3	16.0	3.1	4.8	-108.8	193.7	3.9	88.8
2017		18.1	1.1	20.7	31.7	15.5	16.0	3.2	4.9	-111.2	197.8	4.0	90.5
2018		5.1	0.5	20.7	34.0	15.8	16.0	3.3	5.0	-100.4	201.9	4.0	105.6
2019		5.1	0.5	20.7	36.6	16.0	16.0	3.4	5.2	-103.5	206.0	4.1	106.6
2020		5.1	0.5	20.7	39.3	16.3	16.0	3.6	5.3	-106.6	210.1	4.2	107.7
2021		5.1	23.0	20.7	42.1	16.5	16.0	3.7	5.4	-132.5	214.2	4.3	86.0
2022		5.1	2.6	20.7	45.1	16.7	16.0	3.9	5.5	-115.6	218.4	4.4	107.1
2023		148.5	1.6	20.7	48.4	16.9	16.0	4.1	5.6	-261.6	222.5	4.4	-34.7
2024		41.3	1.6	20.7	51.9	17.0	16.0	4.2	5.7	-158.3	226.6	4.5	72.8
2025		18.1	1.1	20.7	55.6	17.0	16.0	4.4	5.8	-138.6	230.7	4.6	96.7
2026		18.1	0.5	20.7	55.6	17.0	16.0	4.4	5.8	-138.1	230.7	4.6	97.2
2027		18.1	0.5	20.7	55.6	17.0	16.0	4.4	5.8	-138.1	230.7	4.6	97.2
2028		5.1	0.5	20.7	55.6	17.0	16.0	4.4	5.8	-125.0	230.7	4.6	110.3
2029		5.1	23.0	20.7	55.6	17.0	16.0	4.4	5.8	-147.6	230.7	4.6	87.7
2030		5.1	2.6	20.7	55.6	17.0	16.0	4.4	5.8	-127.1	230.7	4.6	108.2
2031		5.1	1.6	20.7	55.6	17.0	16.0	4.4	5.8	-126.1	230.7	4.6	109.2
2032		5.1	1.6	20.7	55.6	17.0	16.0	4.4	5.8	-126.1	230.7	4.6	109.2
2033		148.5	1.1	20.7	55.6	17.0	16.0	4.4	5.8	-269.0	230.7	4.6	-33.7
2034		41.3	0.5	20.7	55.6	17.0	16.0	4.4	5.8	-161.2	230.7	4.6	74.1
2035		18.1	0.5	20.7	55.6	17.0	16.0	4.4	5.8	-138.1	230.7	4.6	97.2
2036		18.1	0.5	20.7	55.6	17.0	16.0	4.4	5.8	-138.1	230.7	4.6	97.2
2037		18.1	23.0	20.7	55.6	17.0	16.0	4.4	5.8	-160.6	230.7	4.6	74.7
2038		18.1	23.0	20.7	55.6	17.0	16.0	4.4	5.8	-160.6	230.7	4.6	74.7
Residual	-17.6	-149.1	-22.2							188.9			188.9
Total	823.7	641.7	115.7	519.4	1190.8	418.9	394.7	100.2	136.6	-4341.7	5462.5	109.3	1230.1

Source: JICA Team estimates

F-IRR	6.6%
F-NPV	-253.5

Table 9.2-21 Sensitivity Analysis of the Entire Project

(%)

Sensitivity Analysis		Increase in Cost			
		Base case	10% increase	20% increase	30% increase
Decrease in Revenue	Base case	6.6	4.2	1.9	-
	10% decrease	3.9	1.4	-	-
	20% decrease	-	-	-	-
	30% decrease	-	-	-	-

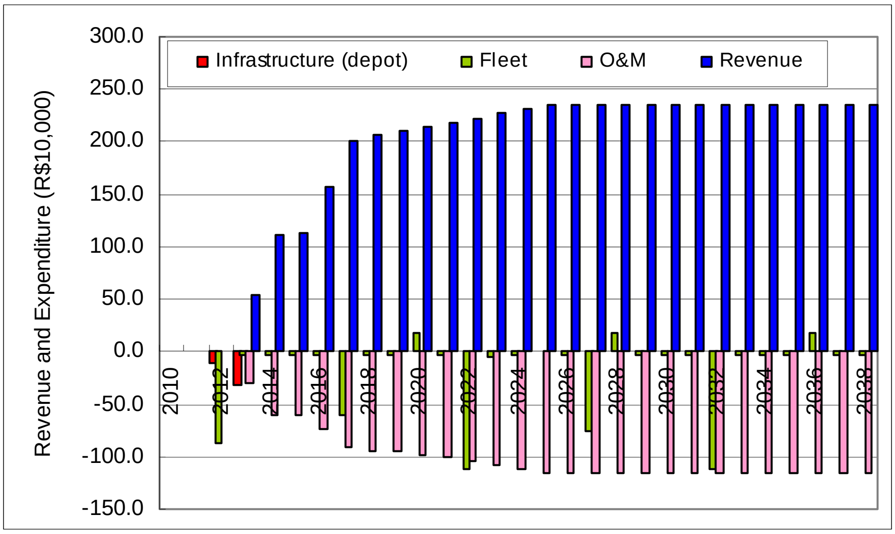
Source: JICA Team estimates

2) *The Case of Government Investment in Infrastructure*

Figure 9.2-8 shows the cash flow after deducting the initial investment in infrastructure by the public sector (shown in red bars). The F-IRR then rises to 38.1%. If the maintenance cost of infrastructure is paid by the government and thus deducted from the cash flow, the rate becomes a high 48.9%. F-IRRs of transport projects are rarely as high.

As seen in Figure 9.2-8 and Table 9.2-22, the cash flow is negative in the first two years but turns positive throughout the rest of the project life. Periodic investment in the renewal of fleets is more than offset by the increase in revenue. The internal rate of return is substantially high in such a case.

The financial net present value is as large as R$280.5 million. However, a high profit does not entirely go to the coffers of the trunk bus company. 27.5% of the current surplus goes to the national treasury as corporate income tax. The fiscal revenue of the government from the trunk bus project is summarily estimated to add up to R$598million over 25 years of project life. The fiscal aspect of the project will be discussed later in the chapter. The government revenue of corporate income tax from the project mentioned above is only a rough estimate, without accounting for depreciation and other factors.



Source: JICA Team estimates

Figure 9.2-8 Cash Flow after Deducting Government Investment in Infrastructure

Table 9.2-22 Cash Flow after Deducting Government Investment in Infrastructure (Phase I +II)

(R$ million: 2009 price)

Year	Fleet Depot Construction	Purchase of Bus Fleet		Maintenance of Infrastructure	Trunk Bus Operation	Feeder Bus Operation	Management of Bus Co	Other Expenses	Management of Joint Adm. Body	Total Cost	Fare Revenue	Non Fare Revenue	Cash Flow
		Trunk	Feeder										
2010										0.0			0.0
2011										0.0			0.0
2012		0.0	0.0							0.0			0.0
2013	22.6	143.4	22.5	7.8	8.8	6.1	4.0	0.9	1.3	-217.5	53.2	1.1	-163.2
2014	16.3	36.2	2.1	15.6	18.5	14.1	8.0	2.0	2.7	-115.6	109.0	2.2	-4.4
2015	4.1	18.1	1.1	19.9	26.4	15.1	14.7	2.8	4.5	-106.5	179.6	3.6	76.7
2016		18.1	1.1	20.7	29.7	15.3	16.0	3.1	4.8	-108.8	193.7	3.9	88.8
2017		18.1	1.1	20.7	31.7	15.5	16.0	3.2	4.9	-111.2	197.8	4.0	90.5
2018		5.1	0.5	20.7	34.0	15.8	16.0	3.3	5.0	-100.4	201.9	4.0	105.6
2019		5.1	0.5	20.7	36.6	16.0	16.0	3.4	5.2	-103.5	206.0	4.1	106.6
2020		5.1	0.5	20.7	39.3	16.3	16.0	3.6	5.3	-106.6	210.1	4.2	107.7
2021		5.1	23.0	20.7	42.1	16.5	16.0	3.7	5.4	-132.5	214.2	4.3	86.0
2022		5.1	2.6	20.7	45.1	16.7	16.0	3.9	5.5	-115.6	218.4	4.4	107.1
2023		148.5	1.6	20.7	48.4	16.9	16.0	4.1	5.6	-261.6	222.5	4.4	-34.7
2024		41.3	1.6	20.7	51.9	17.0	16.0	4.2	5.7	-158.3	226.6	4.5	72.8
2025		18.1	1.1	20.7	55.6	17.0	16.0	4.4	5.8	-138.6	230.7	4.6	96.7
2026		18.1	0.5	20.7	55.6	17.0	16.0	4.4	5.8	-138.1	230.7	4.6	97.2
2027		18.1	0.5	20.7	55.6	17.0	16.0	4.4	5.8	-138.1	230.7	4.6	97.2
2028		5.1	0.5	20.7	55.6	17.0	16.0	4.4	5.8	-125.0	230.7	4.6	110.3
2029		5.1	23.0	20.7	55.6	17.0	16.0	4.4	5.8	-147.6	230.7	4.6	87.7
2030		5.1	2.6	20.7	55.6	17.0	16.0	4.4	5.8	-127.1	230.7	4.6	108.2
2031		5.1	1.6	20.7	55.6	17.0	16.0	4.4	5.8	-126.1	230.7	4.6	109.2
2032		5.1	1.6	20.7	55.6	17.0	16.0	4.4	5.8	-126.1	230.7	4.6	109.2
2033		148.5	1.1	20.7	55.6	17.0	16.0	4.4	5.8	-269.0	230.7	4.6	-33.7
2034		41.3	0.5	20.7	55.6	17.0	16.0	4.4	5.8	-161.2	230.7	4.6	74.1
2035		18.1	0.5	20.7	55.6	17.0	16.0	4.4	5.8	-138.1	230.7	4.6	97.2
2036		18.1	0.5	20.7	55.6	17.0	16.0	4.4	5.8	-138.1	230.7	4.6	97.2
2037		18.1	23.0	20.7	55.6	17.0	16.0	4.4	5.8	-160.6	230.7	4.6	74.7
2038		18.1	23.0	20.7	55.6	17.0	16.0	4.4	5.8	-160.6	230.7	4.6	74.7
Residual		-149.1	-22.2							171.3			171.3
Total	43.0	641.7	115.7	519.4	1190.8	418.9	394.7	100.2	136.6	-3561.0	5462.5	109.3	2010.8

Source: JICA Team estimates

F-IRR	38.1%
F-NPV (12%)	280.5

Table 9.2-23 Sensitivity Analysis after Deducting Government Investment in Infrastructure

(%)

Sensitivity Analysis		Increase in Cost			
		Base case	10% increase	20% increase	30% increase
Decrease in Revenue	Base case	38.1	29.7	22.5	16.1
	10% decrease	28.9	21.0	14.0	7.3
	20% decrease	19.2	11.5	3.9	-
	30% decrease	8.3	-	-	-

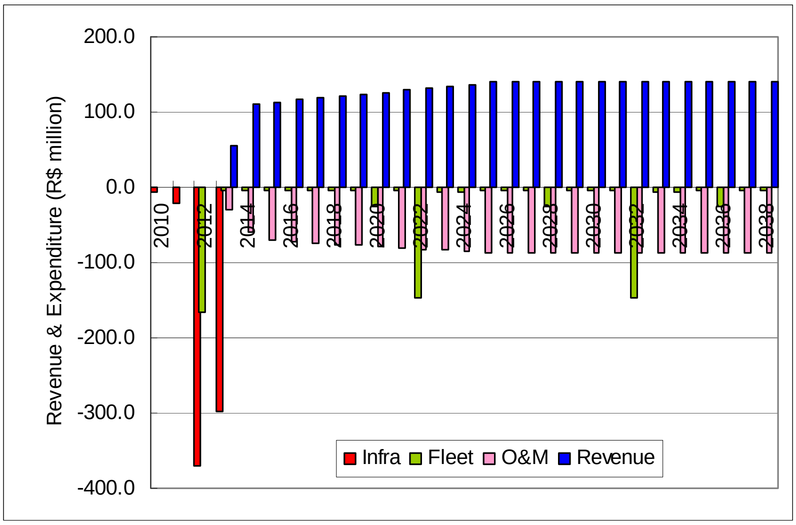
Source: JICA Team estimates

3) *Project Implementation of Phase I Only*

As in the preceding economic analysis, the project implementation of Phase I only is analyzed for its financial feasibility.

The cash flow for this alternative case is shown in Figure 9.2-9 and Table 9.2-24. The estimated internal rate of return is almost zero. Even with a highly concessional loan of Japan's ODA Loan, it is hard to expect that the project is manageable on the financially sound footing.

Notably, Phase II requires far less infrastructure investment (only 25% of Phase I) and yet promises a substantial increase of users, worth two thirds of the estimated increase of Phase I. Therefore, the Phase II implementation is highly recommended for its higher investment efficiency.



Source: JICA Team estimates

Figure 9.2-9 Cash Flow of Phase I Implementation

If the public sector takes care of the needed infrastructure development, the financial viability of the project implementation of Phase I only will be greatly improved, as shown by the sensitivity analysis in Table 9.2-26. The F-IRR will be 27.7%, and even with a 20% increase in cost, or a 8% decrease in revenue, the Phase I implementation remains financially sustainable.

The analysis assumes that the actual maintenance of the infrastructure will be done by the public sector but that the cost will be paid by the trunk bus company. If the public sector should shoulder the cost of maintenance, the F-IRR would rise to 39.8%.

In one of the following sections, examination will be made on the question whether the trunk bus company will be able to run the service under inflationary circumstances, paying the taxes and repaying the loan for fleet purchase.

Table 9.2-24 Cash Flow after Deducting Government Investment in Infrastructure

(Phase I only)

(R$ million: 2009 price)

Year	Fleet Depot Construction	Purchase of Bus Fleet		Maintenance of Infrastructure	Trunk Bus Operation	Feeder Bus Operation	Management of Bus Co	Other Expenses	Management of Joint Adm. Body	Total Cost	Fare Revenue	Non Fare Revenue	Cash Flow
		Trunk	Feeder										
2010	6.9									-6.9			-6.9
2011	25.0									-25.0			-25.0
2012	367.0	0.0	0.0							-367.0			-367.0
2013	265.1	143.4	22.5	7.8	8.8	6.1	4.0	0.9	1.3	-460.0	53.2	1.1	-405.7
2014	0.0	6.7	0.9	15.6	18.5	13.1	8.0	2.0	2.7	-67.4	109.0	2.2	43.7
2015	0.0	3.3	0.5	15.6	19.4	13.5	8.0	2.0	2.8	-65.1	111.5	2.2	48.6
2016		3.3	0.5	15.6	20.5	13.7	8.0	2.1	2.8	-66.5	114.0	2.3	49.7
2017		3.3	0.5	15.6	21.5	13.9	8.0	2.2	2.9	-68.0	116.4	2.3	50.8
2018		3.0	0.5	15.6	22.7	14.2	8.0	2.2	3.0	-69.2	118.9	2.4	52.1
2019		3.0	0.5	15.6	23.8	14.4	8.0	2.3	3.0	-70.8	121.5	2.4	53.2
2020		3.0	0.5	15.6	25.1	14.7	8.0	2.4	3.1	-72.4	124.1	2.5	54.2
2021		3.0	23.0	15.6	26.4	14.9	8.0	2.5	3.2	-96.6	126.6	2.5	32.5
2022		3.0	1.4	15.6	27.8	15.0	8.0	2.5	3.2	-76.6	129.2	2.6	55.1
2023		146.4	1.0	15.6	29.2	15.1	8.0	2.6	3.3	-221.3	131.7	2.6	-86.9
2024		9.7	1.0	15.6	30.8	15.3	8.0	2.7	3.4	-86.3	134.3	2.7	50.6
2025		3.3	0.5	15.6	32.4	15.3	8.0	2.8	3.4	-81.2	136.9	2.7	58.4
2026		3.3	0.5	15.6	32.4	15.3	8.0	2.8	3.4	-81.3	136.9	2.7	58.3
2027		3.3	0.5	15.6	32.4	15.3	8.0	2.8	3.4	-81.3	136.9	2.7	58.3
2028		3.0	0.5	15.6	32.4	15.3	8.0	2.8	3.4	-81.0	136.9	2.7	58.6
2029		3.0	23.0	15.6	32.4	15.3	8.0	2.8	3.4	-103.5	136.9	2.7	36.1
2030		3.0	1.4	15.6	32.4	15.3	8.0	2.8	3.4	-81.9	136.9	2.7	57.7
2031		3.0	1.0	15.6	32.4	15.3	8.0	2.8	3.4	-81.4	136.9	2.7	58.2
2032		3.0	1.0	15.6	32.4	15.3	8.0	2.8	3.4	-81.4	136.9	2.7	58.2
2033		146.4	0.5	15.6	32.4	15.3	8.0	2.8	3.4	-224.4	136.9	2.7	-84.8
2034		9.7	0.5	15.6	32.4	15.3	8.0	2.8	3.4	-87.6	136.9	2.7	52.0
2035		3.3	0.5	15.6	32.4	15.3	8.0	2.8	3.4	-81.3	136.9	2.7	58.3
2036		3.3	0.5	15.6	32.4	15.3	8.0	2.8	3.4	-81.3	136.9	2.7	58.3
2037		3.3	23.0	15.6	32.4	15.3	8.0	2.8	3.4	-103.8	136.9	2.7	35.8
2038		3.3	23.0	15.6	32.4	15.3	8.0	2.8	3.4	-103.8	136.9	2.7	35.8
Residual	-9.6	-92.5	-21.5							123.6			123.6
Total	654.3	433.6	107.5	397.8	728.0	377.4	204.0	65.5	82.7	-3050.6	3306.5	66.1	322.0

Source: JICA Team estimates

F-IRR	2.5%
F-NPV (12%)	-327.9

Table 9.2-25 Sensitivity Analysis of Phase I Implementation

(%)

Sensitivity Analysis		Increase in Cost			
		Base case	10% increase	20% increase	30% increase
Decrease in Revenue	Base case	2.5	-	-	-
	10% decrease	-	-	-	-
	20% decrease	-	-	-	-
	30% decrease	-	-	-	-

Source: JICA Team estimates

Table 9.2-26 Sensitivity Analysis of Phase I Implementation after Deducting Government Investment in Infrastructure

(%)

Sensitivity Analysis		Increase in Cost			
		Base case	10% increase	20% increase	30% increase
Decrease in Revenue	Base case	27.7	19.6	12.4	5.9
	10% decrease	18.7	11.0	3.8	-
	20% decrease	9.1	-	-	-
	30% decrease	-	-	-	-

Source: JICA Team estimates

4) *Improvement in Fuel Consumption*

The analysis examines the fuel consumption in 2025 when the traffic demand is expected to stabilize after the implementation of both Phases I and II. The comparison of “with” and “without” situations consider conventional and trunk buses, but excludes passenger cars because their vehicle operating cost varies little between “with” and “without”. The results of comparison are shown in Table 9.2-27. The vehicle operating cost is expressed in economic price, but the fuel consumption is converted to market price.

Table 9.2-27 Reduction in Fuel Consumption by Project Implementation (as of 2025)

Comparison	VOC (R$/day)			Of which, Fuel Consumption (R$/day)		
	Conventional	Trunk	Total	Conventional	Trunk	Total
Without Project	359,467	-	359,467	181,904	-	181,904
With Phases I & II	307,446	34,676	342,122	155,579	11,140	166,719
Difference	52,021	-34,676	17,345	26,324	-11,140	15,185

Source: JICA Team estimates

The decrease of daily fuel consumption by bus is some R$15,000, and at 307 days a year, this amounts to R$4.7 million per annum. At the price of R$2.27 per liter of diesel, this means the saving of 2 million liters a year. This reduction in diesel consumption is realized by the improved fuel efficiency of the articulated bus fleet and the decreased operating fuel cost due to the easing of traffic congestion.

For the sake of comparing the present situation with the project implementation, the above table does not consider the feeder bus operation. The project proposes the feeder bus operation which will start at four trunk bus terminals in 2025. Under the same assumption as above, the fuel consumption by feeder bus operation will amount to R$8.2 million a year. The inclusion of feeder bus service will add 1.5 million liters to the consumption of diesel oil by the trunk bus system.

5) *Possibility of Articulated Hybrid Bus Fleet*

The inadequate availability of information only allows rough evaluation concerning the possibility of using hybrid buses. According to Eletra S. A., an articulated hybrid bus costs R$1,320,000. Assuming the ICMS tax of 12% and the municipal tax of 5%, the entire fleet will cost R$1,545,000, 2.2 times more than the regular articulated buses that are valued at R$696,150 including taxes. The hybrid bus fleet will cost R$849,000 more. To recover the cost in ten years at the real interest rate of 2.82% (the nominal rate of 16.5%) of BNDES loans, the coefficient of capital recovery is calculated as:

$$i \times (1.0 + i)^{10} / ((1.0 + i)^{10} - 1.0) = 0.0282 \times 1.0282^{10} / (1.0282^{10} - 1) = 0.1161$$

That is to say, the operation cost of the hybrid bus fleet will have to be lower by R$98,600 (=R$849,000 x 0.1161) per year, or R$321 per day, than the regular bus fleet to recover capital in ten years.

Supposing that an articulated bus runs 250km every day at the speed of 30km per hour, the daily vehicle operating cost of a hybrid bus comes to R$740, of which 32%, or R$240, is for fuels. Although the fuel efficiency of hybrid buses are certainly better than the regular bus types at the present moment, this advantage will not result in a reduction of fuel consumption to the amount of R$321 a day. The hybrid bus is yet unlikely to become an economically justifiable alternative to the regular bus.

The certified credit on the CO2 reduction realizable by the hybrid bus fleet is estimated to range from R$2 to 6 million after paying commission charges (cf. Chapter 10). This amount is the aggregation over 10 years. Taking the median of R$4 million, the credit is worth R$400,000 per year, or R$1,300 per day. This means only R$4.2 per vehicle, a pittance against the necessary operating cost reduction of R$321 mentioned above.

The introduction of the hybrid bus fleet would be laudable as “environment-friendly public transport,” and its favorable public image would serve as good public relations for promoting increased use of the new bus system. However, it will be financially risky to start the new trunk bus system with the hybrid bus fleet by paying more than twice the price of regular buses. The fleet must be renewed after ten years at any rate, and it will be possible and better to reconsider the issue by studying the situations of demand and revenue at the time of fleet renewal.

(7) Cash Flow of the Bus Company

The cash flow of the trunk bus company must be analyzed by taking into account the possible effect of inflation. The conditions for analysis is already mentioned in the beginning of the financial analysis but summarized as follows.

a) Period for analysis: 2010 - 2038

b) Payers of the necessary development fund: the Government of the State of Para for the investment, maintenance and management of the infrastructure and the bus company submits 2.5% of its fare revenue to the State Government.

c) Sources of Finance: A yen credit from Japan (interest of 1.2%, repayment in 25 years with 7-year deferment) and a loan from BNDES (interest of 16.5%, repayment in 10 years with no deferment), with the equity capital of 30% accounting for the domestic currency component

d) Inflation: 2.6% per annum for the foreign exchange component and 13.3% for the domestic currency component

e) Foreign exchange rate: the present exchange rate (BRL 1.0 = US$0.435 = JPY41.65) is adjusted by devaluing BRL at 10.43% per annum

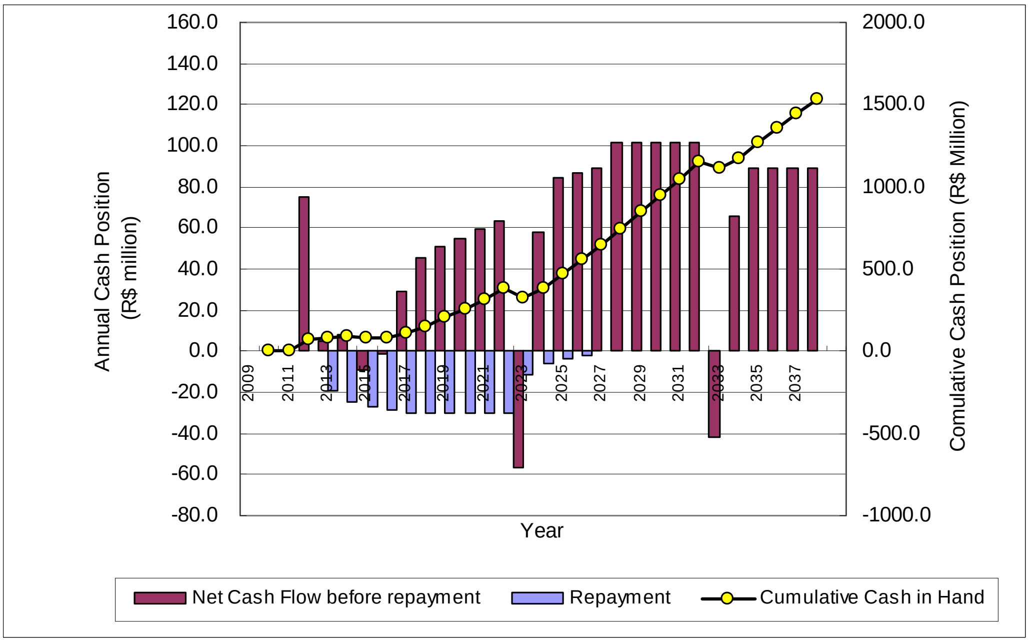
f) The national corporate tax (IRPJ) is 23.5% of net profit and the municipal tax (SSS) is 5% of the same.

To examine the financial viability of the bus company, it is assumed that the state government pays for the infrastructure development and that the bus company invests only in the construction of the fleet depot.

The initial investment by the bus company comprises the construction of the fleet depot at R$43.0 million and the purchase of the trunk and feeder bus fleets totaling R$261.7 million (in 2009 price). 70% of the investment is to be financed by the BNDEZ loan and the remaining 30% by own capital. The depreciation is 25 years for the depot, 10 years for trunk buses and 8 years for feeder buses, and no residual value is counted after their depreciation.

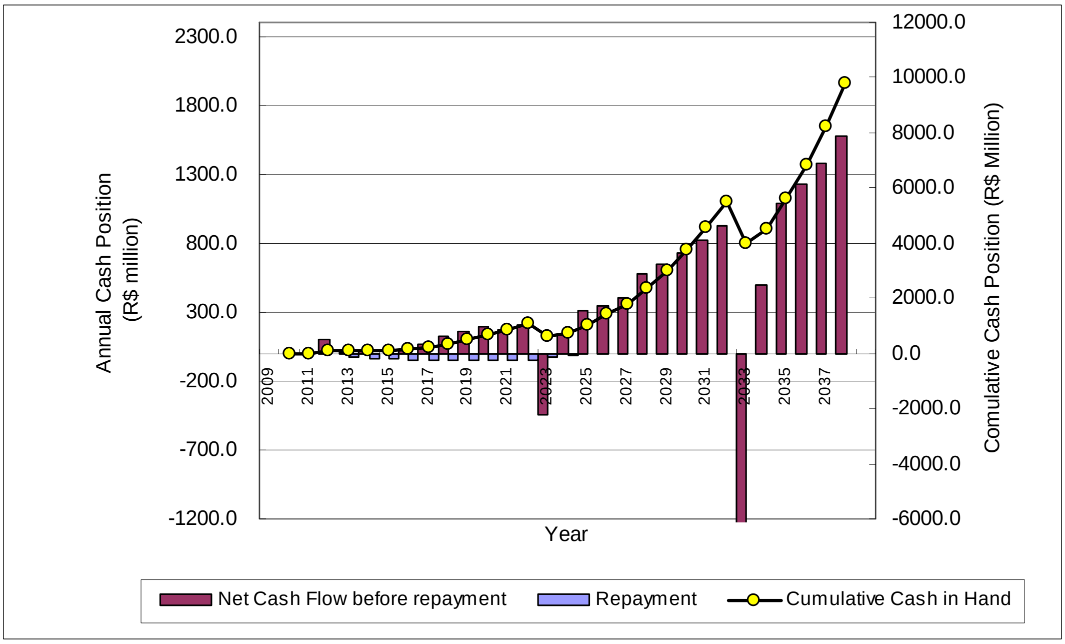
The annual cash flow positions are respectively shown in Figure 9.2-10 and

Table 9.2-28 excluding the effect of inflation and in Figure 9.2-11 and Table 9.2-29 in current price with inflation. Because the initial investment is comparably small, the cash flow turns negative only in inflation-free 2012 when the bus fleets are to be purchased. It will not be difficult to borrow this amount of deficit.



Source: JICA Team estimates

Figure 9.2-10 Net Cash Flow after Corporate Tax (2009 price)



Source: JICA Team estimates

Figure 9.2-11 Net Cash Flow after Corporate Tax (Current price)

Table 9.2-28 Annual Profit and Loss and Cash Flow in Constant Price

(R$ million: 2009 price)

P&L Statement	Total	2010	2011	2012	2013	2014	2015	2016	2017	2018
Account										
Revenue	5182.5	0.0	0.0	0.0	54.3	111.2	113.7	156.9	201.7	205.9
Operating and Maintenance Cost	2111.2	0.0	0.0	0.0	21.2	45.4	63.4	68.9	71.4	74.1
Depreciation	719.4	0.0	0.0	0.0	0.0	18.9	22.8	24.7	26.6	28.6
Operating Income	2351.8	0.0	0.0	0.0	33.1	46.9	27.5	63.2	103.8	103.3
Interest Payment/Commitment Fee	0.0	0.0	0.0	0.0	0.0	28.0	33.0	32.4	30.9	29.0
Interst Payment on STL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Profit before Tax	2186.6	0.0	0.0	0.0	33.1	18.9	-5.5	30.8	72.9	74.2
Corporate Tax	623.2	0.0	0.0	0.0	9.4	5.4	0.0	8.8	20.8	21.2
Net Profit after Tax	1563.4	0.0	0.0	0.0	23.7	13.5	-5.5	22.0	52.1	53.1
Cash Flow										
Loan	266.4	0.0	0.0	0.0	188.6	54.6	23.2	0.0	0.0	0.0
Paid up Capital	75.4	0.0	0.0	75.4	0.0	0.0	0.0	0.0	0.0	0.0
Investment	-595.7	0.0	0.0	0.0	-188.6	-54.6	-23.2	-19.2	-19.2	-5.6
Net Profit After Tax	1563.4	0.0	0.0	0.0	23.7	13.5	-5.5	22.0	52.1	53.1
Depreciation	719.4	0.0	0.0	0.0	0.0	18.9	22.8	24.7	26.6	28.6
Repayment	-234.9	0.0	0.0	0.0	-18.9	-24.3	-26.6	-28.6	-30.5	-30.5
Net Cash Flow	1452.2	0.0	0.0	75.4	4.8	8.1	-9.3	-1.0	29.1	45.6
Cumulative Cash Flow before interest	16491.4	0.0	0.0	75.4	80.2	88.3	79.0	78.0	107.1	152.7
Interest on Short-Term Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Cash Flow after STL interest		0.0	0.0	75.4	4.8	8.1	-9.3	-1.0	29.1	45.6
Cumulative Cash Flow after Interest		0.0	0.0	75.4	80.2	88.3	79.0	78.0	107.1	152.7
Internal Rate of Return										
Project IRR after Tax	22.59%	0.0	0.0	0.0	-164.9	-22.2	-5.9	27.6	59.6	76.1
Equity IRR	25.47%	0.0	0.0	-75.4	0.0	0.0	0.0	-1.0	29.1	45.6

P&L Statement	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Account										
Revenue	210.1	214.3	218.5	222.7	226.9	231.1	235.3	235.3	235.3	235.3
Operating and Maintenance Cost	77.2	80.4	83.7	87.2	90.9	94.7	98.8	98.8	98.8	98.8
Depreciation	29.2	29.7	30.3	30.9	31.4	32.0	32.6	32.6	32.6	32.6
Operation Income	103.7	104.2	104.5	104.6	104.6	104.4	104.0	104.0	104.0	104.0
Interest Payment/Commitment Fee	24.0	19.0	13.9	8.9	3.9	2.0	0.9	0.3	0.0	0.0
Interst Payment on STL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Profit before Tax	79.7	85.3	90.6	95.7	100.7	102.4	103.0	103.6	104.0	104.0
Corporate Tax	22.7	24.3	25.8	27.3	28.7	29.2	29.4	29.5	29.6	29.6
Net Profit after Tax	57.0	61.0	64.8	68.4	72.0	73.2	73.7	74.1	74.3	74.3
Cash Flow										
Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Paid up Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment	-5.1	-5.1	-5.1	-5.1	-148.5	-41.3	-18.1	-18.1	-18.1	-5.1
Net Profit After Tax	57.0	61.0	64.8	68.4	72.0	73.2	73.7	74.1	74.3	74.3
Depreciation	29.2	29.7	30.3	30.9	31.4	32.0	32.6	32.6	32.6	32.6
Repayment	-30.5	-30.5	-30.5	-30.5	-11.6	-6.2	-3.8	-1.9	0.0	0.0
Net Cash Flow	50.6	55.2	59.5	63.8	-56.6	57.8	84.3	86.7	88.8	101.8
Cumulative Cash Flow before interest	203.4	258.5	318.1	381.8	325.2	383.0	467.3	553.9	642.8	744.6
Interest on Short-Term Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Cash Flow after STL interest	50.6	55.2	59.5	63.8	-56.6	57.8	84.3	86.7	88.8	101.8
Cumulative Cash Flow after Interest	203.4	258.5	318.1	381.8	325.2	383.0	467.3	553.9	642.8	744.6
Internal Rate of Return										
Project IRR after Tax	81.1	85.6	90.0	94.2	-45.0	63.9	88.1	88.6	88.8	101.8
Equity IRR	50.6	55.2	59.5	63.8	-56.6	57.8	84.3	86.7	88.8	101.8

P&L Statement	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Account										
Revenue	235.3	235.3	235.3	235.3	235.3	235.3	235.3	235.3	235.3	235.3
Operating and Maintenance Cost	98.8	98.8	98.8	98.8	98.8	98.8	98.8	98.8	98.8	98.8
Depreciation	32.6	32.6	32.6	32.6	32.6	32.6	32.6	32.6	32.6	32.6
Operation Income	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0
Interest Payment/Commitment Fee	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interst Payment on STL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Profit before Tax	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0
Corporate Tax	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6
Net Profit after Tax	74.3	74.3	74.3	74.3	74.3	74.3	74.3	74.3	74.3	74.3
Cash Flow										
Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Paid up Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment	-5.1	-5.1	-5.1	-5.1	-148.5	-41.3	-18.1	-18.1	-18.1	-18.1
Net Profit After Tax	74.3	74.3	74.3	74.3	74.3	74.3	74.3	74.3	74.3	74.3
Depreciation	32.6	32.6	32.6	32.6	32.6	32.6	32.6	32.6	32.6	32.6
Repayment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Cash Flow	101.8	101.8	101.8	101.8	-41.6	65.6	88.8	88.8	88.8	88.8
Cumulative Cash Flow before interest	846.4	948.3	1050.1	1151.9	1110.3	1176.0	1264.8	1353.6	1442.4	1531.2
Interest on Short-Term Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Cash Flow after STL interest	101.8	101.8	101.8	101.8	-41.6	65.6	88.8	88.8	88.8	88.8
Cumulative Cash Flow after Interest	846.4	948.3	1050.1	1151.9	1110.3	1176.0	1264.8	1353.6	1442.4	1531.2
Internal Rate of Return										
Project IRR after Tax	101.8	101.8	101.8	101.8	-41.6	65.6	88.8	88.8	88.8	88.8
Equity IRR	101.8	101.8	101.8	101.8	-41.6	65.6	88.8	88.8	88.8	88.8

Source: JICA Team estimates

Table 9.2-29 Profit and Loss and Cash Flow in Current Price

(R$ million: current price)

P&L Statement	Total	2010	2011	2012	2013	2014	2015	2016	2017	2018
Account										
Revenue	48412.2	0.0	0.0	0.0	79.0	183.2	212.3	331.9	426.8	493.6
Operating and Maintenance Cost	25688.9	0.0	0.0	0.0	30.8	74.7	118.4	145.8	171.0	201.2
Depreciation	4635.3	0.0	0.0	0.0	0.0	27.7	34.1	37.7	41.8	46.4
Operating Income	18088.0	0.0	0.0	0.0	48.2	80.8	59.9	148.4	214.0	245.9
Interest Payment/Commitment Fee	0.0	0.0	0.0	0.0	0.0	40.7	49.6	50.0	49.3	48.7
Interst Payment on STL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Profit before Tax	17811.4	0.0	0.0	0.0	48.2	40.1	10.3	98.4	164.7	197.2
Corporate Tax	5076.3	0.0	0.0	0.0	13.7	11.4	2.9	28.0	46.9	56.2
Net Profit after Tax	12735.2	0.0	0.0	0.0	34.5	28.6	7.4	70.3	117.7	141.0
Cash Flow										
Loan	407.7	0.0	0.0	0.0	274.3	90.0	43.4	0.0	0.0	0.0
Paid up Capital	96.8	0.0	0.0	96.8	0.0	0.0	0.0	0.0	0.0	0.0
Investment	-7333.2	0.0	0.0	0.0	-274.3	-90.0	-43.4	-40.5	-45.9	-15.1
Net Profit After Tax	12735.2	0.0	0.0	0.0	34.5	28.6	7.4	70.3	117.7	141.0
Depreciation	4635.3	0.0	0.0	0.0	0.0	27.7	34.1	37.7	41.8	46.4
Repayment	-389.5	0.0	0.0	0.0	-27.4	-36.4	-40.8	-44.8	-49.4	-49.4
Net Cash Flow	9647.8	0.0	0.0	96.8	7.0	19.9	0.7	22.7	64.2	122.9
Cumulative Cash Flow before interest	67471.8	0.0	0.0	96.8	103.8	123.7	124.4	147.0	211.3	334.2
Interest on Short-Term Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Cash Flow after STL interest		0.0	0.0	96.8	7.0	19.9	0.7	22.7	64.2	122.9
Cumulative Cash Flow after Interest		0.0	0.0	96.8	103.8	123.7	124.4	147.0	211.3	334.2
Internal Rate of Return										
Project IRR after Tax	32.75%	0.0	0.0	0.0	-239.8	-33.7	-2.0	67.5	113.6	172.3
Equity IRR	38.59%	0.0	0.0	-96.8	0.0	0.0	0.0	22.7	64.2	122.9

P&L Statement	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Account										
Revenue	570.6	659.4	672.3	776.3	896.2	1034.1	1192.9	1351.6	1531.3	1735.0
Operating and Maintenance Cost	237.6	280.1	330.5	390.3	460.6	544.2	642.8	728.3	825.1	934.9
Depreciation	48.0	49.7	51.7	61.0	64.3	119.4	138.0	147.0	156.8	167.9
Operation Income	285.0	329.5	290.1	325.1	371.2	370.5	412.1	476.4	549.4	632.3
Interest Payment/Commitment Fee	40.6	32.4	24.3	16.1	8.0	4.3	2.2	0.8	0.0	0.0
Interst Payment on STL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Profit before Tax	244.4	297.1	265.8	309.0	363.3	366.1	409.9	475.6	549.4	632.3
Corporate Tax	69.7	84.7	75.8	88.1	103.5	104.4	116.8	135.5	156.6	180.2
Net Profit after Tax	174.8	212.5	190.1	220.9	259.8	261.8	293.1	340.1	392.9	452.1
Cash Flow										
Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Paid up Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment	-15.6	-17.7	-20.0	-22.7	-752.8	-237.1	-117.8	-133.5	-151.2	-48.0
Net Profit After Tax	174.8	212.5	190.1	220.9	259.8	261.8	293.1	340.1	392.9	452.1
Depreciation	48.0	49.7	51.7	61.0	64.3	119.4	138.0	147.0	156.8	167.9
Repayment	-49.4	-49.4	-49.4	-49.4	-22.0	-13.0	-8.6	-4.6	0.0	0.0
Net Cash Flow	157.7	195.1	172.4	209.8	-450.7	131.2	304.7	349.0	398.4	571.9
Cumulative Cash Flow before interest	491.9	687.0	859.3	1069.2	618.5	749.7	1054.3	1403.3	1801.7	2373.7
Interest on Short-Term Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Cash Flow after STL interest	157.7	195.1	172.4	209.8	-450.7	131.2	304.7	349.0	398.4	571.9
Cumulative Cash Flow after Interest	491.9	687.0	859.3	1069.2	618.5	749.7	1054.3	1403.3	1801.7	2373.7
Internal Rate of Return										
Project IRR after Tax	207.1	244.5	221.8	259.2	-428.7	144.2	313.3	353.6	398.4	571.9
Equity IRR	157.7	195.1	172.4	209.8	-450.7	131.2	304.7	349.0	398.4	571.9

P&L Statement	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Account										
Revenue	1965.8	2227.2	2523.4	2859.0	3239.3	3670.1	4158.3	4711.3	5337.9	6047.8
Operating and Maintenance Cost	1059.2	1200.1	1359.7	1540.5	1745.4	1977.6	2240.6	2538.6	2876.2	3258.7
Depreciation	171.7	195.1	202.0	208.6	216.2	404.8	464.5	494.7	528.8	619.4
Operation Income	734.9	832.1	961.8	1109.9	1277.7	1287.8	1453.2	1678.1	1932.9	2169.7
Interest Payment/Commitment Fee	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interst Payment on STL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Profit before Tax	734.9	832.1	961.8	1109.9	1277.7	1287.8	1453.2	1678.1	1932.9	2169.7
Corporate Tax	209.4	237.1	274.1	316.3	364.1	367.0	414.2	478.3	550.9	618.4
Net Profit after Tax	525.4	594.9	687.7	793.6	913.6	920.8	1039.0	1199.8	1382.0	1551.4
Cash Flow										
Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Paid up Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment	-54.4	-61.6	-69.8	-79.1	-2623.9	-826.4	-410.6	-465.2	-527.1	-597.2
Net Profit After Tax	525.4	594.9	687.7	793.6	913.6	920.8	1039.0	1199.8	1382.0	1551.4
Depreciation	171.7	195.1	202.0	208.6	216.2	404.8	464.5	494.7	528.8	619.4
Repayment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Cash Flow	642.7	728.4	819.8	923.1	-1494.2	499.2	1092.9	1229.3	1383.8	1573.6
Cumulative Cash Flow before interest	3016.4	3744.8	4564.6	5487.7	3993.5	4492.7	5585.6	6814.9	8198.6	9772.2
Interest on Short-Term Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Cash Flow after STL interest	642.7	728.4	819.8	923.1	-1494.2	499.2	1092.9	1229.3	1383.8	1573.6
Cumulative Cash Flow after Interest	3016.4	3744.8	4564.6	5487.7	3993.5	4492.7	5585.6	6814.9	8198.6	9772.2
Internal Rate of Return										
Project IRR after Tax	642.7	728.4	819.8	923.1	-1494.2	499.2	1092.9	1229.3	1383.8	1573.6
Equity IRR	642.7	728.4	819.8	923.1	-1494.2	499.2	1092.9	1229.3	1383.8	1573.6

Source: JICA Team estimates

Table 9.2-30 summarizes the financial criteria for project evaluation from Table 9.2-28 and Table 9.2-29. The internal rate of return is 22.6% in real terms. The rate is appreciably lower than the IRR of 38.1% calculated for the project as a whole, because it is after paying the corporate and the service tax of 23.5% and 5%. The difference in percentage between the current and the real terms approximates the anticipated inflation. The estimated rate of some 20% in real terms clearly shows that the proposed project is a highly profitable venture. It will be possible to renew the bus fleets after ten years without any borrowing.

The equity IRR is the ratio of the annual increases of cash-in-hand to the capital stock. The rate of about 25.5% in real terms is quite high and very attractive to shareholders.

Table 9.2-30 Financial Indices of Evaluation after Tax

(R$ million for NPV)

	Nominal Terms	Real Terms
Project IRR after Tax	32.8%	22.6%
Equity IRR	38.6%	25.5%
Net Present Value (discount rate of 12%)	794.0	137.8

Source: JICA Team estimates

(8) Cash Flow for the Government

It is necessary to examine the return from the proposed project to the public sector. The state government invests in the infrastructural facilities and maintains them for project operation, while receiving tax revenue from the project operation. The state government is responsible for maintenance and management of the facilities, but it is assumed that the bus company pays the cost of such maintenance. Accordingly, this cost is excluded from the cash flow analysis for the government. Although taxes are federal, state and municipal, they are treated as one for the present purpose. In addition, some tax component contained in the cost of operating the trunk bus system (purchase of fuels, salaries and wages and other expenses) is also ignored in the analysis. The corporate tax and the service tax are entered in the cash flow.

The results of analysis are shown in Table 9.2-31. The internal rate of return is 1.0% and the net present value is minus R$266million. In other words, the public sector is in deficit for R$266 million at present value. The amount is equivalent to 33% of the total project cost.

Table 9.2-31 Cash Flow for the Government

(R$ million: 2009 price)

Year	Construction Cost	Tax Revenue		Cash Flow	Discounted Cash Flow	
		During Construction	After the Start of Operation		Construction	Tax Revenue
2010	6.9	2.1	0.0	-4.8	6.1	1.9
2011	25.0	7.7	0.0	-17.2	19.9	6.2
2012	380.7	118.0	0.0	-262.7	271.0	84.0
2013	293.3	90.9	9.4	-192.9	186.4	63.8
2014	72.2	22.4	5.4	-44.4	41.0	15.8
2015	20.2	6.3	0.0	-13.9	10.2	3.2
2016			8.8	8.8	0.0	4.0
2017			20.8	20.8	0.0	8.4
2018			21.2	21.2	0.0	7.6
2019			22.7	22.7	0.0	7.3
2020			24.3	24.3	0.0	7.0
2021			25.8	25.8	0.0	6.6
2022			27.3	27.3	0.0	6.3
2023			28.7	28.7	0.0	5.9
2024			29.2	29.2	0.0	5.3
2025			29.4	29.4	0.0	4.8
2026			29.5	29.5	0.0	4.3
2027			29.6	29.6	0.0	3.9
2028			29.6	29.6	0.0	3.4
2029			29.6	29.6	0.0	3.1
2030			29.6	29.6	0.0	2.7
2031			29.6	29.6	0.0	2.4
2032			29.6	29.6	0.0	2.2
2033			29.6	29.6	0.0	2.0
2034			29.6	29.6	0.0	1.7
2035			29.6	29.6	0.0	1.6
2036			29.6	29.6	0.0	1.4
2037			29.6	29.6	0.0	1.2
2038			29.6	29.6	0.0	1.1
Total	798.3	247.5	638.0	87.2	534.6	269.0

Source: JICA Team estimates

IRR	1.0%
NPV (12%)	-265.6

9.2.3. CONCLUSION

The conclusion from the foregoing economic and financial analysis can be summed up as follows.

1) A trunk bus project requires relatively small initial investment and thus its economic internal rate of return is usually high.[1] The project proposed for Belem shows a high 18.9%, indicating satisfactory feasibility. The sensitivity analysis shows that the project feasibility would not be seriously affected either by a 80% increase in cost or a 36% drop in benefit.

2) The financial analysis of the entire project estimates the F-IRR of 6.6%. The rate suggests that the project would be implementable as a non-profit public service by the government authorities with a concessional ODA loan as Japan's ODA Loan. However, the rate is too low to justify the private sector investment inclusive of infrastructure development.

[1] For example, another JICA team proposed in its 2007 – 2008 study a trunk bus system called metro bus for metropolitan Istanbul (rapid bus service on the exclusive inner lane of the highway). The project is estimated to have the E-IRR ranging from 31% to 140% during Phases 4 through 10, averaging 101%.

3) By using the PPP scheme in which the government takes care of the necessary infrastructural development and the private interest operates the trunk bus service, the project is expected to have a high internal rate of return, 22.6% after tax.

4) The cash flow analysis indicates that the project operation is financially self-sustainable after the initial borrowing from BNDES for the purchase of fleet vehicles (at the interest rate of 16.5%).

5) If Phase II of the proposed project should be cancelled after the completion of Phase I, the economic IRR would be down to 13.8%, while the running of the bus company under the PPP scheme would drop from the F-IRR of 38.1% to 27.7%. Both the economic and the financial feasibility of the project remain adequate nonetheless. However, it is recommendable to implement Phase II for its excellent investment efficiency.

6) Although the government must shoulder the full cost of infrastructural development, it should be able to recover substantial part of the investment as tax revenue, about 50% of the project cost in net present value.

7) The articulated hybrid bus is yet too expensive to consider for the trunk bus system. Its known advantage in fuel efficiency alone does not pay, even if the certified credit obtainable for the CO_2 reduction is taken into account. It must be admitted however that the eco-mindedness of hybrid buses would be good public relations.

CHAPTER 10
CDM Projects

10. CDM PROJECTS

All documents, resolutions and cases cited in this chapter are as of March 2009.

10.1. GLOSSARY OF CDM-RELATED ACRONYMS

The following is the list of CDM-related acronyms used in this chapter.

Table 10.1-1 CDM-related Acronyms

AM	Approved Methodology
CDM	Clean Development Mechanism
CDM M&P	CDM Modalities and Procedures (Decision 17/CP.7, contained in the document FCCC/CP/2001/13/Add.2)
CER	Certified Emission Reduction
COP	Conference of the Parties to the UNFCCC
DAC	Development Assistance Committee
DCP	Documento de Concepcao de Projeto
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board
GHGs	Greenhouse Gases
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
ICGCC	Interministerial Commission on Global Climate Change
IPCC	Intergovernmental Panel on Climate Change
Meth Panel	Methodologies Panel
PDD	Project Design Document
PFCs	Perfluorocarbons
UNFCCC	United Nations Framework Convention on Climate Change

10.2. SUMMARY OF CDM PROJECTS IN BRAZIL

Table 10.2-1 lists CDM projects in various stages of preparation and implementation in Brazil. CDM projects approved by ICGCC totals 198, of which 156 have been registered by EB. Once approved by ICGCC in Brazil, most projects (so far 78%) have been endorsed and registered by EB.

Table 10.2-1 CDM Projects in Brazil

Authority	Classification	No.
ICGCC	Approved CDM projects	198
	Conditionally approved CDM projects	5
	CDM projects under review	8
	Projects under preparation for CDM application	3
	Total CDM projects under ICGCC	214
EB	Registered CDM projects	156
	Projects under deliberation	31
	Total projects under EB	187

Of the total CDM projects approved by ICGCC and registered by EB, Japanese enterprises are participating in the following projects, as shown in Table 10.2-2.

Table 10.2-2 Participation of Japanese Enterprises in ICGCC-approved and EB-registered CDM Projects in Brazil

No.	CDM Project	Participating Japanese Enterprise	Estimated Emission Reduction (tCO_2/year)	Date of Registration
23	GEEA Biomass 5 MW Power Plant Project	Chugoku Electric Power	19,486	Jul. 19, 2008
22	GEEA-SBS Biomass Treatment Project in Alegrete, Rio Grande do Sul, Brazil	Mitsubishi UFJ Securities	19,223	Sep. 14, 2007
21	Ceran's Monte Claro Run of River Hydropower Plant CDM Project Activity	Tokyo Electric Power	121,721	Apr. 8, 2007
20	Canabrava Landfill Gas Project	Natsource Japan	202,867	Apr. 8, 2007
19	Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)	Japan Carbon Finance	107,881	Dec. 31, 2006
18	Aquarius Hydroelectric Project	J-Power	13,436	Dec. 15, 2006
17	ARAPUtanga Centrais ELétricas S. A. - ARAPUCEL - Small Hydroelectric Power Plants Project	Chugoku Electric Power	106,924	Dec. 15, 2006
16	Cachoeira – Encobelta – Toriunfo Small Hydropower Plant, Brascan Energetica Minas Gerais S. A.	Chugoku Electric Power	45,337	Oct. 2, 2006
15	Nova Sinceridade Small Hydroelectric Power Plant - Brascan Energética Minas Gerais S.A. (BEMG) Project Activity	Chugoku Electric Power	17,086	Sep. 24, 2006
14	Jaguari Energética S. A. – Furnas do Segredo Small Hydro Power Plant	Chugoku Electric Power	28,189	Sep. 8, 2006
13	Palestina Small Hydroelectric Power Plant - Brascan Energética Minas Gerais S.A. (BEMG) Project Activity	Chugoku Electric Power	27,357	Aug. 28, 2006
12	Lages Methane Avoidance Projec	Consortium of 10 enterprises*	220,496	Apr. 23, 2006
11	BT Geradora de Energia Elétrica S. A. – Ferradura Small Hydro Power Plant – Small Scale CDM Project	Chugoku Electric Power	23,496	Apr. 22, 2006
10	Usinas Itamarati Cogeneration Project	Chugoku Electric Power	7,990	Apr. 6, 2006
9	Caieiras landfill gas emission reduction	J-Power	770,932	Mar. 9, 2006
8	Southeast Caeté Mills Bagasse Cogeneration Project (SECMBCP)	Chugoku Electric Power	30,326	Mar. 3, 2006
7	Bioenergia Cogeradora S.A. (“Bioenergia”), corresponding to the Santo Antonio Mill (USA – from the Portuguese “Usina Santo Antônio”) and the São Francisco mill (USFR – from the Portuguese “Usina São Francisco”)	Chugoku Electric Power	20,840	Mar. 3, 2006
6	Pesqueiro Energia Small Hydroelectric Project (PESHP)	Chugoku Electric Power	42,009	Feb. 26, 2006
5	Alta Mogiana Bagasse Cogeneration Project (AMBCP)	Consortium of 10 enterprises*	12,024	Feb. 20, 2006
4	Koblitz - Piratini Energia S. A - Biomass Power Plant – Small Scale CDM Project	Chugoku Electric Power, Mitsui Sumitomo Bank, Japan Smart Energy	172,763	Feb. 11, 2006
3	Brazil MARCA Landfill Gas to Energy Project	Showa Shell Petroleum	231,405	Jan. 23, 2006
2	N_2O Emission Reduction in Paulínia, SP, Brazil	Rhodia Japan	5,961,165	Dec. 25, 2005
1	Salvador da Bahia Landfill Gas Management Project	Showa Shell Petroleum	664,674	Aug. 8, 2005

* Seven regional electric power companies (Kyushu, Shikoku, Chugoku, Chubu, Tokyo and Tohoku), Mitsui & Co., Mit Carbon Fund, Mitsubishi Corp. and Japan Bank for International Cooperation (JBIC).

10.3. PROCEDURE OF CDM APPLICATION IN BRAZIL

10.3.1. CDM SYSTEM AND DECISION MAKING BODIES

(1) Evolution of CDM System

Table 10.3-1 summarizes the evolution of the CDM system in Brazil in reference to official resolutions.

Table 10.3-1 Outline of CDM-related Official Resolutions

Resolution	Date of Decision	Outline of Resolution
Establishment of ICGCC	Jul. 7, 1999	Interministerial Commission on Global Climate Change was established by Presidential Decree of July 7, 1999.
Resolution No. 1	Nov. 11, 2003	Establishes the procedures for approval of project activities under the Clean Development Mechanism of the Kyoto Protocol and makes other provisions. Approved by Administrative Ruling no. 863, of November 27, 2003 and published in the Federal Official Gazette of December 2, 2003
Resolution No. 2	Aug. 10, 2005	Changes Resolution No. 1 of September 11, 2003, which establishes the procedures for approval of project activities under the Clean Development Mechanism of the Kyoto Protocol, approves the procedures for afforestation and reforestation project activities under the Clean Development Mechanism of the Kyoto Protocol
Revision of Pres. Decree	Jan. 10, 2006	Revision of the Presidential Decree of July 7, 1999
Resolution No. 3	Mar. 24, 2006	Establishes the procedures for approval of small scale project activities under the Clean Development Mechanism of the Kyoto Protocol, among other provisions. Published in the Federal Official Gazette of May 19, 2006
Resolution No. 4	Dec. 6, 2006	Amends Resolutions no. 1 and no. 3 of this Commission, among other provisions. Published in the Federal Official Gazette of December 26, 2006
Resolution No. 5	Apr. 11, 2007	Revises the definitions for small-scale Clean Development Mechanism project activities, among other provisions. Published in the Federal Official Gazette of April 11, 2007
Resolution No. 6	Jun. 6, 2007	Amends Resolution no. 2, of August 10, 2005, with regard to the version of the project design document of the Clean Development Mechanism Executive Board. Published in the Federal Official Gazette of June 27, 2007
Resolution No. 7	Mar. 5, 2008	Amends resolutions no. 1, no. 2, no. 3 and no. 4 of this same Commission concerning the invitations for comments sent by project proponents to the stakeholders involved, interested and/or affected by project activities under the Clean Development Mechanism and provides other measures
Resolution No. 8	May 26, 2008	Adopts a single system as definition of a project electric system in the National Interconnected System for purposes of CDM project activity
Resolution No. 9	Mar. 20, 2009	Determines the Clean Development Mechanism Programme of Activities

(2) Organizational Setup for CDM Project Approval

The interministerial Commission on Global Climate Change is the designated national authority (DNA) for CDM project approval in Brazil. ICGCC meets every two months, with participation of the representatives from the following 11 government ministries.

I) Ministry of External Relations (Ministerio das Relacoes Exteriores)

II) Ministry of Agriculture, Fisheries and Food Supply (Ministerio da Agricultura, Pecuaria e Abastecimento)

III) Ministry of Transport (Ministerio dos Transportes)

IV) Ministry of Mining and Energy (Ministerio de Minas e Energia)

V) Ministry of Planning, Budgeting and Operation (Ministerio do Planejamento, Orcamento e Gestao: wording amended by Decree of Jan. 10, 2006)

VI) Ministry of Environment (Ministerio do Meio Ambiante), providing the vice-chairman of ICGCC

VII) Ministry of Science and Technology (Ministerio da Ciencia e Tecnologia), providing the chairman and the secretariat for ICGCC

VIII) Ministry of Development, Industry and International Trade (Ministerio do Desenvolvimento, Industria e Comercio Exterior: wording amended by Decree of Jan. 10, 2006)

IX) Secretariat of President's Office (Casa Civil da Presidencia da Republica)

X) Ministry of Cities (Ministerio das Cidades: wording amended by Decree of Jan. 10, 2006)

XI) Ministry of Finance (Ministerio da Fazenda: wording amended by the Decree of Jan. 10, 2006)

10.3.2. Procedure of CDM Application in Brazil

(1) Steps of CDM Application and Project Approval

The procedure of CDM application and project approval is shown in Figure 10.3-1.

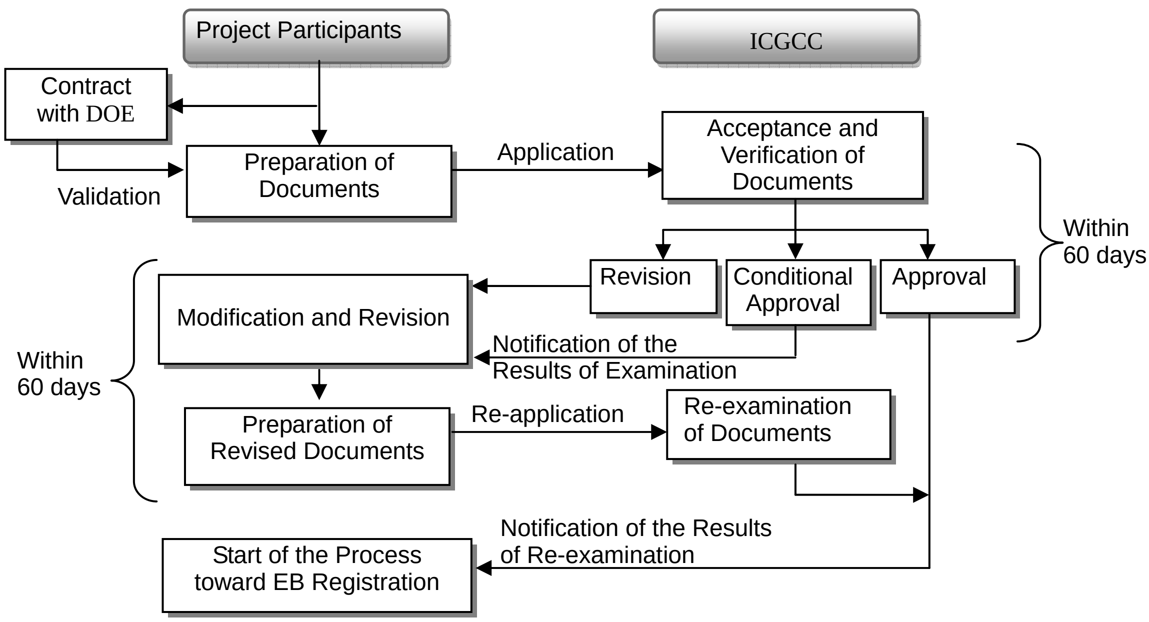


Figure 10.3-1 Procedure of CDM Application and Project Approval

(2) Necessary Documents

The first step is to submit necessary application documents to the Executive Secretary of the Interministerial Commission on Global Climate Change. ICGCC examines the applications for approval and notifies the applicants of its decisions within 60 days. All applications are open to the public including project design documents, although certain confidential information is not disclosed under the protection of the relevant Brazilian law. The application must be presented both in paper document and computer file that are identical in content.

The application to ICGCC consists of the following documents.

Forward Letter

(1) The project design document (PDD) written in English as stipulated in the EB regulations (cf. 10.6.1)

(2) The DCP written in Portuguese as stipulated in the ICGCC regulations (cf. the next (3))

(3) The document as stipulated in Annex III of Resolution No. 1

(4) Stakeholders' comments

(5) The validation report by the designated operational entity (in English and Portuguese)

(6) The declaration of participation

(7) Declaration of the designated operational entity (DOE)

Table 10.3-2 Documents Submitted to the ICGCC Executive Secretary

Document	Paper Document	Computer File
Forward letter	●	●
Project design document (PDD)	●	●
Documento de concepcao de projeto (DCP)	●	●
Document as stipulated in Annex III of Resolution No. 1	●	●
Stakeholders' comments	●	●
Validation report (in English and Portuguese)	●	●
Declaration of participation	●	●
Declaration of DOE	●	●
Other related information	●	●

1) PDD

The requirements of the project design document are described in detail in Section 10.6.1.

2) DCP

A DCP is a PDD written in Portuguese. Only the documents written in Portuguese are legally binding in Brazil and subject to the ICGCC examination and approval. Therefore, the content of the DCP must conform to the description of PDD. If the two documents do not correspond exactly, ICGCC is authorized to request a review during the process of EB examination (Resolution No. 3, Clause 9).

The DCP must be prepared in the latest form as required by ICGCC. The application form was first stipulated in Annex II of Resolution No. 1 of Dec. 2, 2003. The latest form shown in Figure 10.3-2 is the third version as revised in July 28, 2006 (Resolution No. 6, Annex I).

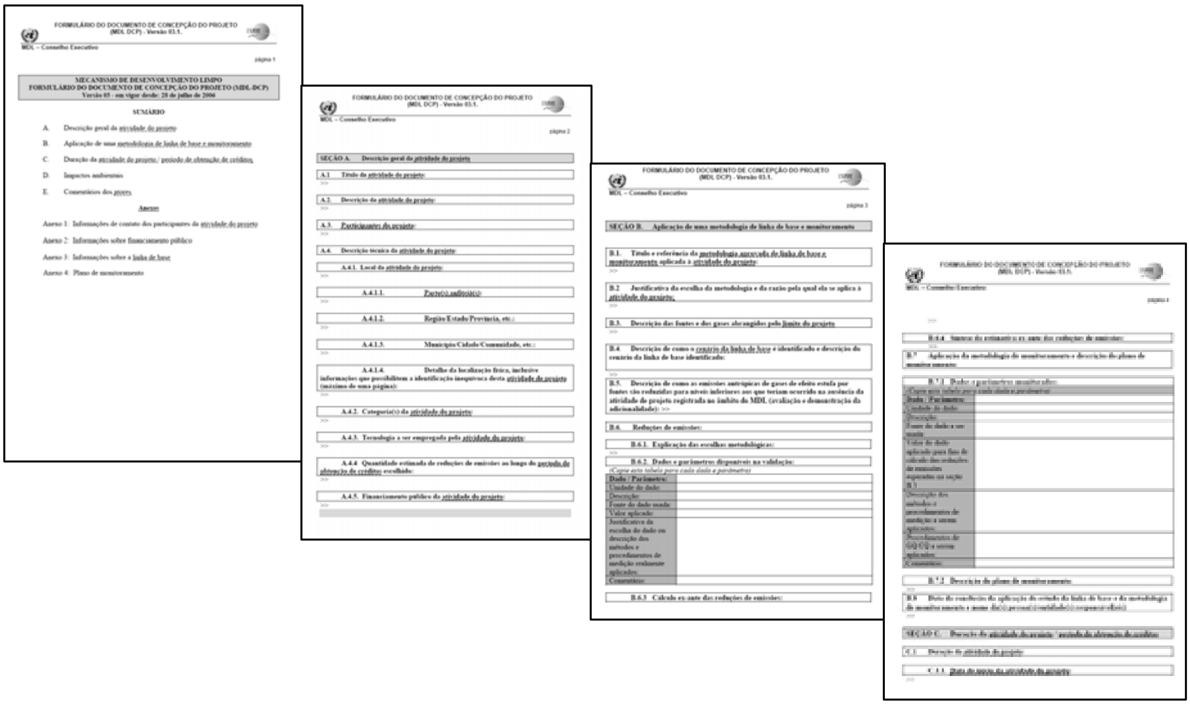


Figure 10.3-2 DCP Form (Version 3)

3) Annex III

Resolution No. 1 of 2003 states in its Annex III the contribution to be made by CDM projects to sustainable development. The annex describes the following five points of interest regarding the contribution of CDM projects.

(1) Contribution to the environmental sustainability of local communities

(2) Contribution to the improvement of labor relations and the creation of job opportunities

(3) Contribution to the fairer income distribution

(4) Contribution to the development of technologies and human skills

(5) Contribution to the integrated regional development through project implementation

The information and data contained in the DCP/PDD and the validation report thereof must conform to the statement of Annex III.

Anexo III - Contribuição da Atividade de Projeto para o Desenvolvimento Sustentável

Os participantes do projeto deverão descrever se e como a atividade de projeto contribuirá para o desenvolvimento sustentável no que diz respeito aos seguintes aspectos:

a) Contribuição para a sustentabilidade ambiental local

Avalia a mitigação dos impactos ambientais locais (resíduos sólidos, efluentes líquidos, poluentes atmosféricos, dentre outros) propiciada pelo projeto em comparação com os impactos ambientais locais estimados para o cenário de referência.

b) Contribuição para o desenvolvimento das condições de trabalho e a geração líquida de empregos

Avalia o compromisso do projeto com responsabilidades sociais e trabalhistas, programas de saúde e educação e defesa dos direitos civis. Avalia, também, o incremento no nível qualitativo e quantitativo de empregos (diretos e indiretos) comparando-se o cenário do projeto com o cenário de referência.

c) Contribuição para a distribuição de renda

Avalia os efeitos diretos e indiretos sobre a qualidade de vida das populações de baixa renda, observando os benefícios socioeconômicos propiciados pelo projeto em relação ao cenário de referência.

d) Contribuição para capacitação e desenvolvimento tecnológico

Avalia o grau de inovação tecnológica do projeto em relação ao cenário de referência e às tecnologias empregadas em atividades passíveis de comparação com as previstas no projeto. Avalia também a possibilidade de reprodução da tecnologia empregada, observando o seu efeito demonstrativo, avaliando, ainda, a origem dos equipamentos, a existência de *royalties* e de licenças tecnológicas e a necessidade de assistência técnica internacional.

e) Contribuição para a integração regional e a articulação com outros setores

A contribuição para o desenvolvimento regional pode ser medida a partir da integração do projeto com outras atividades socioeconômicas na região de sua implantação.

Figure 10.3-3 Annex III of Resolution No. 1

4) Stakeholders' Comments

The opinions over a proposed CDM project must be collected from stakeholders and submitted to ICGCC. Relevant stakeholders would be as follows.

(1) Municipal offices and councils
(2) State government departments or bureaus for environmental administration
(3) Municipal departments or bureaus for environmental administration
(4) NGO forum (Forum Brasileiro de Organizacoes nao-Governamentais)
(5) Local communities directly and indirectly influenced by the proposed CDM project
(6) Representatives and heads of local municipal governments
(7) Ministerio Publico Federal

5) *Validation Report*

A project application must be evaluated by the third independent party (DOE) whether the project in question satisfies the CDM requirements. Figure 10.3-4 shows an example of the validation report.

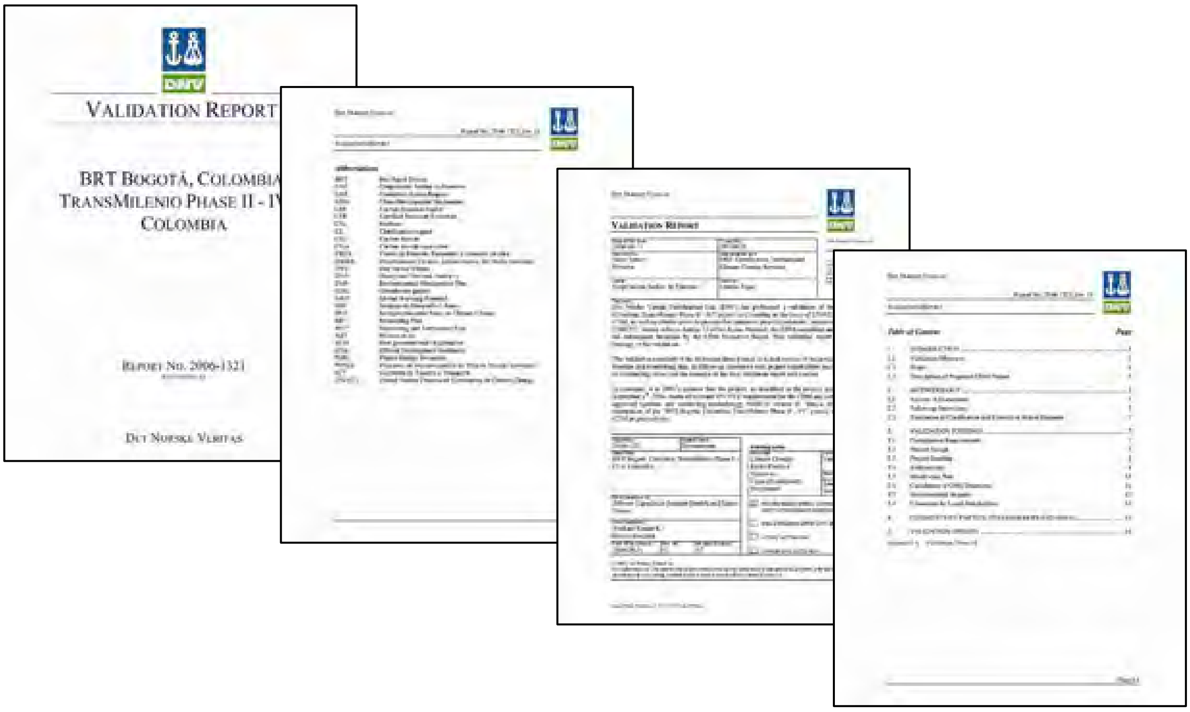


Figure 10.3-4 An Example of the Validation Report (on BRT Bogota Colombia: TransMilenio Phases II through IV)

6) *Declaration of Participation*

A declaration of participation must be attached with the following documents.

(1) Testimony to the observance of the communication and information disclosure requirement

(2) Testimony to the environmental conservation efforts in project activities

(3) Testimony to the adherence to the requirements of the labor law.

DECLARAÇÃO

(O participante do projeto), em atendimento ao inciso IV do Artigo 3° da Resolução n° 1 da Comissão Interministerial de Mudança Global do Clima, vem declarar que:

O responsável pela comunicação com a Secretaria Executiva da Comissão Interministerial de Mudança Global do Clima do projeto (nome do projeto e localização), é (o nome e o CNPJ da Empresa), representada por (Nome, nacionalidade, estado civil, profissão), que pode ser contatado no (endereço, telefones, fax correio eletrônico).

Data:

Assinatura do representante legal de cada participante nacional da atividade de projeto.

Figure 10.3-5 Letterhead of Declaration (Portuguese version)

7) Declaration of DOE

An EB-designated operational entity undertakes project validation. DOEs must be formally registered as corporate entities in Brazil. Table 10.3.3 shows DOEs incorporated in Brazil, with their qualified capability in the transport sector.

Table 10.3-3 DOEs Incorporated in Brazil

Firm	Country of Origin	Capability in Transport Sector
Det Norske Veritas Certification AS	United Kingdom of Great Britain and Northern Ireland	Qualified
SGS United Kingdom Ltd.	United Kingdom of Great Britain and Northern Ireland	Qualified
TÜV NORD CERT GmbH	Germany	Qualified
Bureau Veritas Certification Holding SAS	United Kingdom of Great Britain and Northern Ireland	Not qualified
RINA S.p.A.	Italy	Qualified
Spanish Association for Standardisation and Certification	Spain	Not qualified
Colombian Institute for Technical Standards and Certification	Colombia	Not qualified

Figure 10.3-6 shows the declaration form used by designated operational entities in Brazil.

DECLARAÇÃO DA ENTIDADE OPERACIONAL DESIGNADA

(A Entidade Operacional Designada), em atendimento ao Artigo 4° da Resolução n° 1 da Comissão Interministerial de Mudança Global do Clima, vem declarar que:

1) Foi credenciada junto ao Conselho Executivo do Mecanismo de Desenvolvimento Limpo em (data), estando este credenciamento em vigor na presente data para os seguintes escopos específicos de atuação: xxx.

2) É plenamente estabelecida no Brasil, desde (data), no endereço (endereço telefone).

3) Tem capacidade de assegurar o cumprimento dos requerimentos pertinentes da Legislação Brasileira.

Data:

Assinatura do responsável pela Entidade Operacional Designada.

Figure 10.3-6 Declaration by DOE (in Portuguese)

(3) Procedure after Approval

When a proposed project activity is approved, the Letter of Approval, signed by the Minister of Science and Technology, is forwarded to the national proponents of the CDM project activity immediately as soon as possible after the meeting of the Interministerial Commission that decided for the approval.

(4) Procedure after Conditional Approval

If the proposed project activity is approved conditionally, the Executive Secretary of the Interministerial Commission will forward to the proponent a letter indicating the restrictions that need to be solved before a Letter of Approval. A project activity will be approved with restrictions if its contribution to sustainable development is considered adequate by the members of the Interministerial Commission, but it contains editorial errors or inconsistencies that would not affect the relevance of the proposal itself and could be corrected with relative ease. If necessary, the project proponent can send a communication requesting additional clarification of the restrictions.

The proponent must correct the project documentation as required by the CGCC, and submit the corrected version within the period not exceeding 60 days after the receipt of the “restrictions” letter. If the deadline is not met, the project application may be judged withdrawn.

When the corrected version is considered satisfactory by the Executive Secretary of CGCC, the Letter of Approval is immediately forwarded to the project proponent.

(5) Procedure for Revision

When the application is judged inadequate for approval, the applicant receives a letter from ICGCC specifying what is required for revision. The applicant has to revise the application to the ICGCC specifications and submit the revised version within 60 days. If the re-submission should be late, the project itself would be denied approval.

If the revision satisfies ICGCC, the letter of approval will be immediately sent to the applicant. ICGCC is to spend at least 10 days (excluding holidays) to make sure that the application is in fact revised to the ICGCC requirements.

(6) Revocation and Cancellation of Approval

The ICGCC approval once issued would be revoked or cancelled any time during the process of application or of project implementation, if the evidence proves some legal infraction or damage to the public interests.

(7) Procedural Schedule

1) Approved CDM Projects

(1) Deadline for delivery of the documents to ensure that the project is submitted at the next meeting of ICGCC

(2) Receipt and check up of the documentation

(3) Meeting of ICGCC

(4) Public dissemination at the site of the Ministry of Science and Technology

(5) Deadline for ICGCC to analyze the project

(6) Issuance of the Letter of Approval, if the project was considered approved by the members of ICGCC

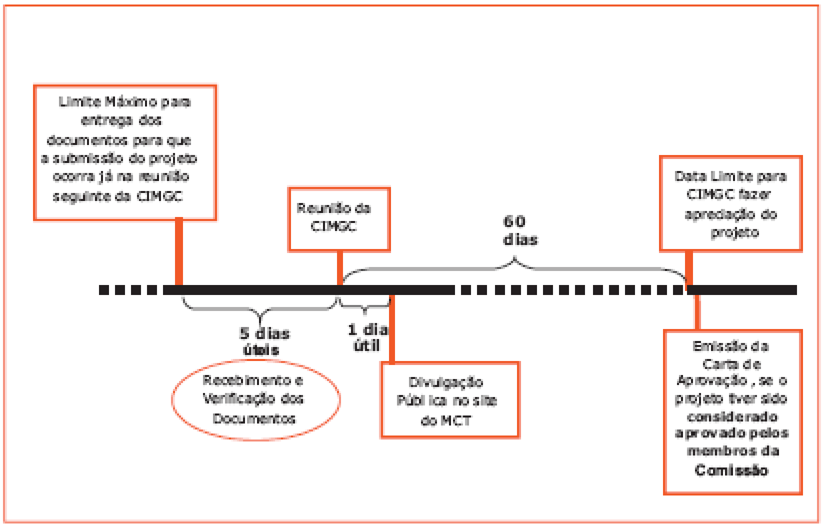


Figure 10.3-7 Schedule for Approval

2) Conditionally Approved Projects

(1) Analysis of the Project by ICGCC

(2) Letter forwarded to the responsible for communication indicating the restrictions that shall be addressed before approval of the project

(3) Receipt of the letter by the Project Proponents

(4) Deadline to meet the requirements by ICGCC

(5) Issuance of the Letter of Approval after corrections are considered satisfactory by the Executive Secretary of ICGCC

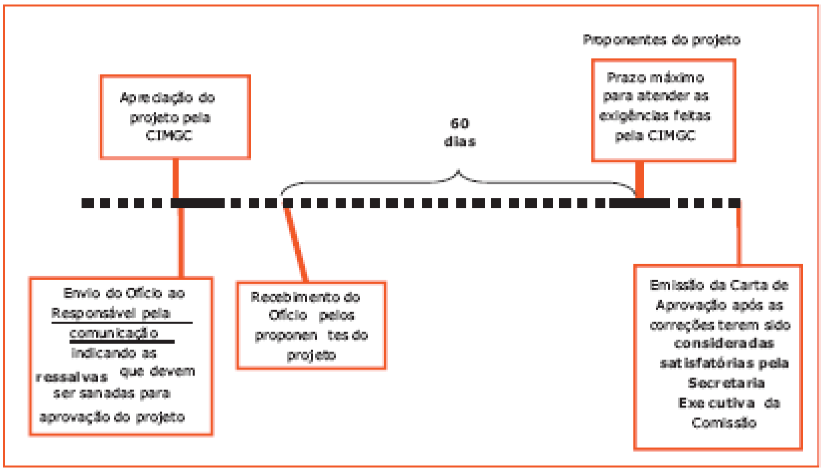


Figure 10.3-8 Schedule for Conditional Approval

3) Projects to be Revised

(1) Analysis of the Project by ICGCC

(2) Projects under Revision: Letter forwarded to the responsible for communication explaining the reasons of the decision by ICGCC

(3) Receipt of the letter by the Project Proponents

(4) Deadline to meet the requirements by ICGCC

(5) Issuance of the Letter of Approval after corrections are considered satisfactory by the members of ICGCC

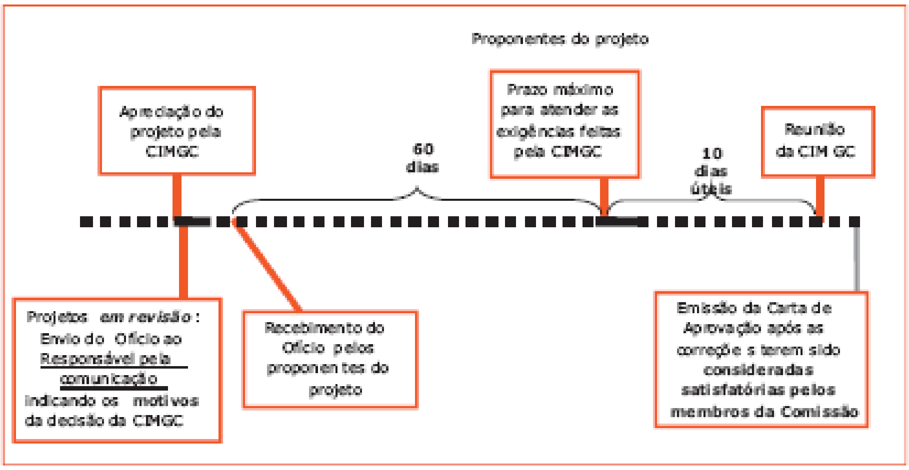


Figure 10.3-9 Schedule for Revision

10.3.3. PROCEDURES OF EB REGISTRATION AFTER ICGCC APPROVAL

After the IGCC approval in Brazil, the proposed project activity is brought up to the Executive Board for registration. The project is formally recognized as a CDM project after the registration. The procedures of registration are as follows.

- The Letter of Approval signed by the Minister of Science and Technology is forwarded to the project proponent.

- The DOE forwards the PDD and other documentation to the Secretariat of UNFCC.
- The project documentation is closely examined by the EB directors and when found satisfactory, is registered as a CDM project.

10.3.4. Reminders for CDM Applicants

CDM project participants from countries other than Brazil need be reminded of certain issues and problems that may arise during the process of application.

- It must be kept in mind that ICGCC revokes its approval when some legal breach is discovered regarding any already approved CDM project (Resolution No. 4). Prospective CDM participants must be alert to any possibility of legal transgressions during the process of application.
- The PDD and the DCP are required to be identical in content. The likely course of action would be to finish a PDD first and then after careful examination of the document translate it into a DCP. The satisfactory translation into Portuguese would take, for example, three weeks or so for a 100-page PDD. (The PDD for the BRT Bogota Colombia: TransMilenio Phases II to IV, Project Approval No. 0672, was as long as 120 pages.)
- It would be better to have the validation report by the third-party DOE written in English. The report should be translated into Portuguese only after careful examination of the English version.
- Regarding other documents necessary for CDM application, it will be wise to check up on any application in progress and thereby get the latest documentary requirements. For this purpose, it is desirable to secure the support from a local consultant in Brazil.
- Before submitting the application documents to ICGCC, it would be better to confer with some experienced DOE. This might help smoothen up the actual process of CDM application later on. In Japan, for example, there are a number of DOEs qualified to conduct analysis necessary for validation in the transport sector (e.g., Japan Quality Assurance Organization). Such organizations will be able to give advices worth listening to.
- At the present moment, ICGCC has no explicit rules or provisions for the CDM application financed by ODA.
- The relationship between ODA and CDM had been in discussion since Marrakech Agreement in 2001. At the high-level DAC meeting held in April 2004, it was agreed that the ODA spending on CDM projects could be recorded as ODA of the donor in the DAC report after deducting the amount equivalent to the credit gained by the donor for emission reduction.[1]

  On June 22, 2007, after three years since the DAC agreement, the CDM project by JBIC（Japan Bank of International Cooperation, now taken over by JICA） and Japan Carbon Finance Co., viz. Zafarana Aerogeneration Project in the Arab Republic of Egypt, was approved registration by EB. In other words, it is possible to obtain EB registration for an ODA-financed CDM project.
- It is necessary to state explicitly in the PDD that the project finance is not the misappropriation of ODA, with a letter of certification from the donor.

[1] Statement Adopted by Members of the OECD’s Development Assistance Committee (DAC) High Level Meeting, pp. 15-16, April 2004.

10.4. APPLICABLE ALTERNATIVE APPROVED METHODOLOGIES AND COLLECTION OF RELEVANT INFORMATION

10.4.1. APPLICABLE ALTERNATIVE APPROVED METHODOLOGIES

(1) Sectoral Scopes

As shown in Table 10.4-1, the Clean Development Mechanism covers 15 different sectoral scopes for project application and approval. The procedure of application and the approved methodology vary among these sectoral scopes. The trunk bus system in Belem is classified as a transport project of Scope 7.

Table 10.4-1 Sectoral Scopes for CDM Projects

Scope No.	Sectoral Scopes
1	Energy industry (recyclable / non-recyclable energies)
2	Energy supply
3	Energy demand
4	Manufacturing
5	Chemical industry
6	Construction industry
7	Transport
8	Mining and mineral resource processing
9	Metal industry
10	Leakage of fuels (solid, petroleum, gas)
11	Leakage of halocarbon and sulfur hexafluoride during production and consumption
12	Use of solvents
13	Processing and disposal of wastes
14	Afforestation and reforestation
15	Agriculture

(2) Approved Methodologies Available for Trunk Bus Project

A CDM applicant needs to ascertain whether any approved methodology is available for the sectoral scope in which the project in question is classified. If there is no ready AM, the applicant will have to develop a new suitable AM for CDM application.

As of March 2009, the only available approved methodology for the transportation sector is AM0031 entitled “Baseline Methodology for Bus Rapid Transit Projects.” This AM was proposed and approved in the CDM application of BRT Bogota Colombia: TransMilenio Phases II to IV. AM0031 is approved for BRT projects and therefore suitable to the trunk bus project in Belem.

10.4.2. OUTLINE OF BRT BOGOTA COLOMBIA: TRANSMILENIO PHASES II TO IV

Table 10.4.2 shows the skeleton profile of BRT Bogota Colombia: TransMilenio Phases II to IV in which AM0031 was used.

Table 10.4-2 Outline of BRT Bogota Colombia: TransMilenio Phases II to IV

Project number	0672
Project title	BRT Bogotá Colombia: TransMilenio Phase II to IV
Registration date	07/12/2006
Start of crediting period	01/01/2006
Sector scope	Transport
Methodology used	AM0031 “Baseline Methodology for Bus Rapid Transit Projects”
Monitoring period	01/01/2008 – 31/12/2008
Project participants	TransMilenio S.A. and CAF

Host country	Colombia
Project developer	Grütter Consulting (Swiss consultant)

10.4.3. Applicability of AM0031

AM0031 is considered applicable to those projects that newly construct and operate a BRT system, or improvement projects that expand the existing BRT network, for the purpose of reducing emissions. The projects have to satisfy the following conditions.

- The project has a clear plan to reduce existing public transport capacities either through scrapping, permit restrictions, economic instruments or other means and replacing them by a BRT system;
- Local regulations do not constrain the establishment or expansion of a BRT system;
- The fuel(s) used in the baseline and/or project case are unblended[2] gasoline, diesel, LNG or CNG. Projects using biofuels either in the baseline or project case are not eligible to use this methodology;[3]
- The project activity BRT system is road-based. The baseline public transport system and other public transport options are road- or rail-based (the methodology excludes air and waterbased systems from analysis). However the methodology is not applicable if the project activity BRT system replaces an urban rail-based Mass Rapid Transit System (MRTS), i.e. if the MRTS stops operating after project implementation due to the project activity;
- The BRT system partially or fully replaces a traditional public transport system in a given city. The methodology cannot be used for BRT systems in areas where currently no public transport is available;
- The methodology is applicable if the analysis of possible baseline scenario alternatives leads to the result that a continuation of the current public transport system is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity (i.e. the baseline scenario).

Table 10.4-3 summarizes the applicability of AM0031 to the trunk bus system proposed for Belem.

Table 10.4-3 Applicability of AM0031 to Trunk Bus Project

Condition for Application	Situation of Trunk Bus Project
The project has a clear plan how to reduce existing public transport capacities either through scrapping, permit restrictions, economic instruments or other means and replacing them by a BRT system.	The project replaces the present public transport system with a BRT system of trunk bus service.
Local regulations do not constrain the establishment or expansion of a BRT system.	The proposed project strictly conforms to the regulations on the national, state and municipal levels.
Fuels used in the baseline and/or project case are unblended gasoline, diesel, LNG or CNG. Projects using bio-fuels either in the baseline or project case are not eligible to use this methodology.	The proposed BRT system uses diesel and do not use bio fuels. When the possibility of hybrid buses is examined, the analysis utilizes emission factors publicly announced by bus manufacturers. The project is a trunk bus system and excludes from monitoring and analysis passenger cars, taxis, buses unrelated to the project and other vehicles. Those vehicles other than trunk buses are taken into account only when the baseline emissions are estimated.

[2] Less than 3 % fuel additive is permitted.

[3] Project participants wishing to consider biofuels may propose a revision to this methodology.

	In the baseline transport system, 90% of the public transport (buses) uses diesel. Bio fuels are not used at all. 28.1% of passenger cars use ethanol-mixed gasoline and other bio fuel mixtures. IPCC now publishes the emission factors of vehicles that use fuels containing alcohol. It is therefore possible to calculate the emissions of such bio gasoline cars for the baseline analysis.
The BRT system as well as the baseline public transport system and other public transport options are road-based.	The baseline public transport system, the proposed BRT system and other possible public transport options all concern road transport only.
The BRT system partially or fully replaces a traditional public transport system in a given city. The methodology cannot be used for BRT systems in areas where currently no public transport is available.	The trunk bus system will gradually replace the present public transport system. The present system is operating in the metropolitan area of Belem where the proposed project will directly influence.
The methodology is applicable if the analysis of possible baseline scenario alternatives leads to the result that a continuation of the current public transport system is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity (i.e. the baseline scenario)	The baseline scenario assumes that the present system will continue to operate in the future, as mentioned in 11.5.2 of Chapter 10.

10.4.4. Time Limit on AM0031 Application

AM0031 has been effective since July 28, 2006 and there is no stipulation to end its future application. It is safe to apply it to the trunk bus system.

10.4.5. Applicability of AMs for Small-scale Projects

AM0031 is so far the only approved methodology in the transport sector. The present Study examined the applicability of five AMs developed for small-scale projects, as shown below.

- AMS III.C（Emission reduction by low-greenhouse gas emitting vehicles）
- AMS-III.S（Introduction of low-emission vehicles to commercial vehicle fleets）
- AMS-III.T（Plant oil production and use for transport application）
- AMS-III.U（Cable Cars for Mass Rapid Transit System）
- AMS-III.AA（Transportation Energy Efficiency Activities Using Retrofit Technologies）

Among the five considered, only AMS II.C appears to have some relevance to the trunk bus project. The present Study considers that the introduction of hybrid buses would be economically too early for the trunk bus system, based on the financial and economic analysis. Therefore, this AM is not applied to the estimation of emissions.

However, if the advancement of technology should serve to lower the price of the hybrid bus substantially by 2013, it would become necessary to consider the possibility of introducing it to the trunk bus system. In such a case, the estimation of emission reductions will have to be made by studying the performance of BRT systems that use hybrid buses.

Table 10.4-4 Applicability of Small-scale AMS

Small-scale AM	Conditions for Application	Applicability to Trunk Bus Project
AMS III.C (Emission reduction by low-greenhouse gas emitting vehicles)	Shift from conventional vehicles to the less GHGs emitting vehicles like electric cars and hybrid cars.	Applicable if and when the trunk bus system introduces hybrid buses
AMS-III.S (Introduction of low-emission vehicles to commercial vehicle fleets)	Project activities introducing low-greenhouse gas emitting vehicles for commercial passenger and freight transport, operating on a number of identified fixed routes.	Not applicable The trunk bus system includes neither commercial cars nor freight vehicles, and needs no navigational support of the kind proposed in the AM.
AMS-III.T (Plant oil production and use for transport application)	Utilization of fuels derived from plants and vegetables	Not applicable The trunk bus system does not use fuels of plant origin.
AMS-III.U (Cable Cars for Mass Rapid Transit System)	Introduction of a mass transit system by cable car to replace the road-based public transport	Not applicable There is no possibility of the cable car system in the area to be serviced by the trunk bus system.
AMS-III.AA (Transportation Energy Efficiency Activities Using Retrofit Technologies)	Improvement of fuel efficiency by the addition of new engine parts	Not applicable The trunk bus project does not include the improvement of fuel efficiency by the introduction of new engine parts.

10.4.6. Possibility of CDM Approval

As shown in Table 10.4-4, the trunk bus project is fit for the conditions necessary for the application of AM0031, almost but not quite. However, because IPCC publishes the emission factors of ethanol-mixed fuels and AM0031 will remain effective for application, it is reasonable to expect that the trunk bus project will get the CDM approval. The remaining need is to obtain relevant information on a possible DOE, as mentioned below.

10.5. ANALYSIS OF GHGS EMISSION REDUCTION

The present Study calculated the emission reduction by applying AM0031 to the estimation of GHGs emissions of the baseline scenario and the following two cases of project implementation.

1) Implementation of all the projects updated by the present Study: Phases I and II
2) Implementation of those projects selected for the Yen Credit application: Y-net development (hereafter referred to as Phase I)

10.5.1. Scenario for Emission Reduction

A number of options are adopted in the trunk bus system to compare anthropogenic GHGs emitted between “with” and “without” situations.

Objective of the Project: Replacement of the present public transport system by a more efficient system which will radically reduce the emission of GHGs from passenger traffic

The emission reduction results from the following options taken for the trunk bus system.

- Replacement of the bus fleet:

  The present buses are in operation for some 15 years on average. The project proposes a fleet of new bus type manufactured with advanced technology. The fuel efficiency is sure to rise, thus reducing the emission of GHGs.

- Increase of bus capacity:

The fleet consists of buses with 160-passenger capacity, much larger than the present fleet. This will reduce the emission per passenger kilometer.

- Improvement of the bus operating rate:

The provision of exclusive and priority trunk bus lanes will eliminate the traffic interference by other vehicles and enable more efficient operation of the available fleet. This reduces the consumption of fuels and thus the emission of GHGs. The present bus fleet has to compete with other motorized vehicles for the same road space.

- Centralized bus-fleet control:

The centralized control enables a coordinated scheduling of bus services that dynamically adjusts bus frequency with demand. Fewer buses are scheduled during off-peak hours. The load factor of the bus fleet is thus optimized, leading to lower emissions per passenger transported. The present conventional system consists of a large number of very small bus companies, with no mutual schedule coordination. The load factors of their fleets drop sharply during off-peak hours, because individual operators continue their daily services to cover the variable costs of operation. A centrally controlled system reduces the total vehicle operating cost by optimizing the daily load factor of bus fleet.

- Improvement of Operation Service:

The advantages of the BRT system are speed, stability, safety and convenience of service. The proposed trunk bus system will reduce the travel time of passengers and improve the amenity and safety during travel.

- Introduction of the prepaid fare system:

The prepaid fare system will speed the flow of passengers at the time of boarding, and thus reduce the emission of GHGs during idling.

10.5.2. ESTIMATION OF EMISSION IN BASELINE SCENARIO

The emission in the baseline scenario is estimated in the steps indicated in

Figure 10.5-1.

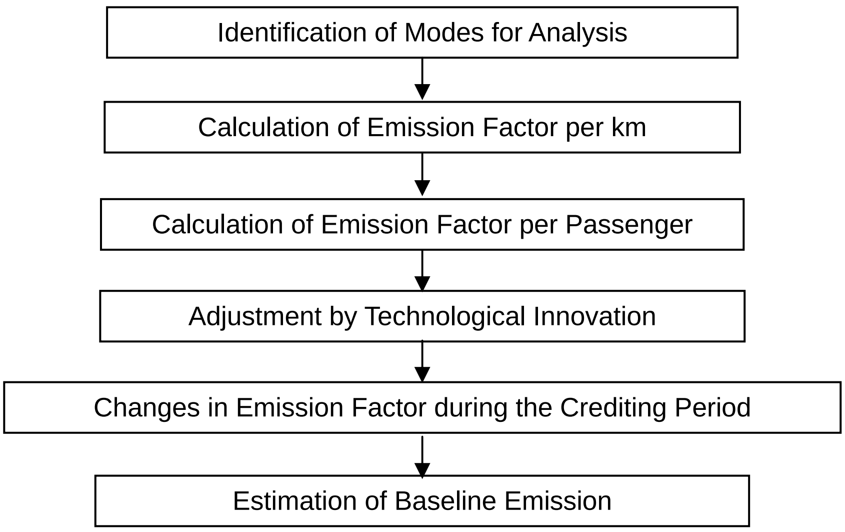


Figure 10.5-1 Steps for Estimating Baseline Emission

10.5.3. CREDITING PERIOD

It is necessary to establish the start and the duration of the crediting period during which the emission reduction is certified for a CDM project. The start of the CDM status for a given project is the starting date of implementation, construction or any action taken for the project. The crediting period for a given project starts when the estimated emission reduction is validated by a DOE and lasts for the duration chosen by the project participants. There are two options for choosing the duration of the crediting period.

(1) Fixed Crediting Period

The start and the duration of the crediting period are unchangeable after a given CDM project is registered as such. The maximum period is 10 years.

(2) Renewable Crediting Period

The first crediting period is 7 years at maximum and renewable twice at maximum. The longest possible period is thus 21 years. At the time of renewal, it is necessary to have the validity of the original baseline scenario or the updated version derived from new data base reconfirmed by the DOE and then to notify EB accordingly.

The following points need be noted for the interest of project participants.

- The crediting period should not exceed the period of project operation.
- The start of the CDM status does not necessarily coincide with that of the crediting period.
- It is necessary to decide the start and the duration of the crediting period before EB registration is finalized. The project participants can decide the starting date after the registration, unless they choose the retroactive crediting option.[4]

After close examination of the available options mentioned above, the emission reduction is estimated by assuming the CDM starting date of 2013 and the crediting period of 10 years.

10.5.4. ESTIMATED EMISSION REDUCTION WITH CDM APPROVAL (CASE 1: PHASES I & II, DIESEL BUS)

(1) Basic Parameters

Basic parameters and other factors used for estimation are summarized with their sources and brief descriptions in Table 10.5-1.

Table 10.5-1 Parameters for Estimating Emission Reduction

Parameter	Source	Comment
Specific energy consumption of fuel type x in vehicle category i	Arpel, 2005, Measurement of In-Service Vehicle Emissions in Sao Paulo, Santiago and Buenos Aires	Vintage 2005; see arguments chapter E.4. 2.1. why this value is considered as conservative; original data was taken from the report including only gasoline fuelled vehicles in the three cities; the value taken is the average mean of the average means of each city; emissions reported in gr. CO2 were converted to liters gasoline based on EFCO2
emission factor for fuel type x	IPCC	Default value; see baseline methodology Appendix A, Table A.1.
Number of vehicles in vehicle category i using fuel type x	GOVERNO DO ESTADO DO PARÁ DEPARTAMENTO DE TRÂNSITO DO ESTADO DO PARÁ DIRETORIA DE TECNOLOGIA DA INFORMAÇÃO REFERÊNCIA:	
Total number of vehicles in category i		

[4] It is possible to claim the retroactive CER dating back to the year 2000, which was before the first commitment period (2008 – 2012) stipulated in the Kyoto Protocol.

	MARÇO/2009 ASSUNTO : IDADE FROTA, TIPO, COMBUSTIVEL POR MUNICIPIO.	
Number of vehicles in vehicle category large bus using fuel type diesel	SETRAN/BEL, Mai/2009	
average trip distance for vehicle category i	Report 2009	
average vehicle occupancy rate of vehicle category i	Report 2009	Summary of Screen line and Cordon line Past Volume（2009）
Specific energy consumption of fuel type x in project bus category j in year y	TransMilenio 2006	Data of fuel consumption reported by all trunk route operators 1-5, 2006
Leakage emissions from construction in year y		Implementation Program for Trunk Busway Projects (Package-1 and 2)
Bus units scrapped by project in year w, where w = 1 to y (NB: if buses are not scrapped the estimated number of retired buses is taken)	SETRAN/BEL, Mai/2009	
Emissions factor for bus manufacturing	SAEFL	Based on default value in baseline methodology Appendix A, leakage parameters, number 3
Upstream emissions multiplier, based on default factor from literature (see appendix)	L-Bsystemtechnik GmbH, 2002	Based on default value in baseline methodology Appendix A, baseline and project emissions parameters number 5

(2) Points for Attention

- The estimated emission for the baseline scenario is converted to CO2.
- The modes used for estimation consist of passenger car, small bus and large bus in the baseline scenario and feeder bus and articulated trunk bus added in the project implementing scenario.

(3) Steps for Estimating Emission Reduction

The key steps used to estimate the emission reduction are as follows.

1) *Step 1: Determination of Baseline Emissions*

$$BE_y = \sum_i \left(EF_{P,i,y} \times P_{i,y} \right)$$

Where:

BE_y Baseline emissions in year y (CO_2e)

$EF_{P,i,y}$ Transport emissions factor per passenger in vehicle category i in year y (grams per passenger)

$P_{i,y}$ Passengers transported by the project (BRT) in year y that without the project activity would have used category i, where i= Z (buses, public transport), T (taxis), C (passenger cars) or M (motorcycles)[5] (millions of passengers).

2) *Step 2: Project activity emissions*

Alternative B: Use of Specific Fuel Consumption and Distance Data

$$PF_y = \left[\left(EF_{KM,TB,y} \times DD_{TB,y} \right) + \left(EF_{KM,FB,y} \times DD_{FB,y} \right) \right]$$

[5] NMT and IT are not included as emissions are 0 for this category in the baseline

Where:

PE_y Project emissions in year y (tCO2e)

$EF_{KM,TB,y}$ Transport emissions factor per distance for trunk buses in year y (gCO_2e per kilometer)

$DD_{TB,y}$ Total distance driven by trunk buses in year y (million kilometers)

$EF_{KM,FB,y}$ Transport emissions factor per distance for feeder buses in year y (gCO_2e per kilometer)

$DD_{FB,y}$ Total distance driven by feeder buses in year y (million kilometers)

3) *Step 3: Total Leakage*

$$LE_y = LE_{UP,y} + LE_{LF,Z,y} + LE_{LF,T,y} + LE_{CONG,y}$$

Where:

LE_y Emissions leakage in year y (CO_2e)

$LE_{UP,y}$ Leakage emissions due to upstream processes in year y (tCO_2e)

$LE_{LF,Z,y}$ Leakage emissions from change of load factor in buses in year y (tCO_2e)

$LE_{LF,T,y}$ Leakage emissions from change of load factor in taxis in year y (tCO_2e)

$LE_{CONG,y}$ Leakage emissions from reduced congestion in year y (tCO_2e)

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

If $LE_y > 0$, then leakage is included

Emission reductions

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y Emission reductions in year y (tCO_2e)

BE_y Baseline emissions in year y (CO_2e)

PE_y Project emissions in year y (CO_2e)

LE_y Emissions leakage in year y (CO_2e)

(4) Results of Estimation

The total emission reduction by the CDM implementation of the trunk bus project is estimated at 360,900 t/CO2eq, as shown in from Table 10.5-2. to 10.5-5. The annual average emission is 36,090 t/CO2eq. The details of the estimation are given in the PDD in the Annex of this report. The estimated figure for the trunk bus project in Belem stands as reasonable as the estimation for the BRT in Bogota, after adjusting the differences in the size of fleet, transport demand and other factors between the two cities.

Table 10.5-2 Baseline Emissions

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
$EF_{P,C,y}$	1385	1389	1392	1396	1399	1403	1408	1414	1420	1425
$EF_{P,Z,y}$	5265	5486	5534	5693	5666	5562	5458	5636	5821	5654
$P_{C,y}$	1.81	1.90	1.99	2.09	2.18	2.27	2.44	2.60	2.77	2.93
$P_{Z,y}$	2.91	2.96	3.01	3.06	3.11	3.16	3.23	3.31	3.38	3.45
BE_y	49427	52328	53840	56313	57221	57457	58355	61800	65383	65679

Where:

EFP,i,y — Transport emissions factor per passenger in vehicle category i in year y (grams per passenger)

Pi,y — Passengers transported by the project which in absence of latter would have used transport type i, where i= Z (buses, public transport), T (taxis), C (passenger cars), M (motorcycles), NMT (non-motorized transport) and IT (induced transport, i.e. would not have travelled in absence of project) (millions).

Table 10.5-3 Emissions with Trunk Bus System

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
$EF_{KM,TB,y}$	9.6	9.6	9.5	9.4	9.4	9.3	9.3	9.3	9.3	9.3
$DD_{TB,y}$	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640
$EF_{KM,FB,y}$	6.1	6.0	5.9	5.7	5.6	5.4	5.4	5.4	5.5	5.5
$DD_{FB,y}$	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015
PE_y	21975	21740	21505	21270	21035	20800	20803	20806	20810	20813

Where:

EFKM,TB,y — Transport emissions factor per distance for trunk buses in year y (gCO2e per kilometer)

DDTB,y — Total distance driven by trunk buses in year y (million kilometers)

EFKM,FB,y — Transport emissions factor per distance for feeder buses in year y (gCO2e per kilometer)

DDFB,y — Total distance driven by feeder buses in year y (million kilometers)

Table 10.5-4 Leakage Emissions with Trunk Bus System

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
$LE_{UP,y}$	2385	959	935	789	1152	1685	2022	1715	1388	2001
$LE_{LF,Z,y}$	0	0	0	0	0	0	0	0	0	0
$LE_{CONG,y}$	-1000	-1000	-1000	-1000	-1000	-1000	-1000	-1000	-1000	-1000
LE_y	1385	0	0	0	152	685	1022	715	388	1001

Where:

LEUP,y — Leakage emissions due to upstream processes in year y (tCO2e)

LELF,Z,y — Leakage emissions from change of load factor in buses in year y (tCO2e)

LECONG,y — Leakage emissions from reduced congestion in year y (tCO2e)

Table 10.5-5 Emission Reduction during Crediting Period

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	total
BE_y	49427	52328	53840	56313	57221	57457	58355	61800	65383	65679	577803
PE_y	21975	21740	21505	21270	21035	20800	20803	20806	20810	20813	211555
LE_y	1385	0	0	0	152	685	1022	715	388	1001	5349
ER_y	26067	30588	32336	35043	36034	35972	36530	40278	44185	43866	360900

(5) Expected Acquisition of Certified Emission Reductions (CER)

The CER acquisition during the crediting period of ten years could add up to US$1 to US$6 million, as shown in Table 10.5-6.

Table 10.5-6 Estimated Income from CER Sale

	USD 3/tCO_{2eq}	USD 10/tCO_{2eq}	USD 18/tCO_{2eq}
Total estimated reductions (tones of CO2 e)	360,900		
Expected Income in USD first crediting period	USD 1,000,000	USD 4,000,000	USD 6,000,000

For the sake of reference, for example, the BRT project in Bogota showed the average credited ratio of 48.2% per annum relative to the initial estimation during the monitored period from 2006 to 2008. The transactions of certified emission reductions require the payment of the following two commissions.

- Contribution to the overhead cost (SOP-Admin): 0.10/CER for the sale of up to 15,000t/CO2eq and 0.20/CER for the sale of over 15,000 t/CO2eq
- Contribution supporting the adaptation in developing countries (SOP-Adaptation): 2% of the issued CER

Assuming the credited ratio of 50% as ascertained by the monitoring and the deduction of two commissions, the expected acquisition of CER will vary from US$0.5 to 3.2 million as shown in Table 10.5-7.

Table 10.5-7 Estimated Income from CER Sale (after adjustment)

	USD 3/tCO_{2eq}	USD 10/tCO_{2eq}	USD 18/tCO_{2eq}
Total estimated reductions (tones of CO2 e)	360,900		
SOP-Admin	USD 34,590		
SOP-Adaptation	USD 3,609		
Expected Income in USD first crediting period	USD 500,000	USD 1,800,000	USD 3,200,000

10.5.5. Estimated Emission Reduction with CDM Approval(Case 2: Phases I & II, Hybrid Bus)

(1) Basic Parameters

Basic parameters used for estimation are the same as the diesel bus fleet (Table 10.5-1). However, the emission factor of the hybrid bus is yet unavailable from IPCC. Therefore, the ratio of green house gas reduction given by the manufacturer, Eletra Inc., i.e. a reduction of 90% vis-à-vis the conventional bus type of the said company, is used for the estimation.

(2) Results of Estimation

The total emission reduction by the CDM project implementation is 590,821 t/CO2eq, as shown in Table 10.5-8, or annual average emission of 59,082 t/CO2eq.

Table 10.5-8 Emission Reduction Estimated during Crediting Period

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	total
BE_y	49427	52328	53840	56313	57221	57457	58355	61800	65383	65679	577803
PE_y	210	208	206	203	201	199	199	199	199	199	2023
LE_y	-1662	0	0	0	-2764	-2199	-1862	-2170	-2497	-1885	-15040
ER_y	50879	52120	53635	56109	59785	59457	60018	63771	67682	67366	590821

(3) Expected Acquisition of CER

The CER acquisition over the crediting period could total from US$2 to 11 million, as shown in Table 10.5-9.

Table 10.5-9 Estimated Income from CER Sale

	USD 3/tCO_{2eq}	USD 10/tCO_{2eq}	USD 18/tCO_{2eq}
Total estimated reductions (tones of CO2 e)	590,821		
Expected Income in USD first crediting period	USD 2,000,000	USD 6,000,000	USD 11,000,000

Assuming the credited ratio of 50% as ascertained by the monitoring and the deduction of two commissions, the expected acquisition of CER will range from US$0.8 to 5.3 million as shown in Table 10.5-10.

Table 10.5-10 Estimated Income from CER Sale (after adjustment)

	USD 3/tCO_{2eq}	USD 10/tCO_{2eq}	USD 18/tCO_{2eq}
Total estimated reductions (tones of CO2 e)	590,821		
SOP-Admin	USD 57,582		
SOP-Adaptation	USD 5,908		
Expected Income in USD first crediting period	USD 800,000	USD 2,900,000	USD 5,300,000

10.5.6. Estimated Emission Reduction with CDM Approval (Case 3: Phase I, Diesel Bus)

(1) Basic Parameters

The parameters are exactly the same as Case 1.

(2) Results of Estimation

The emission reduction in Case 3 is estimated to reach 352,219 t/CO2eq, or an annual average of 35,222 t/CO2eq, as shown in Table 10.5.11.

Table 10.5-11 Emission Reduction Estimated during Crediting Period

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	total
BE_y	49427	52328	53840	56313	57221	57457	58355	61800	65383	65679	577803
PE_y	21975	21980	21985	21990	21995	22001	22003	22006	22008	22011	219954
LE_y	1385	0	0	0	202	740	1071	761	432	1040	5630
ER_y	26067	30348	31855	34323	35024	34716	35281	39033	42943	42629	352219

(3) Expected Acquisition of CER

The CER acquisition is estimated to range US$1 to 6 million, as shown in Table 10.5.12.

Table 10.5-12 Estimated Income from CER Sale

	USD 3/tCO_{2eq}	USD 10/tCO_{2eq}	USD 18/tCO_{2eq}
Total estimated reductions (tones of CO2 e)	352,219		
Expected Income in USD first crediting period	USD 1,000,000	USD 4,000,000	USD 6,000,000

With the credited ratio of 50% and the deduction of commissions, the estimated income from CER is estimated to amount to US$0.5 to 3.1 million, as shown in the table below.

Table 10.5-13 Estimated Income from CER Sale (after adjustment)

	USD 3/tCO_{2eq}	USD 10/tCO_{2eq}	USD 18/tCO_{2eq}
Total estimated reductions (tones of CO2 e)	352,219		
SOP-Admin	USD 33,722		
SOP-Adaptation	USD 3,522		
Expected Income in USD first crediting period	USD 500,000	USD 1,700,000	USD 3,100,000

10.5.7. ESTIMATED EMISSION REDUCTION WITH CDM APPROVAL (CASE 4: PHASE I, HYBRID BUS)

(1) Basic Parameters

The parameters are exactly the same with Case 1.

(2) Results of Estimation

The emission reduction in Case 4 is estimated to reach 591,424 t/CO2eq, an annual average of 59,142 t/CO2eq, as shown in Table 10.5.14.

Table 10.5-14 Emission Reduction Estimated during Crediting Period

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	total
BE_y	49427	52328	53840	56313	57221	57457	58355	61800	65383	65679	577803
PE_y	210	210	210	210	210	210	210	210	210	210	2103
LE_y	-1662	0	0	0	-2848	-2311	-1980	-2290	-2620	-2012	-15724
ER_y	50879	52118	53630	56103	59859	59558	60125	63880	67793	67481	591424

(3) Expected Acquisition of CER

The CER acquisition during the crediting period could range US$2 to 11 million, as shown in the table below.

Table 10.5-15 Estimated Income from CER Sale

	USD 3/tCO_{2eq}	USD 10/tCO_{2eq}	USD 18/tCO_{2eq}
Total estimated reductions (tones of CO2 e)	591,424		
Expected Income in USD first crediting period	USD 2,000,000	USD 6,000,000	USD 11,000,000

With the credited ratio of 50% and the deduction of commissions, the income from CER sale could amount to US$0.8 to 5.3 million, as shown in Table 10.5.16.

Table 10.5-16 Estimated Income from CER Sale (after adjustment)

	USD 3/tCO_{2eq}	USD 10/tCO_{2eq}	USD 18/tCO_{2eq}
Total estimated reductions (tones of CO2 e)	591,424		
SOP-Admin	USD 57,642		
SOP-Adaptation	USD 5,914		
Expected Income in USD first crediting period	USD 800,000	USD 2,900,000	USD 5,300,000

10.6. DRAFT PDD

The draft project design document is prepared partly according to the manual by the Ministry of Environment in Japan.[6] The following is the summary description of the PDD (the details of the PDD are presented in the volume on statistics and other information).

10.6.1. OUTLINE OF PDD

The process begins with the preparation of the CDM project design document (CDM-PDD), which describes the intended project activities and the manner in which the baseline method is applied to formulate the project. The PDD is then submitted to EB to undergo the process of validation, periodic verification and certification. The PDD must be prepared according to the latest form prescribed by EB. The latest form in force is the third version released on July 28, 2006.[7]

[6] Ministry of Environment, *The Study of CDM/JI Projects: the Manual for Project Implementation*, 2007 (in Japanese).

[7] A revision of the PDD from becomes effective when it is formally adopted by the Executive Board (EB). The following allowances must be noted regarding the EB's revision. A new version of the form does not apply to

The detailed guideline, "the Guideline for Preparing CDM-PDDs and CDM-NMs," is published together with the PDD form. The project participants need to refer to the latest guideline when they prepare PDDs.

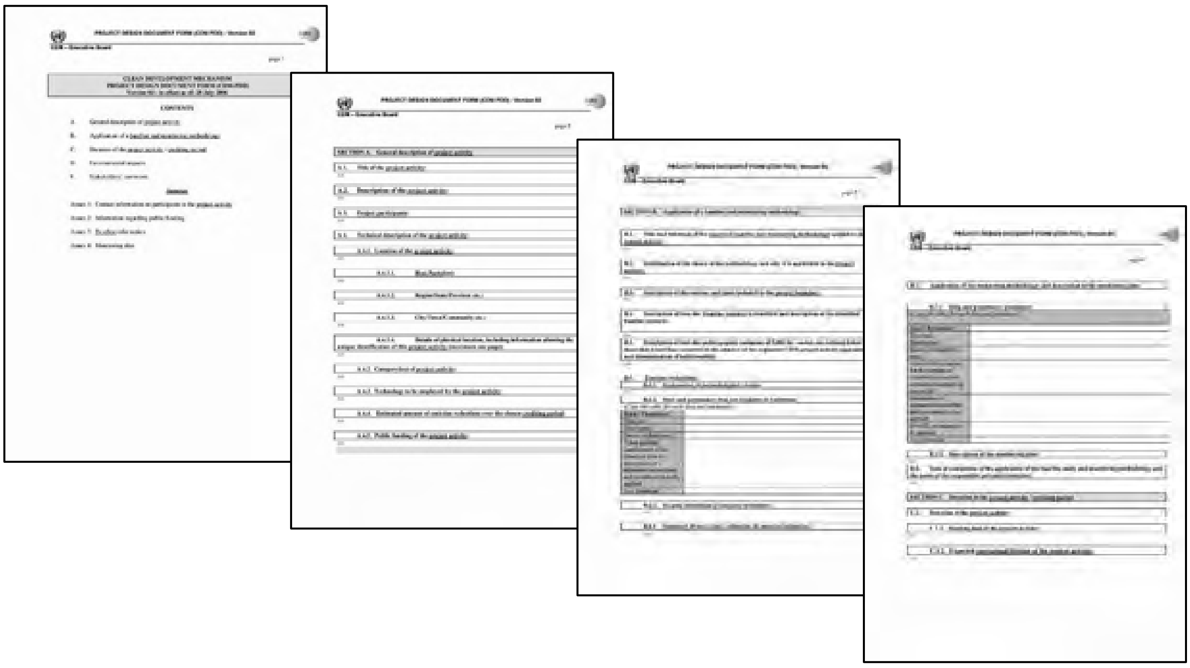


Figure 10.6-1 PDD Form (Version 3)

10.6.2. PDD CONTENTS

According to the latest form (Version 3), the PDD contents are structured as follows.

Contents A. General description of project activity B. Application of a baseline and monitoring methodology C. Duration of project Activity / crediting period D. Environmental impacts E. Stakeholders' comments Annexes Annex 1: Contact information on participants in the project activity Annex 2: Information regarding public funding Annex 3: Baseline information Annex 4: Monitoring plan

10.6.3. DESCRIPTIVE REQUIREMENTS

(1) Section A: General Description of Project Activity

Section A describes the general outline of the proposed CDM project activity, as shown below.

A.1. Title of the project activity A.2. Description of the project activity A.3. Project participants A.4. Technical description of the project activity A.4.1. Location of the project activity

(a) those CDM PDDs which pass the DOE validation or are already submitted to an OOE for validation before the date when the new version is issued and (b) those PDDs which are submitted to DOEs within one month after the issue of the new version. After six months from the issue of the new version, those PDDs prepared according to the old form are not accepted any more.

A.4.2. Category(ies) of project activity A.4.3. Technology to be employed by the project activity A.4.4. Estimated amount of emissions reductions over the chosen crediting period A.4.5. Public funding of the project activity

(2) Section B: Application of a Baseline and Monitoring Methodology

Section B explains how a given baseline methodology is chosen and applicable to the project identification as follows.

B.1.	Title of the approved baseline and monitoring methodology applied to the project activity
B.2.	Justification of the choice and the applicability of the methodology
B.3.	Sources of gases emitted within the project boundary
B.4.	Identification of the baseline scenario
B.5.	Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality)
B.6.	Emission reductions B.6.1. Explanation of methodological choices B.6.2. Data and parameters available at validation B.6.3. Ex-ante calculation of emission reductions B.6.4. Summary of the ex-ante estimation of emission reductions.
B7.	Monitoring methodology and monitoring plan B.7.1. Data and parameters for monitoring B.7.2. Monitoring plan
B8.	Person in charge of baseline and monitoring methodology

1) B.1. Title of the Approved Baseline and Monitoring Methodology

The approved methodology chosen by the project participants is indicated by its title and EB registration number (for example, “Baseline Methodology for Bus Rapid Transit”, AM0031).

2) B.2. Justification of the Choice and the Applicability of the Methodology

It is necessary to explain why a given AM is chosen and applicable to the proposed CDM project. When the intended project activity falls a little short of the applicable requirements of the approved methodology and yet the deficiency is not significant enough to warrant the development of a new methodology, the project participants can submit the PDD prepared by the chosen AM to the process of validation by a DOE.

When the DOE recognizes the deficiency of the proposed project activity vis-à-vis the chosen AM during validation but judges that any methodological revision henceforth is not necessary, it may request the guidance on the problem from the EB prior to CDM registration. If the DOE judges that the deficiency calls for the revision of the chosen AM, the procedure of methodological revision duly comes into effect (EB24, Annex30).

3) B.3. Sources of Gases Emitted within the Project Boundary

It is defined by the CDM-EB to the effect that the boundary of a given CDM project includes all prominent sources of anthropogenic GHGs that are caused by the project activity in the area commanded by the project. The project boundary as used in the application of the approved methodology means both a certain spatial expanse and a selected list of gases emitted within that space. It will be important to prepare a graphic presentation of the spatial boundary for the project activity, as indicated in Figure 10.6-2.

If the approved methodology offers certain alternatives of consideration regarding emission sources and greenhouse gases, the project participants need to justify why a given alternative is chosen and judged relevant to the project activity.

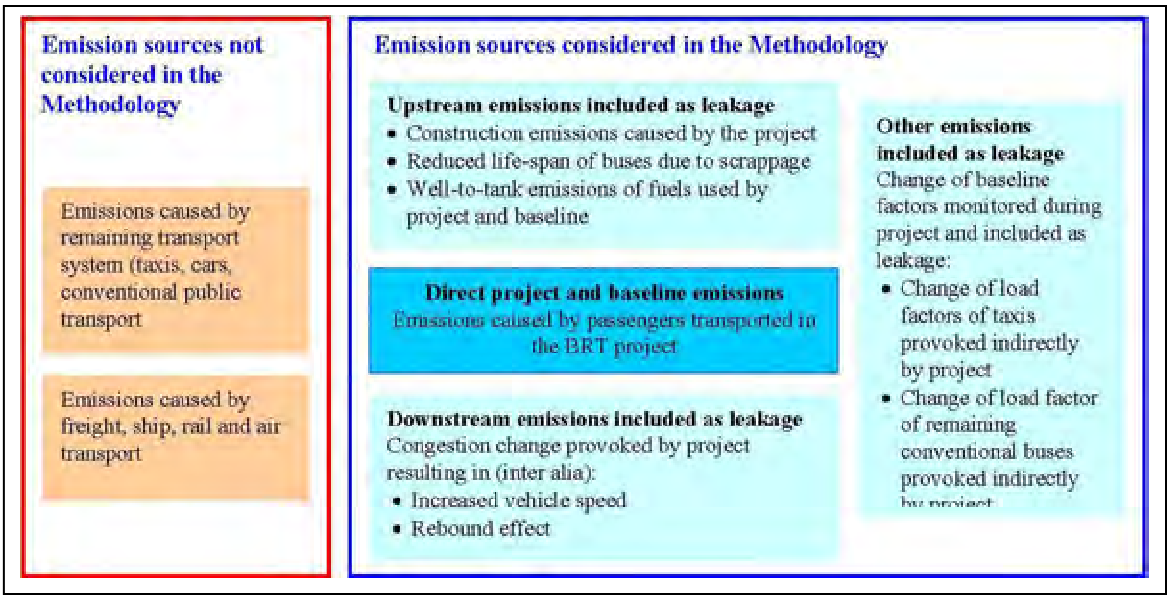


Figure 10.6-2 Project Boundary Defined by AM0031

4) B.4. Identification of the Baseline Scenario

The baseline scenario provides the basis for calculating emission reductions. The definition of the baseline scenario is that it logically expresses the emissions of greenhouse gases when the proposed project activity does not take place (CDM M&P, Paragraph 44).

The estimation of emissions in the baseline scenario must include all greenhouse gases mentioned in Kyoto Protocol (viz. CO2, CH4, N2O, HFC, PFC and SF6) and the sectors or categories of their sources. The identification of the baseline scenario must proceed in the manner indicated by the chosen AM, following the designated steps.

The identification might necessitate alternative baseline scenarios concerning the vision of the future. The continuation of the present situation into the future is one such alternative, and there are many other likely scenarios. During the process of identification, the project participants are asked to describe all alternative scenarios considered relevant. They are required to justify in the PDD why their baseline scenario is identified out of the alternatives envisioned in accordance with the chosen AM or NM. To prepare alternative scenarios, it is necessary to consider a range of variables, in addition to the ones suggested in the EB guideline, such as national policy stance on industries, actual industrial performance of the economy, technological innovations, investment barriers and others.

5) B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionally):

The project proponent must explain how and why the project activity is judged additional, as distinct from the baseline scenario drawn up with the selected baseline methodology. When the procedure consists of several steps, the proponent needs to describe what is done in each step and document the outcome of each step with transparency. When the demonstration of additionality is hampered by a number of barriers, the proponent can select only the relevant barriers for description. He needs to explain and justify key assumptions and rationales he used in project documentation. The proponent must provide relevant references and materials consulted, including the presentation of the data used to assess the additionality of the project activity (variables, parameters, data sources etc.).

If the starting date of the project activity is before the date of validation, the proponent must present the evidence showing that his decision to proceed with the project activity was strongly influenced by the incentive from the CDM. The evidence must be derived from the documentation that was available at or prior to the start of the project activity (e.g. official, legal and/or other corporate documents).

The proponent needs to provide a chronology of events pertaining to the proposed CDM project activity: namely, the date of the investment decision, the date of the start of construction, the date of the start of commissioning, and the date of start-up (e.g. the date when the trunk bus system begins its operation). In addition, the proponent has to provide a chronology of actions taken to achieve CDM registration, with the documentary evidence supporting such actions. These chronologies are expected to let the DOE assess the seriousness of the proponent's intent in seeking the CDM registration and in subsequent implementation of the project activity. (EB 41, Para 68).

This section and Section B.4 are complementary, in the sense that some of the steps required in this section may overlap with those undertaken in Section B.4, depending on the procedures employed for the baseline scenario and the demonstration of additionality. If the "Combined tool to identify the baseline scenario and demonstrate additionality" is used, the same information need not be replicated in both sections.

Step 1: Identification of alternative scenarios which conform to the laws in force

Substep 1a: Identification of alternative scenarios

Alternative scenarios must be practicable, realistic and credible not only to the participants in the project in question but to other participants in the similar projects. Such alternative scenarios include the following possibilities.

- Scenarios which proceed without CDM application and approval
- All other scenarios that are relevant and credible for the proposed project activity (i.e., scenarios which can supply the equivalent quantity and quality of production or service)
- Scenarios based on the continuity of the present situation into the future (when neither the proposed project nor any of the other alternative scenarios is implemented)

Substep 1b: Conformity to the laws

- The alternative scenarios indentified in Substep 1a might have an objective other than the reduction of GHGs emissions (for example, alleviation of air pollution), but nonetheless they must conform to the current laws in force. (This substep does not take into consideration those regulations and ordinances with no binding force.)
- When the alternative scenarios do not exactly adhere to the stipulations of the current laws, the project participants must investigate how far the laws in question are actually binding the activities they were legislated to be and show that the laws are in fact widely ineffective. Otherwise, scenarios lacking adherence to the laws must be discarded.
- If the proposed CDM project activity is the only option that conforms to the laws while all other scenarios considered by the project participants do not, that proposed project activity is judged having no additionality.

The project participants proceed to Step 2 (investment analysis) or Step 3(barrier analysis), or both.

Step 2: Investment analysis

The project participants can choose from the following three options for investment analysis.

- Option 1 Simple cost analysis: suitable to the project activity which realizes no economic benefit other than the CDM-defined benefits
- Option 2 Investment analysis: suitable to the project activity which realizes economic benefits independent of the CDM framework. By identifying financial indices appropriate for evaluation, the CDM project activity and other scenarios are comparatively analyzed on the basis of the indices. The sensitivity analysis is necessary.
- Option 3 Benchmark analysis: suitable to the project activity which realizes economic benefits independent of the CDM framework. By identifying financial indices appropriate for evaluation, the proposed CDM project activity and the benchmark (e.g. the rate of government bonds) are comparatively analyzed on the basis of the indices. The sensitivity analysis is necessary.

*All assumptions made in the CDM-PDD must be clearly stated in order to ensure transparency of the results of analysis. This makes it possible for the third party to test repeatability. It is necessary to show those technical and economic variables and hypotheses which decisively influence the results of analysis, e.g., capital cost, fuel prices, life expectancy, discount rates and so on.

Step 3: Barrier analysis

The project participants are required to identify the presence or absence of barriers in the following two substeps.

Substep 3a: Identification of the presence of barriers

When a proposed CDM project is not accepted to the EB registration, it is necessary to explain the presence of real and credible barriers that might have prevented the project from CDM acceptance. Examples of such barriers are:

- Investment barriers other than the economic and financial factors analyzed in Step 2 above: namely,
  - Project activities of similar nature are found to be unsustainable without heavy subsidization.
  - The international and the domestic capital market are inaccessible for finance because of the real and perceived investment risks in the host country.
- Technological barriers, such as:
  - Skilled labor or suitably trained workers who handle the project technology are not available in the host country. The host country lacks educational or training institutions that supply trained workers. The project facilities are thus liable to fail and get dilapidated for lack of proper maintenance and operation.

  - Infrastructure is too underdeveloped to support the operation of the proposed technology.
  - The risks of technological failure are too large, or the technology proposed in the CDM project activity stands alone, with no possibility of application to the similar activities planned in the same area.
- Barriers arising from general practices, such as:
  - The proposed project activity is the first of its kind. No similar activity has ever been tried before in the host country or region.
- Other barriers:
  - It would be better to refer to the presence of a barrier of this kind specifically in the baseline study based on the approved methodology.

Substep 3b: Demonstration of the sustainability of at least one alternative scenario despite the presence of barriers

The project participants must demonstrate why one, at least, of the alternative scenarios would be sustainable despite the identified barrier(s). When any of the alternative scenarios identified in Substep 3a is likely to be seriously hampered by one barrier or another, it is not justifiable and must be abandoned.

*The project participants must submit a documentary evidence of high transparency regarding the presence of barriers. They should refrain from exaggerating the gravity of the barriers and stay conservative about their assessment. The evidence can be supported by citing specific examples but one example alone is not sufficient. When Substeps 3a and 3b are satisfactorily attended to, the project participants proceed to Step 4 below. If either of the two substeps above is inadequately handled, the CDM application itself will be judged lacking additionality.

Step 4: Analysis of general practices

Substep 4a: Identification of other activities similar to the proposed project

The project proponent must identify the completed or on-going activities similar to the proposed CDM project. “Similar CDM projects” are the ones in the same region or host country which are of the broadly similar technological component and the equivalent scale of operation and are subjected to the similar set of laws, investment climate, access to technologies and capital and other general circumstances. CDM projects that do not fit the definition are excluded from analysis. The project proponent must report his findings with evidential documents and related statistical information and explain whether the similar activities are already in operation and how they have been performing.

Substep 4b: Analysis of similar project activities

- The project participants must demonstrate that the performances of the similar activities identified in Substep 4a do not contradict their conservative assessment of the barriers facing their own CDM project proposal. The comparison of the similar projects with their own should point to their basic differences: viz., their ready access to preferential financing (e.g., government subsidies or private donations) or their immunity or protection from the barriers.
- The project participants might find a significant change or changes in the project environment. This is the most crucial angle for comparing the similar projects with their own proposal. For example, new barriers might have been introduced or emerged, or

some government incentive policy might have been rescinded after these projects went into operation. The "similar project activities" might not be sustainable now in the prevailing environment, unless they are supported by the CDM incentives. The project participants must identify and demonstrate such decisive changes with sufficient documentary proofs.

* When Substeps 4a and 4b are satisfactorily dealt with, or in other words, when the project participants demonstrate either that there is no similar activity, or that the similar activities exhibit fundamental differences from their own CDM proposal, their project activity is judged to have additionality.

6) B.6. Emission Reductions

In Section B.6.1, the project participants are asked to explain their methodological choices. In addition to the equations selected to calculate emission reductions, they need to explain the following choices with satisfactory justification.

<u>Choices over alternative scenarios and cases:</u>

The project participants must explain and justify their choice of the scenario or the case employed in their CDM project proposal. Suppose that the baseline methodology designates different components between the baseline emission estimates and the "with-project" estimates. In such a case, the project participants must choose the components which are included in the emission calculation and satisfactorily justify their choices in line with the baseline scenario and the proposed CDM activity identified in Section B.4.

<u>Choices over alternative approaches:</u>

When the approved methodology indicates two or more approaches, the project participants must explain their choice and justify the relevance of the chosen approach in the proposed project activity.

<u>Choices over defaults:</u>

The approved methodologies for the baseline study sometimes offer a range of defaults to choose from for the purpose of meeting the different conditions arising from each individual project. The project participants must explain and justify their choices of defaults.

In Section B.6.2, the project participants need to mention the data and parameters that are available at validation. The presentation must follow the form indicated in the PDD form.

Details of the data and parameters need be placed in Annex 3: Baseline information. The following data must be described in the PDD.

- Data which, once measured, stay constant throughout the crediting period
- Data which are available at the time of validation
- Data which are not subject to monitoring during the crediting period

The following data must not be mentioned in the PDD.

- Data which are calculated by the equations included in the approved methodology
- Data which are presented as defaults by the approved methodology

In Section B.6.3, the project participants perform ex-ante calculation of emission reductions. They need to describe how individual equations are employed and ensure the repeatability of calculation.

In Section B.6.4, the project participants give a summary statement of the ex-ante estimation of emission reductions over the crediting period. The presentation must be done in the spreadsheet as indicated in the PDD form.

7) B.7. Monitoring Methodology and Monitoring Plan

The project participants need to explain how the monitoring methodology is applied and describe the monitoring plan.

The description in Section B.7 is subject to the validation by a DOE and will be referred to when the emission reductions by the proposed project are calculated. Because the difference between the baseline estimates and the actual emissions is claimable as certified emission reduction (CER), it is very important to formulate a detailed and practicable plan for monitoring.

The project participants describe how they are going to monitor the parameters and data identified by the approved methodology. It is important to adhere strictly to the procedure of monitoring prescribed in the approved methodology. If the project participants anticipate some deviation from the procedure, they need to explain what steps they will take instead and justify the deviation.

The presentation of parameters and data for monitoring must be done in the set form indicated in the PDD form, as follows.

- Data unit
- Data description
- Data sources

  The data that are actually used in the proposed project activity must be identified by their respective sources (e.g., specifying the titles of statistics). If the data are available from two or more sources, the project participants need to explain and justify their choice.

- Value of data applied to the ex-ante calculation of emission reductions
- Measurement methods and procedures

  In addition to the methods and the procedures for measuring the parameters and data, the project participants are asked to describe the industrial standards (domestic and international) to be applied, types of devices and meters to be used and their measuring procedures, proof-reading procedures, expected precision of measurement, the personnel or organization responsible for measurement and recording, intervals of measurement and so on.

- QA/QC procedures
- Comment

  All comments regarding the monitoring plan need be briefly mentioned, while the detailed account is given in Annex 4 of the PDD.

  The project participants are asked to describe the organization in charge of monitoring. It will be useful to give a graphic presentation of the organizational structure and the division of responsibility among the personnel.

8) B.8 Person(s) in Charge of Baseline and Monitoring Methodology

The name(s) of the responsible person(s) or the entity(ies) that undertook the application of the baseline and monitoring methodology must be mentioned, including the communication access and the place of work.

(3) Section C: Duration of the Project Activity and the Crediting Period

Section C describes the duration of the proposed project activity and the crediting period. The crediting period means the duration over which the certified emission reduction is issued by the

Clean Development Mechanism and starts from the date when a DOE completes the validation of the expected emission reductions.

C.1. Duration of the CDM project activity
    C.1.1. Starting date
    C.1.2. Expected operational lifetime of the project activity
C.2. Choice of the crediting period
    C.2.1. Renewable crediting period
        C.2.1.1. Starting date
        C.2.1.2. Duration
    C.2.2. Fixed crediting period
        C.2.2.1. Starting date
        C.2.2.2. Duration

(4) Section D: Environmental Impacts

Section D describes the analysis of environmental impacts from the proposed project activity. The section consists of the following subdivisions.

D.1. Description of the analysis of environmental impacts, including cross-border impacts D.2. Documents required by the procedure of environmental impact assessment in the host country

The PDD must be attached with the document concerning the analysis of the environmental impacts, including cross-border impacts. The document needs to contain the subjects legally required by the host country and the descriptions of the following issues.

- Names and outlines of national acts and municipal ordinances regulating the environmental issues (impact assessment procedures and environmental standards) that directly concern the proposed project activity
- Description of the analysis of impacts on local environment and community
- Description of the environmental impacts (positive or negative) before and after the project implementation
- Description of the impacts by categories such as air, water, noise, natural resources and human habitation
- Findings of the monitoring as required by CDM regarding environmental impact assessment
- Findings of the analysis for ascertaining the gravity of impacts by the proposed project activity
- Summary of the environmental impact assessment (subjects assessed, magnitude and frequency of impacts, findings of environmental impact analysis and mitigating measures)

(5) Section E: Stakeholders' Comments

Section E describes the legal requirements in the host country regarding the project implementation and the procedure employed to collect comments from stakeholders. The section is subdivided into the following sub-headings.

E.1. Procedures of inviting and collecting stakeholders' comments E.2. Summary of received comments E.3. Report on the actions taken in response to the comments

1) *E.1. Procedures of Inviting and Collecting Stakeholders' Comments*

- Identification of stakeholders who have different interests in the proposed project from their standpoints (municipal governments, local communities, local inhabitants, consultants, project participants, etc.)
- Meetings with stakeholders, invitations to presentation meetings and methods of announcement
- Summary of the agenda and the minutes of the meetings (project-related materials used for presentation, questions and answers, etc.)
- Findings from the interviews with individual stakeholders regarding the proposed project.

2) *E.2. Summary of Received Comments*

- A summary and a list of the comments received from individual stakeholders (counter proposals, points of anxiety, complaints, etc.)
- Analysis of the comments (whether and how stakeholders favor or oppose the project)

3) *E.3. Report on the Actions Taken in Response to Comments*

- Description of what was done in the PDD preparation after hearing the comments
- Description of the presentations made for stakeholders and other efforts to respond to their expectations
- Description of the steps which the project participants intend to take in response to the stakeholders' comments.

10.6.4. NOTES ON THE PDD PREPARATION

Judging from what was experienced in the PDD preparation for the similar project in Colombia, i.e., BRT Bogota Colombia: TransMilenio Phases II to IV (CDM Registration No. 0672), the prospective CDM project participants are advised to take note of the following points.

- PDDs must be prepared in strict adherence to the latest PDD form, without changing anything including the header and the logo.
- The project participants are not allowed to change or delete part of the spreadsheet forms indicated in the latest PDD form. However, they may add rows if deemed necessary.
- The number of PDD copies printed and the date of the PDD completion must be added to Section A.1 of the PDD form.
- When a section of the PDD form is judged unnecessary to fill in, the project participants can leave it blank, with due explanation why.

The PDD guideline by EB offers the following statements regarding the CDM application. The project participants are strongly advised to check and recheck their PDDs in close reference to the statements before application.

- The project design document should give the crucial information on technical and organizational aspects of the project activity. It is considered by UNFCCC as the important basis for validation, registration and verification carried out in adherence to the Kyoto Protocol. The details of PDD requirements regarding approved methodologies and procedures are found in the resolution (17/CP.7) contained in the Document No. FCCC/CP2001/13/Add.2.
- PDDs must describe the contents of the project activity and the approved baseline methodology and monitoring methodology which are applied to the activity.

- The project participants need to submit to the DOE their completed PDD, with supporting documents attached when deemed necessary. The DOE in its turn needs to validate the received PDD by checking whether its contents satisfy the form and the procedure required by CDM, and issues the validation report.
- As stated in Paragraph 66 of CDM M&P, the project participants are asked to submit two versions explained below, when their PDD contains some confidential information.
  - In one version, the project participants illegibly blacken out the secret parts of the project information.
  - The other version is complete. Persons in the positions to receive this version (DOE, members of CDM-EB, members of CDM-related panels, committees and working groups, external advisors invited to attend the ICGCC and EB board meetings for consultation, the ICGCC secretariat) are required to treat it as strictly confidential.
- According to Paragraph 6 of CDM M&P, the following information is not considered confidential.
  - Information used to assess the additionality of a given project
  - Information used to describe the baseline methodology and its application to the project
  - Information used to support the environmental impact assessment
- As stated in Paragraph 45(b) of CDM M&P, the project participants are asked to maintain transparency and remain conservative in their descriptions of chosen approaches, assumptions, methodologies, variables, data sources, additionality and other important choices. The information described in the PDD must be precise and detailed enough for the third party to test its repeatability.

APPENDIX

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Appendix
Road Construction Project

APPENDIX

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1. ROAD CONSTRUCTION PROJECT

1.1. OBJECTIVES

Within the Metropolis Action Plan, the road construction of Av. Joao Paulo II is discussed as a by-pass route for BR-316 in order to ease a chronic traffic congestion of BR-316. This new road will function as the shortest route, connecting residential zones of nearest satellite cities and the downtown Centro Area of Belem. Para State has planned to construct a trunk busway on BR-316 and one of the objectives of developing this Av. Joao Paulo II is to provide a traffic detour at the time of constructing the trunk busway. Main objectives of this study are to analyze its best road alignment, carry out relevant basic design, estimate construction costs, and a preliminary environmental study on surrounding roadside environment covering resettlement issue.

1.2. ROUTE PLANNING

Following 2 routes are of concerns within this road construction-related design study.

1) Av. Joao Paulo II
2) Estr. de Pedreirinha

Differences from the road alignment originally designed at the time of the previous study and the current one are given in Figure 1.2-1 . Relevant standard cross-sections are given in Figure 1.2-2 .

The basic design of this road project was based on the Road Design Standards (NORMA) established by Departamento National de Estradas de Rodagem (DNER). The road design classes stipulated in these Design Standards are given in Table 1.2-1.

Table 1.2-1 Road Classification and Design Class

Road	Design Class	Design Speed (km/h)
Av. Joao Paulo II	Class-II	70 (50)
Estr. de Pedreirinha	Class-IV	60

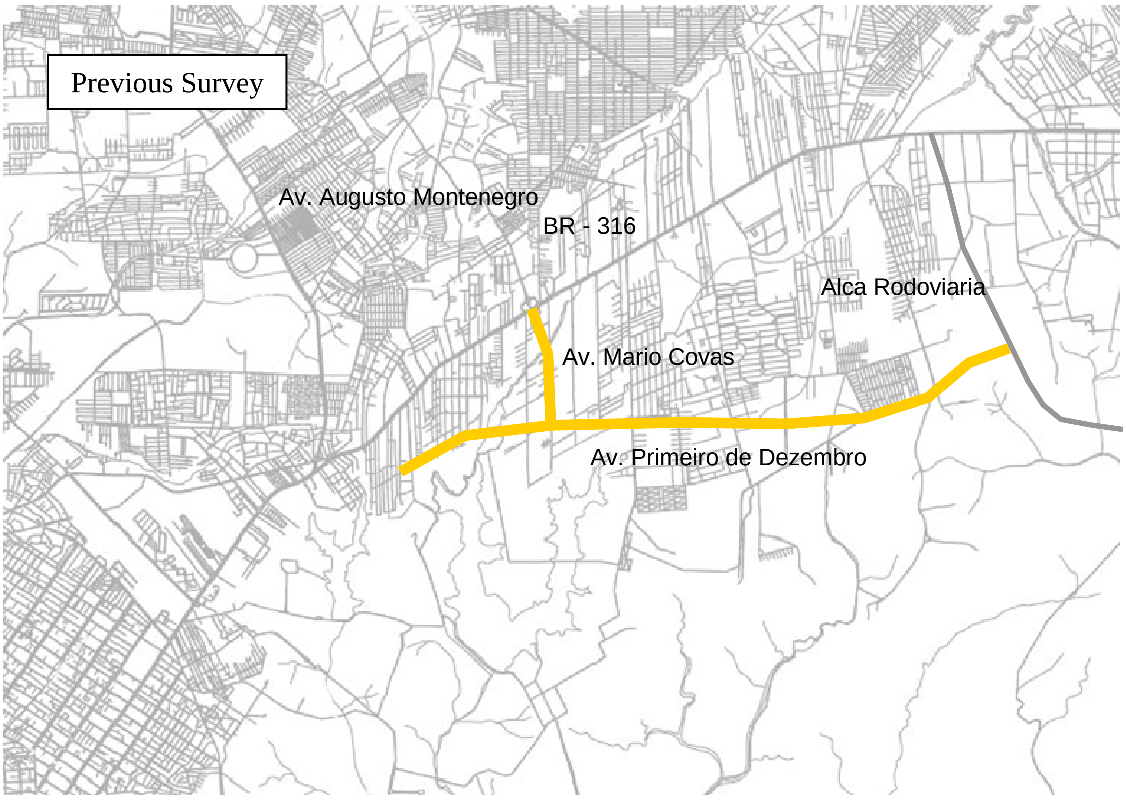
Note: Figures in parenthesis indicate minimum requirement.

The design standards corresponding to the Road Design Class are given in Table 1.2-2 . These are the standard values established by Brazil AUSTROADS (Lustrous National Office).

Table 1.2-2 Geometric Design Standards

Road Name	Unit	Av. João Paulo II	Estr. de Pedreirinha
Road Design Class		Class-II	Class-IV
Design Speed	km/h	70 (50)	60 (30)
Minimum Radius	M	170 (80)	125 (25)
Maximum grade	%	4.5 (5.5)	4.5 (5.5)
Width of Lane	M	3.5 (3.3)	3.0
Width of shoulder (out)	M	2.5 (0.5)	1.3 (0.5)
Vertical Clearance	M	5.5 (4.5)	5.5 (4.5)
Lateral Clearance			
Continuous	M	0.5	0.3
Spot	M	1.5	0.5

Note: Figures in parenthesis indicate minimum requirement.
Source: DNER



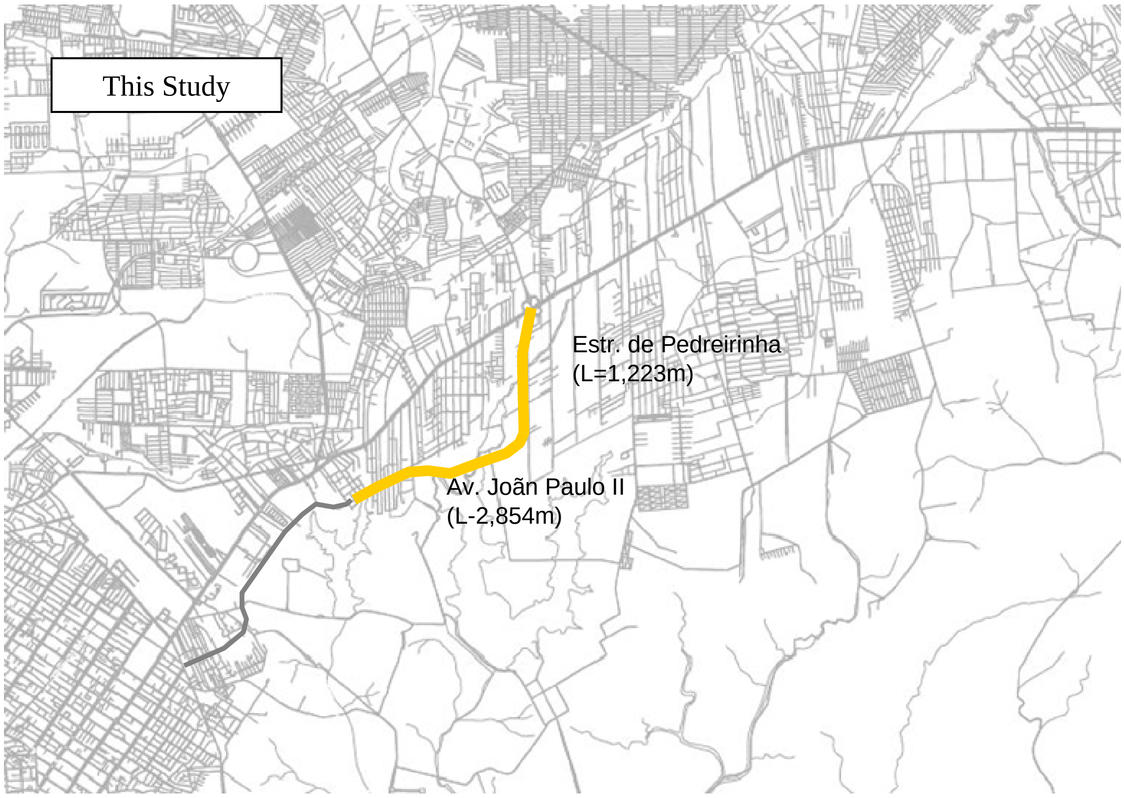
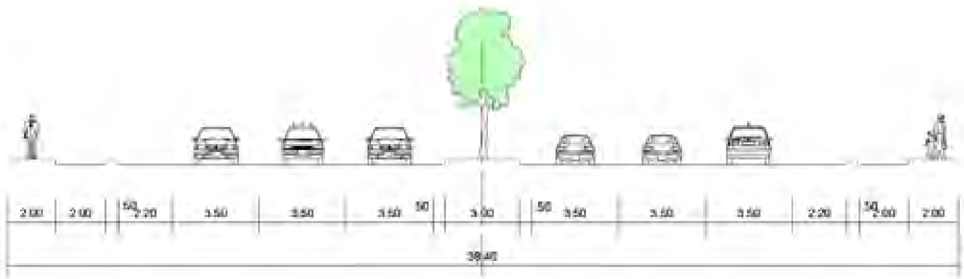
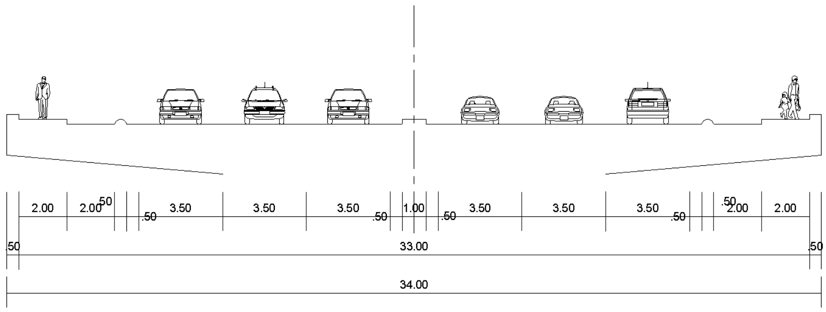


Figure 1.2-1 Route to be Designed

Standard Section

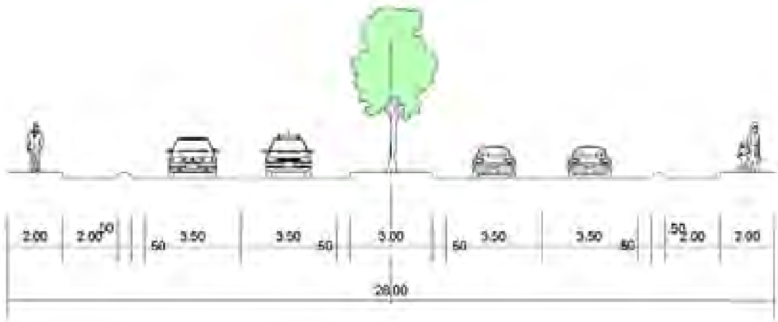


Bridge Section

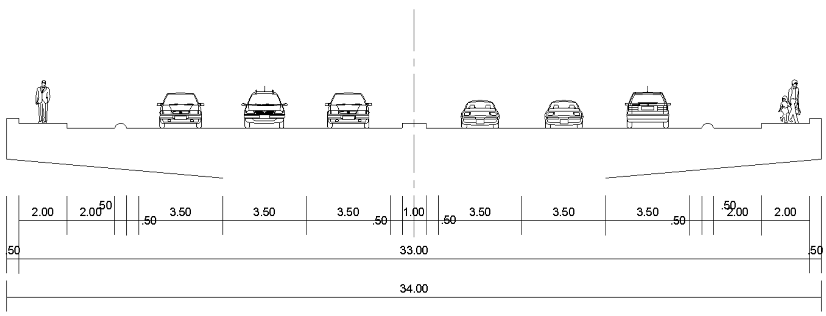


Av. João Paulo II

Standard Section



Bridge Section



Estr. de Pedreirinha

Figure 1.2-2 Cross-sectional Composition

1.3. ROAD INFRASTRUCTURE DESIGN

1.3.1. AV. JOAO PAULO II

Av. Joao Paulo II is a Secondary Arterial Road running parallel to the south side of Rod. BR-316. It functions as an alternate route to reduce the excess traffic on Rod. BR-316 which has a heavy traffic volume. It is also used as the shortest route connecting the inner-city and the north-eastern region where housing development is progressing. The land along the route is being used as a residential area.

The design conditions in the horizontal alignment plan model are given below.

a) Since there has been a lot of housing development on the Rod. BR-316 side, the locations in the alignment plan were selected to avoid the existing residential areas as far as possible.

b) The environmental borderline of Lago Agua Preta and reservoir areas were considered as the control points of the alignment plan.

c) The point of intersection with Estr. de Pedreirinha was set as a T-type at-grade intersection, with the new road to be constructed as the main direction.

1.3.2. ROD. MARIO COVAS EXTENSION

This extension connects the current Rod. Mario Covas from Rod. BR-316 to Av. João Paulo II. The cloverleaf overpass point of the current Rod. BR-316 was taken as the control point. The end of the overpass bridge was considered as the starting point of the alignment plan. In the horizontal alignment, the existing Rod. Mario Covas is extended and is aligned with the center of an existing city street (Estr. de Pedreirinha). For safety considerations, the horizontal alignment in the vicinity of the ramp is made as wide as possible.

Road to be constructed
Avenida Joao Paulo II
and
Estrada da Pedreirinha
Plan (1/2)

Legend:

Existing

Via a ser construída Avenida João Paulo II e Estrada da Pedreirinha Planta (1/2)	GOVERNO DO ESTADO DO PARÁ SECRETARIA DE ESTADO DE PROJETOS ESTRATÉGICOS (SEPE) NÚCLEO DE GERENCIAMENTO DE TRANSPORTE METROPOLITANO (NGTM)	AGÊNCIA DE COOPERAÇÃO INTERNACIONAL DO JAPÃO (J.I.C.A.)	ESTUDO PREPARATÓRIO PARA O PROJETO DE SISTEMA DE TRANSPORTE DE ÔNIBUS DA REGIÃO METROPOLITANA DE BELÉM ESCALA 1 / 10.000 PÁGINA No. 52

Figure 1.3-1 Road Outline Design (1)

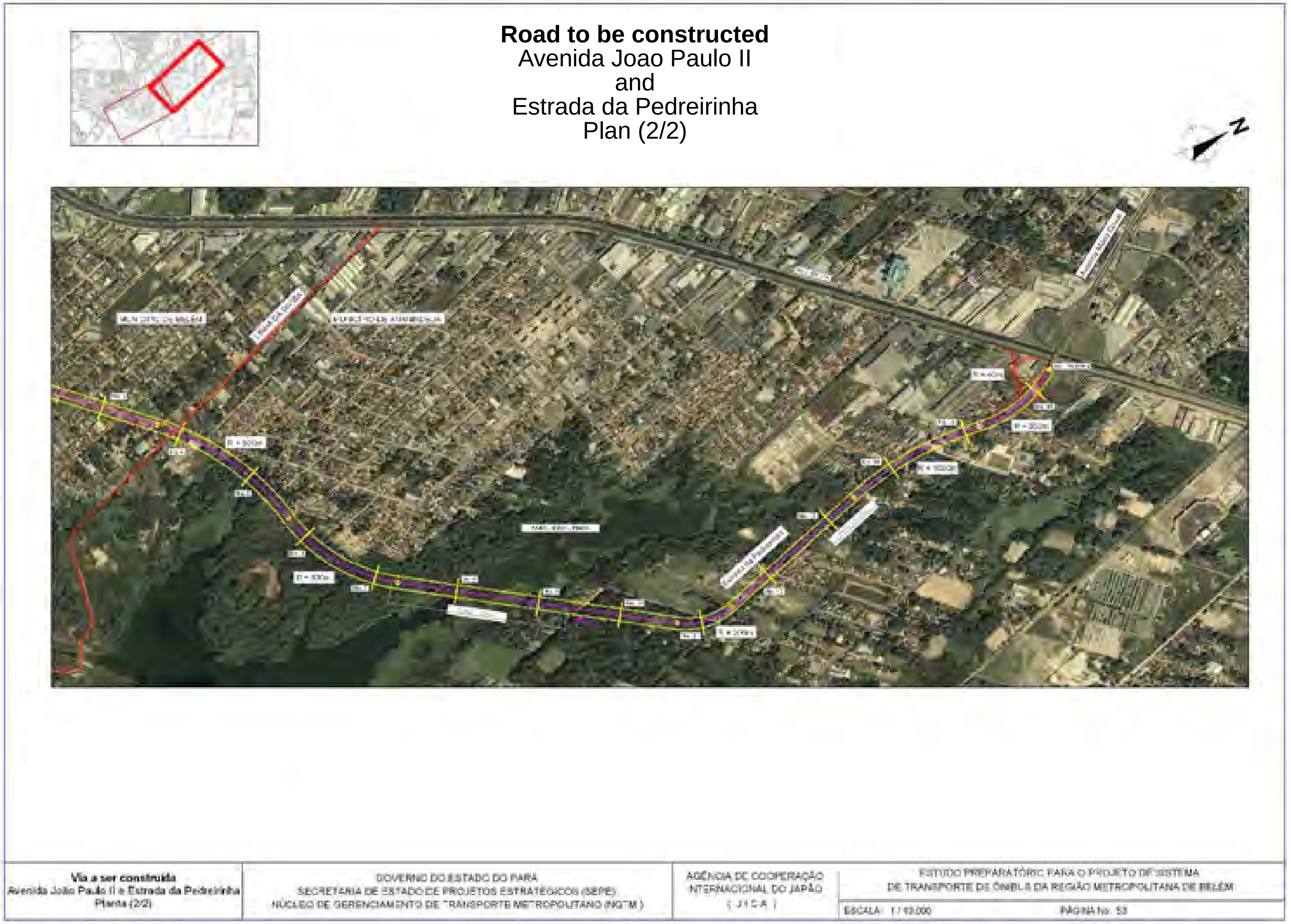


Figure 1.3-2 Road Outline Design (2)

1.4. PROBLEMS AND ISSUES IN THE ROUTE PLAN

Problems and issues in this route plan are as follows.

a) Urbanization is progressing along this route and the route plan was implemented in order to avoid resettlement of the residents, with reference to the 2003 F/S results. However, there is a possibility that 245 residents may have to be relocated for developing this route.

b) Environmental conservation is necessary since this route passes through environmentally protected areas including the reservoirs in Belem city.

c) As part of the “the Metropolis Action Plan”, the State of Para has requested the Caixa Economica Federal (federal savings bank of Brazil) to finance the construction of this route, and the financing has almost been finalized, thus there is almost no possibility of a Japan’s ODA loan request to the Japanese government.

d) At present, the State of Para aims to open this road to traffic in 2011 and is holding repeated consultations with the Para State Secretariat of the Environment (SEMA).

1.5. ROAD CONSTRUCTION COST

The cost of road construction was estimated based on the Road Development Plan (see Table 1.5-1).

Table 1.5-1 Road Construction Cost

	Road name	Number of lanes	Distance (km)	Cost (BRL)	Cost (USD)	Cost (JPY)
1)	Av. João Paulo II	6	2.85	191,286,171.00	83,164,284.59	7,697,069,022
2)	Estr. De Pedreirinha	4	1.22	49,305,767.85	21,436,358.35	2,053,585,231
Total				240,591,938.85	104,600,642.94	10,020,654,253

1.6. ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

Preliminary environmental screening and scoping for the proposed road construction project (total length is of approximately 4.08 km), which is a part of Road Development Master Plan, are conducted based on the JBIC Environmental Guidelines. Review of past environmental studies, conducted in 2003 F/S, is also carried out, and necessities of relevant additional and/or supplemental environmental studies are discussed. A JBIC environmental checklist was prepared in order to support a smooth Japan’s ODA loan financing.

(1) Project Description related to Environmental Scoping

Project description (PD), a basis for the environmental scoping for the road construction project is prepared (see Table 1.6-1).

Table 1.6-1 Project Description (PD: Road Construction Project)

Item	Details
Background	- Recent city-wide traffic congestion across Metropolitan Belem (Belem, Ananindeua and Marituba Cities) in Para State, Brazil, has become worse and severe. So, improvement of urban transport system is prioritized among regional infrastructure development plan in Para State to improve region-wide distribution of goods and stimulate the regional economy.
Objective	- Av. João Paulo II is being considered as a by-pass route for Rod. BR-316 in the Metropolitan Action Plan in order to ease the traffic congestion on BR-316 and also as a traffic detour at the time of constructing the trunk bus route.
Location	- Southern part of Metropolitan Belem (Belem and Ananindeua Cities)
Executing agency	- NGTM (Nucleo de Gerenciamento de Transporte Metropolitano: Nucleus of Administration of Metropolitan Transport), SEPE (Secretaria Especial de Projetos Estrategicos: State Secretariat of Strategic Projects)
Beneficiary population	- Unknown
- Project Outline	
Type of Project	- New road construction
Type of Road	- General, urban area
Target Year ／Traffic Demands	- 25,000 PCU/day in 2013, 33,200 PCU/day in 2018 (average traffic volume on the route)
Distance／Width／Vehicle Lane	- Total extension 4.08 km - Width 34.0 - 38.4m - 6 lanes
Relevant Facilities	- 1 Interchange
Others	- This Project is based on Av. Primeiro de Dezembro Road Plan of 2003 JICA-funded F/S. - As of now, Belem City has constructed the Av. Joao Paulo II, up to Rua da Marinha in Utinga region, and its operation has already started. Area of concern of proposed project covers from Rua da Marinha to overpass of BR316 and Rod. Mario Covas (communities of illegal squatters exist around project route). - A part of project route goes through APA BELEM, special environmental protection area (L ≒ 2.123 km). Fences and walls have been constructed around APA Belem to prevent trespassing, but some parts of those facilities have been found to be broken already. - At present, the Para State government has requested Caixa Economica Federal to finance this road construction project, and relevant financing negotiation has almost been finalized.

(2) Environmental Scoping

The field survey conducted in May 2009 included environmental scoping with the focus on field surveys and interview surveys regarding the Trunk Bus System Plan (total length approximately 73.6 km) and the road construction project (total length approximately 4.08 km) related to this Trunk Bus System Plan. Thus that study helped in understanding the present status of the natural and social environment in the region targeted in this project, and in forecasting the items that will have an environmental impact when this plan is implemented. Results of this environmental scoping are summarized in Table 1.6-2 .

The environmental study results of the 2003 JICA F/S Report were reviewed on the basis of this scoping result, and the necessity for additional/supplementary surveys related to the proposed road development plan was discussed (taking environmental and social aspects into consideration).

Table 1.6-2 Summary of Environmental Scoping

(Road Construction Project)

Item	Overview of the survey result
Topography, geology, climate and vegetation	- No steep slope nor cliff in vicinity of project route, that may cause mudslides or landslides exist.
Ecosystems, protected areas	- APA BELEM, a special environmental protection area, was established to conserve regional water resources, and is located around project route. Project route partially passes through APA BELEM (route passing distance: 2.123 km). In 2003 F/S report, 48 species of fauna (including 13 species of mammals) and 34 species of flora were confirmed around project route including APA BELEM, and valuable species were also reported.
Noise, vibrations	- Field measurement, analysis and impact forecast evaluations were carried out in 2003 F/S along Av. Joao Paulo II that is already open to traffic, and it was reported that present roadside noise environment satisfied Brazil's environmental quality standards because there was less traffic volume in surrounding area and road is adjacent to APA BELEM. - Roadside noise will be worsened due to new traffic after construction period.
Air quality	- A field survey and analysis of air quality along Av. Joao Paulo II was carried out in 2003 F/S, and it was reported that roadside air quality satisfied Brazil's environmental standards as there was less traffic volume in surrounding area and road was adjacent to APA BELEM. Even now there is small traffic volume around project route and there are no industrial groups that will cause air pollution. - Roadside air quality will be deteriorated during construction period due to a temporary increase in traffic volume on account of construction related vehicles and due to new traffic after construction period.
Water quality	- There are concerns about sediment runoff, and generation and mixing of turbid water due to construction within APA BELEM catchment area. - Moreover, groundwater is being used through shallow wells among several communities of illegal squatters, and there are concerns about temporary deterioration in the water quality during the construction period. Consequently, an appropriate wastewater treatment plan is necessary.
Hydrology	- APA BELEM is located around the project route. Use of shallow wells has also been observed. No large-scale earthworks such as excavation and embankment will be conducted within this proposed road construction work. Thus it can be said risk of local groundwater flow obstruction to be caused by proposed road construction project is very small. - However, it has been reported that at present there is a lack of proper maintenance and management of drainage facilities and inadequate maintenance of drainage networks in some parts of the project route, which may lead to problems of poor drainage such as flooding around the route during rainy season.
Resettlement	- Large-scale resident resettlement and land acquisition will take place for both road construction and overpass work (245 units, see Table 1.6-6 for details).
Livelihood	- According to 2003 F/S, there are many low-income communities around project route and about 90% of them are classified as illegal squatters. Small businesses/services such as shops and diners coexist therein. - There are medium-sized shops and offices at planning site of BR-316 overpass work. Power transmission line exists along project route partially.
Cultural heritage, scenery and landscape, ethnic minorities	- There are no ethnic minority / indigenous communities in the vicinity of the project route. Moreover, there are no landscapes or cultural heritages that need to be protected.

(3) Description of Baseline Environment

The project site description (SD), the basis for the scoping of the target area, is given in Table 1.6-3. The project description (PD) used for this scoping work is given in Table 1.6-1 .

Table 1.6-3 Project Site Description (SD)

Items	Details
Social environment	
Community (residents /minority/ awareness to the proposed project and others)	- Existence of ethnic minorities around project route has not been specifically reported. According to 2003 F/S, there are many low-income groups around project route and around 90% of them are illegal squatters.
Land Use (urban/ rural/historical sites/ scenic places/ hospitals and others)	- No historical nor scenic sites that need the protections exist around project route. - Local infrastructure development is not so organized: some roads are unpaved, and several regional drainage, water supply and sewage systems are not well-developed. Most of household effluents from surrounding residential area is discharged without any treatments.
Regional economy/ transport condition (commercial / agricultural activities, industrial park/ bus terminal and others)	- Several communities of illegal squatters exist around project route, and small businesses/services such as shops and diners coexist. - There are medium-sized shops and offices at point where BR-316 overpass work is planned. Moreover, power transmission line exists along project route partially.
Natural environment	
Topography/Geology (e.g., Cliff, Steep slope, floodplain, marsh, wetland/fault lines)	- Project route will pass through APA BELEM catchment area (route passing distance L ≒ 2.123km). - Minor inundations and/or flooding due to poor regional drainage system are observed.
Important flora/fauna (e.g., national parks, occurrence of rare/or endangered species).	- Project route is located near APA BELEM, important regional water reservoir area. - Relevant protected areas including this APA BELEM and its vegetation are regulated d by Belem City Ordinance No. 266. A 200 meter-wide strip zone adjacent to APA Belem such as Utinga Complex, defined in State Ordinances No. 3251 and 3252, are also covered in conditional clause No III of those ordinances. - According to Belem City Ordinance No. 269, if a development project is to be executed in these protected areas, vegetation therein cannot be cleared or moved without any official permissions and appropriate environmental assessment studies. - Several communities of illegal squatters exist around APA BELEM, and there have been encroachments in some parts of this protected region. Protective barriers and fences have been installed since 2003 to prevent such trespassing.
Pollution	
Complaints	- Poor Regional Drainage, trespassing in APA BELEM
Mitigations	- Guards around APA BELEM (environmental police), construct protective barriers and fences, etc.
Miscellaneous	- None

(4) Environmental Scoping

A preliminary environmental study was conducted in accordance with the JBIC Environmental Guidelines (JBIC, 2002) in order to identify the potential negative impact to be caused by the construction of the proposed new road. This study result is summarized in Table 1.6-8. Environmental scoping was carried out based on the result of this preliminary environmental study in order to assess significances of each environmental factors during the construction of this proposed project.

The results of this environmental scoping are summarized in Table 1.6-4 and Table 1.6-5. Significant negative impact are identified, regarding following four environmental factors , namely, Item 2 “Water quality”, Item 4 “Waste Resources”, Item 14 “Involuntary resettlement” and Item 19 “The Poor, indigenous of ethnic people”. In particular, Items 14 19 would be greatly significant since large-scale expropriation (i.e., 245 residences of the poor communities around Av. Joao Paulo II) would be necessary for the construction of this road (see the next section (5) for more detailed discussion). For the acquisition, it may be necessary to formulate a comprehensive resettlement action plan based on both the final D/D results of the proposed road construction project and the latest real estate market value information.

(5) Necessity of Additional and/or Supplemental Studies

By reviewing the environmental studies of 2003 JICA-funded F/S Report, the necessity of relevant additional and/or supplemental studies, regarding the proposed road construction project, are assessed. Based on these results, it is found that no further study regarding the natural environment is required for the proposed road construction study, similar to review results for the BRT project. Note that minor sediment runoff and resultant water quality degradation (e.g., worsened water turbidity) due to the construction work may occur within the catchment area of APA BELEM (route passing distance = 2.123 km).

Moreover, ground water is used through shallow wells among communities of illegal squatters along the project route, and there are concerns about temporary deterioration in the water quality during the construction period. It is important to develop appropriate environmental management plan and construction schedule that includes an appropriate wastewater treatment program not to worsen the water quality of APA BELEM and surrounding shallow wells.

By the same tokens, it is also important to formulate a proper wastewater treatment program not to cause serious impact on entire ecosystem of APA BELEM (Item 10, “Flora and fauna”). Regarding Item 13, “Global warming”, there is major changes in the vehicle emission factors due to the improvement of ethanol-based vehicle engine in Brazil after the 2003 F/S. It is recommended to carry out supplemental a study of regional CO2 emissions for this road construction project, taking into accounts these recent shifts of the vehicle engine and fuel share in Brazil.

Moreover, there will be a large-scale resettlement and land acquisition for the construction of the new road and overpass. It is necessary to support the formulation of the land acquisition and compensation plan based on both the final D/D results of this road construction project and the latest real estate market price information (details are given in the next section (5)).

Table 1.6-4 Belem City Traffic Improvement Plan (Road Construction Project)

Environmental Scoping Checklist (1/2)

Environmental items	Evalu-ation	Remarks
1. Air Quality	B	- Roadside air quality may be deteriorated due to temporary increase in construction vehicles and material transport vehicles during construction period, and due to the new traffic volume after construction period.
2. Water Quality	A	- Minor sediment runoff and resultant turbid waters may occur due to road construction within catchment area of APA BELEM (route passing distance = 2.123km). - Moreover, groundwater is being used through shallow wells in parts of the illegally occupied zone, and there are concerns about temporary deterioration in the water quality during construction period.

3. Soil and Sedimentation	D	- N/A
4. Waste Disposal	B	- Generation of construction waste soil and scrap is expected.
5. Noise/Vibration	B	- Roadside noise will be deteriorated due to temporary increase in construction vehicles and material transport vehicles during construction period, and due to new traffic volume after construction period.
6. Ground Subsidence	D	- N/A
7. Bad Smell	B	- There are concerns of foul odor of decayed plants caused by long-term local flooding and/or inundation due to poor regional drainage system.
8. Topography/Geology	B	- There will be temporary problems of poor road surface drainage and flooding during rainy season, due to poor area drainage in some sections of project route.
9. River Bed	D	- N/A
10. Flora/Fauna	B	- Minor negative impact on ecosystem due to partial sediment runoff and resultant turbid waters due to road construction within catchment area of APA BELEM may occur (route passing distance = 2.123 km).
11. Water Resources	D	- N/A
12. Accidents	D	- N/A
13. Global Warming	C	- There were significant changes in vehicle fuel (ethanol) and related engines in Brazil after 2003 F/S. - It is necessary to study LCA-based regional CO2 emissions, including road construction.

Notes: A: Significant impact, B: Minor impact, C: Unknown and need further relevant studies for its evaluation, D: Less significant or None (i.e., no need to carry out IEE and/or EIA Study)

Table 1.6-5 Belem City Traffic Improvement Plan (Road Construction Project)

Environmental Scoping Check-list (2/2)

Environmental Factors	Evalu-ation	Remarks
14. Involuntary Resettlement	A	- It is forecast that large-scale resident resettlement and land acquisition will occur during the road construction and overpass work (245 units to be expropriated, see Table 1.6-6).
15. Local Economy	B	- Local socio-economic activity may be deteriorated temporally due to local traffic jams, land acquisition and resettlement.
16. Land Use, Utilization of Local Resources	D	- N/A
17. Social Institutions	D	- N/A
18. Existing Social Infrastructure and Services	B	- Power-transmission line exists along project route partially.
19. The poor, indigenous of ethnic group	A	- Communities of low-income, illegal squatters exist around project route.
20. Misdistribution of benefit and damage	D	- N/A
21. Local Conflict of Interests	D	- N/A
22. Gender	D	- N/A
23. Children's Rights	D	- N/A
24. Cultural Heritage	D	- N/A
25. Infectious Diseases	D	- N/A

Notes: A: Significant impact, B: Minor impact, C: Unknown and need further relevant studies for its evaluation, D: Less significant or None (i.e., no need to carry out IEE and/or EIA Study)

(6) Land Acquisition and Resettlement

The required land acquisition area and the number of house/building units to be expropriated were estimated based on the final basic design, using the satellite image of 2006.

Within this estimation, following assumptions are introduced for the clarification: [1] the road width around Casatanheira, Belem City and Guanabara of Ananindeua City is assumed to be of 5m, and [2] around Estrada Pedreirinha, the road width is assumed to be of 10m. Table 1.6-6 summarizes the number of properties to be expropriated by the proposed road construction project (245 units and/or 75,000 m^2 to be affected).

Table 1.6-6 List of Resident Resettlements under the Road Development Plan

No.	Development section	Project route area (m^2)	Existing route area (m^2)	Required acquisition area (m^2)	Number of structures to be relocated	Average area of the structures (m^2)	Average area of the plots (m^2)	Legal / illegal classification
1.	Belem City, Castanheira municipality - CA	9.080	1,655	7,425	45	65	165	Illegal city block
2.	Section passing through state park – 1	5,669	0	(5,669)	0			-
3.	Belem City, Castanheira municipality - CB	29,634	6,134	23,500	100	65	235	Illegal city block
4.	Section passing through state park - 2	46,969	0	(46,969)	0			-
5.	Area in the neighborhood of Rua Natal	15,301	0	15,301	0			-
6.	Section passing through state park – 3	20,693	7,500	(11,543)	0			
6.1	Residential area in park area (*1)			1,650	10	65	165	Illegal city block
7.	Ananindeua City, Guanabara municipality	10,129	409	9,720	60	90	90	Legal city block
8	Dwelling units in interchange section	17,365	0	4,212	26	90	162	Legal city block
8.1	Commercial buildings in interchange section			13,153	4			Legal city block
Total		154,840	15,698	74,961	241			Legal city block
Total number of commercial buildings					4			Legal city block

(Note-1): The area of the section passing through the state park and the area of the zone with increased width in the state park (figures above in parentheses) are government-owned grounds, thus they have not been added in the required land acquisition.

(7) JBIC Environmental Checklist

The JBIC Environment Checklist of the proposed road construction project is prepared based on major findings and/or facts obtained from environmental screening/scoping conducted within this study (see Table 1.6-7).

Table 1.6-7 Environmental Checklist (Road Construction Project)

Classi-Fication	Environmental item	Main check items	Environmental considerations confirmation results
1 Permits and explanation	(1) EIA and environmental permits	① Have EIA reports been officially completed? ② Have EIA reports been approved by authorities of the host country's government? ③ Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? ④ In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	- ①, ②EIA report has not been prepared nor completed for this road construction project. Project Route passes through special environmental protection area, APA BELEM, thus EIA/RIMA is required for applying of environmental license. NGTM has following time schedule for entire environmental license (LP) application process. - September, 2009: Submit the Project Description to SEMA (Secretariat of State for the Environment) - Late September, 2009: ToR finalization on EIA/RIMA-related studies to be required for LP application. - November, 2009: Selection of EIA Consultant by NGTM - May, 2010: Submission of EIA/RIMA documents (D/F) for LP application - Approval of LP is scheduled around end of November, 2010 - ③, ④ N/A.
	(2) Explanation to local residents	① Are contents of the project and the potential impacts adequately explained to the public based on appropriate procedures, including information disclosure? Is understanding obtained from the public? ② Are proper responses made to comments from the public and regulatory authorities?	- ① No explanation nor information disclosure to local residents, conducted yet. ② Pará State will carry out relevant PI-related activities such as community briefing after this road development proposal is officially approved and registered in state legislature.
2 Measures for pollution control	(1) Air quality	① Is there a possibility that air pollutants emitted from various sources, such as vehicle traffic will affect ambient air quality? Does ambient air quality comply with the country's ambient air quality standards? ② Where industrial areas already exist near the route, is there a possibility that the project will make air pollution worse?	- ① Field survey and analysis was carried out around Av. Joao Paulo II in 2003 F/S. It was found that air quality therein at that time satisfied Brazil's environmental standards due to its small local traffic volume. - Even now there is low traffic volume around project route, and there are no groups of factories that cause additional air pollution. - Roadside air quality may be deteriorated during and after construction period. - ② N/A.
	(2) Water quality	① Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? ② Is there a possibility that surface runoff from roads will contaminate water sources, such as groundwater? ③ Do effluents from various facilities, such as stations and parking areas/service areas comply with the country's effluent standards and ambient water quality standards? Is there a possibility that the effluents will cause areas that do not comply with the country's ambient water quality standards?	- ①, ②, ③ There are concerns about sediment runoff, and generation and mixing of turbid waters due to construction within catchment area of APA BELEM. - Moreover, groundwater is used (shallow wells) around surrounding communities of illegal squatters, and there are concerns about temporary deterioration in the water quality during construction period. Consequently, an appropriate wastewater treatment plan is necessary.

	(3) Noise and vibration	① Do noise and vibrations from vehicle and train traffic comply with the country's standards?	- ① Field measurement, analysis and impact forecast evaluations were carried out in 2003 F/S. It was reported that roadside noise environment therein at that time satisfied Brazil's environmental quality standards, because there was less traffic volume in surrounding area and site was adjacent to APA BELEM. - Roadside noise may be deteriorated during and after construction period.
3 Natural environment	(1) Protected areas	① Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	- ① Project route partially runs through catchment area of APA BELEM, which was established to protect the reservoir area. - All protected areas including APA BELEM and their important vegetation are regulated by Belem City Ordinance No. 266. A 200 meter wide zone adjacent to APA Belem such as Utinga Complex set down in State Ordinances No. 3251 and 3252, are also covered in conditional clause No. III of this ordinance. - According to Belem City Ordinance No. 269, if a public works project is to be executed in these special environmental protection areas, the vegetation therein cannot be cleared or relocated without official permission and proper relevant environmental assessment study. - Several communities of illegal squatters exist around APA BELEM and there have been encroachments in some parts of this protected region. Thus protective barriers and fences have been installed since 2003 to prevent trespassing.
	(2) Ecosystem and biota	① Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? ② Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? ③ If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? ④ Are adequate protection measures taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock? ⑤ Is there a possibility that installation of roads will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered? ⑥ In cases where the project site is located at undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?	- ① In 2003 F/S report, 48 species of fauna (including 13 species of mammals) and 34 species of flora were confirmed around project route including APA BELEM, and occurrences of valuable species were also reported. - ② N/A - ③, ④, ⑤ Within EIA/RIMA – related studies to be undertaken later, relevant mitigation measures and/or program, will be discussed based on D/D results of this road construction project. - ⑥ N/A

	(3) Hydrology	① Is there a possibility that alteration of topographic features and installation of structures, such as tunnels will adversely affect surface water and groundwater flows?	- ① APA BELEM is located around project route. Use of shallow wells has also been observed in surrounding communities. However, there will be no large-scale earthworks such as excavation and embankment within this road construction work. Thus it can be said that risk of obstruction of local groundwater flow is very small. - However, it has been reported that at present there is a lack of proper maintenance and management of drainage facilities and inadequate maintenance of drainage networks in some parts of project route which may lead to problems of poor drainage such as flooding around project route during rainy season.
	(4) Topography and geology	① Is there a soft ground on the route that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed? ② Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? ③ Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff ?	- ① No soft ground nor steep slopes in vicinity of project route, that may cause mudslides and landslides exist around project route. - ② No large-scale earthwork such as cutting/or filling will be taken place, so risk of relevant landslide is very small. - ③ Project route will partially pass through catchment area of APA Belem and risk of soil runoff is not negligible. Relevant mitigation measures and/or program will be established within EIA/RIMA-related studies based on D/D results of this road construction project.
4 Social environment	(1) Resettlement	① Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? ② Is adequate explanation on relocation and compensation given to affected persons prior to resettlement? ③ Is the resettlement plan, including proper compensation, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? ④ Does the resettlement plan pay particular attention to vulnerable groups or persons, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? ⑤ Are agreements with the affected persons obtained prior to resettlement? ⑥ Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? ⑦ Is a plan developed to monitor the impacts of resettlement?	- ① A total of 245 resident families, 90 families from legal city blocks (27,085m^2) and 155 families from illegally occupied city blocks (32,575m^2) would be relocated. - ② Advance explanation regarding this public works project would be given prior to land acquisition, and mainly monetary compensation would be provided on basis of evaluations of land, building and business compensation. - ③ An execution system has been set up wherein the public works agency, which is the state land acquisition organization, will execute the land acquisition on the basis of the basic design provided by the State Secretariat of Strategic Project and Nucleus of Administration of Metropolitan Transport. - To execute this project, financial negotiations are progressing between Para State Government and Caixa Economica Federal (federal savings bank), and it has been decided that expenses related to involuntary resettlement of residents will be incorporated into the execution budget. - ④, ⑤, ⑥, ⑦ Comprehensive RAP including relevant mitigation and monitoring program will be discussed within EIA/RIMA-related studies based on D/D results of proposed road construction project.

	(2) Living and Livelihood	① Where roads or railways are newly installed, is there a possibility that the project will affect the existing means of transportation and the associated workers? Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of livelihood, or unemployment? Are adequate measures considered for preventing these impacts? ② Is there a possibility that the project will adversely affect the living conditions of inhabitants other than the affected inhabitants? Are adequate measures considered to reduce the impacts, if necessary? ③ Is there a possibility that diseases, including communicable diseases, such as HIV will be introduced due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? ④ Is there a possibility that the project will adversely affect road traffic in the surrounding areas (e.g., by causing increases in traffic congestion and traffic accidents)? ⑤ Is there a possibility that roads and railways will cause impede the movement of inhabitants? ⑥ Is there a possibility that structures associated with roads (such as bridges) will cause a sun shading and radio interference?	- ① Some influence caused by such as temporally worsened noise and air quality on socio-economic activities of local residents around project route cannot be avoided during construction period. - ② A social measures department has been setup in NGTM, which is in charge of this project, and it has internal regulations to organize resident participation type supervisory committees for each business/industrial district. - Therefore, this project is expected to have a system built through which dissatisfaction, complaints, protests, etc. of residents in surrounding area will be regularly conveyed to people involved in work. Through these processes, it will be possible to reduce impacts on surrounding social environment and minimize friction with residents. - ③ Relevant public health-related education program will be discussed within EIA/RIMA-related studies. - ④, ⑤ After construction, significant improvement is expected in bus transport and other existing means of transport in surrounding area. - It is thought there will be small changes in land use and livelihood means, with little unemployment generation, etc. - ⑥ It is necessary to pay attention to obstruction of sunlight and electromagnetic waves around expropriated land with regards to overpass at intersection with BR-316.
	(3) Heritage	① Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with the country's laws?	- ① There is no cultural heritage that should be protected in vicinity of project route.
	(4) Landscape	① Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	- ① There are no scenic sites that should be protected in vicinity of project route.
	(5) Ethnic Minorities, and Indigenous People	① Where ethnic minorities and indigenous peoples are living in the rights-of-way, are considerations given to reduce the impacts on culture and lifestyle of ethnic minorities and indigenous peoples? ② Does the project comply with the country's laws for rights of ethnic minorities and indigenous peoples?	- ① No communities of ethnic minorities nor indigenous people residing in vicinity of project route exist. - ② N/A
5 Others	(1) Impacts during Construction	① Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? ② If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? ③ If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	- ①, ②, ③ It is proposed NGTM to prepare comprehensive environmental management program, regarding temporal pollution during construction (e.g. noise, vibration, turbid water, dust, vehicular emissions, construction waste and others) and impacts on social environment within application process of LP. - Currently, NGTM does not have any environmental staff, so, NGTM is requesting SEMA (Secretariat of State for the Environment) for assigning a qualified staff for supervising all environmental and social issues related to this project.

	(2) Monitoring	① Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? ② Are the items, methods and frequencies included in the monitoring program judged to be appropriate? ③ Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? ④ Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	- ①, ② A proposal has been put forward in LP application related review to carry out a study related to environment monitoring system, its implementation procedure, and reporting means for this Road Development Plan. - ③, ④ As mentioned previously, NGTM is requesting SEMA (Secretariat of State for the Environment) for transferring a qualified staff for supervising all environmental and social issues related to both BRT and this road construction projects.
6 Notes	Reference to Checklist of Other Sector	① Where necessary, pertinent items described in the Forestry Projects checklist should also be checked (e.g., projects including large areas of deforestation). ② Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of power transmission lines and/or electric distribution facilities)	- None.
	Note on Using Environmental Checklist	① If necessary, the impacts to transboundary or global issues should be confirmed, if necessary (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	- None.

(8) Environmental License Application Schedule

Proposed route alignment partially passes through the special environmental protection area, APA BELEM (route length = 2,123km), thus it is mandatory to prepare an EIA/RIMA for the environmental license application (LP) of the proposed road construction project. NGTM is planning to have relevant environmental studies for the environmental license (LP) application as follows,

September 2009: Submit the Project Description to SEMA (Secretariat of State for the Environment).

Late September, 2009: Development of ToR of RIMA/EIA-related studies to be required for LP application.

November 2009: EIA/RIMA-Consultant LP Selection (NGTM)

May 2010: Submission of EIA/RIMA documents to SEMA

End of November 2010: LP is scheduled to be approved

In Brazil, it is mandatory to hire EIA consultant, registered in the Ministry of the Environment of Brazil to prepare official EIA/RIMA documents. Here selection of EIA Consultant will be conducted through the tender process organized by NGTM after relevant ToR of the EIA/RIMA to be required for the LP application is formally developed and its budget are approved officially.

(9) Environmental Checklist

The detailed results of the environmental checklist for the proposed road construction project are given in Table 1.6-8 and Table 1.6-9.

Table 1.6-8 Belem City Traffic Development Plan (Road Construction Project)

Environmental Checklist (1/2)

Environmental item	Content	Evalu-ation	Remarks
1. Air quality	Pollution due to emissions and harmful gases from vehicles and factories	Yes	- Roadside air quality will be deteriorated during/and after construction period.
2. Water quality	Pollution due to the influx of sediments and factory water discharge	Yes	- Partial sediment runoff and resultant turbid water may occur due to construction within catchment area APA BELEM. - Groundwater is used through shallow wells among illegal squatter's communities, and water quality therein may be worsened temporally during construction period.
3. Soil and Sedimentation	Pollution due to dust, agricultural chemicals, emulsified asphalt, etc.	No	-
4. Waste Disposal	Generation of construction scrap, surplus soil, general waste, etc.	Yes	- Large amount of construction waste will be generated during construction period.
5. Noise/Vibration	Generation of noise and vibrations by vehicles etc.	Yes	- Roadside noise and vibrations will be worsened during and after construction period.
6. Ground Subsidence	Ground transformation following changes in geological features or due to drop in groundwater level	No	-
7. Bad Smell	Generation of exhaust gases and foul smelling substances	Unknown	- There are concerns of generation of foul smell due to problems of local inundation caused by poor regional drainage system.
8. Topography/Geology	Modifications in the important topography or geological features due to digging, landfill, etc.	Unknown	- Problem of temporary inundation and/or flooding during rainy season in some sections of project route, due to poor regional drainage system may occur.
9. River Bed	Impact on the riverbed due to sediment runoff or construction in water	No	-
10. Flora/Fauna	Obstruction to breeding and extinction of species due to changes in habitat conditions	No	-
11. Water Resources	Drying up of wells due to draining etc. following excavation	No	- APA BELEM is located around project route. Use of shallow wells has been observed among surrounding communities. There will be no large-scale earthworks such as earth excavation and embankment within construction work. So, it can be said risk of obstruction of regional groundwater flow is very small.
12. Accidents	Increase in hazards such landslides, cave-ins, accidents, etc.	No	
13. Global Warming	Increase in the amount of CO2 exhaust from vehicles and construction equipment	Unknown	

Table 1.6-9 Belem City Traffic Development Plan (Road Construction Project)

Environmental Checklist (2/2)

Environmental item	Content	Evalu-ation	Remarks
14. Involuntary Resettlement	Resettlement following taking possession of land (conversion of the right of residence and land ownership)	Yes	- Large-scale resettlement and land acquisition will occur.
15. Local Economy	Loss of production opportunity such as land etc. and changes in the economic structure	Yes	- Local socio-economic activity may be hampered temporally due to local traffic jams during construction period
16. Land Use, Utilization of Local Resources	Segmentation of community due to the obstruction of traffic	No	-
17. Social Institutions	Changes in the power balance and the decision making system of each region due to road improvement.	No	-
18. Existing Social Infrastructure and Services	Effect of congestion, accidents, etc. on existing traffic, schools, hospitals, etc.	Yes	- Power-transmission line exists along project route partially.
19. The poor, indigenous of ethnic group	Effect on the residential areas of the poor, minority groups, indigenous population, etc., due to taking possession of land	Yes	- There are many low-income houses (i.e., illegal squatters) around project route.
20. Misdistribution of benefit and damage	Concentration or uneven distribution of the adverse effects and damage due to construction work	No	-
21. Local Conflict of Interests	Conflict of interests between environmental protection and development of the region	No	-
22. Gender	Improvement in the status of women	No	-
23. Children's Rights	Occurrence of illegal employment of school age children	No	-
24. Cultural Heritage	Loss or decrease in the value of temples or burial cultural assets	No	-
25. Infectious Diseases	Deterioration of the health environment because of spread of infectious diseases such as HIV/AIDS	Unknown	- Outbreak of cholera, typhoid, malaria, dengue and other waterborne diseases have been reported at low land area around Belem.

1.7. ECONOMIC EVALUATION

(1) Economic Cost of the Project

The economic cost is estimated to be of R$1 million after deducting the VAT or import duties and the cost reserve fund etc. from the total project cost of R$476 million. The annual maintenance and management cost for this project road is expected to be R$13.3 million, which is 5% of the total project cost.

Table 1.7-1 Annual Investments for Av. Joao Paulo II Road Project (Economic costs)

(Million real, 2009 prices)

Year	Total	International loans	Domestic loans
2013	77.0	0.0	77.0
2014	102.7	0.0	102.7
2015	85.6	0.0	85.6
2016	0.0	0.0	0.0
Total	265.3	0.0	265.3

(Source) JICA Inquiry Commission

(2) Benefits of the Project

The benefits will be low when the road opens for traffic but thereafter there will be a rapid growth with the benefits reaching R$97 million in 2025, which is about one-third of the project cost. 70% or more of the source of this benefit lies in the reduction in travel time. In twenty years from opening the road to traffic (around the middle of the 2030's), the traffic on the road will approach its full capacity and then the benefits will peak. From the point of view of car types, it is believed that passenger car users will benefit the most from this road.

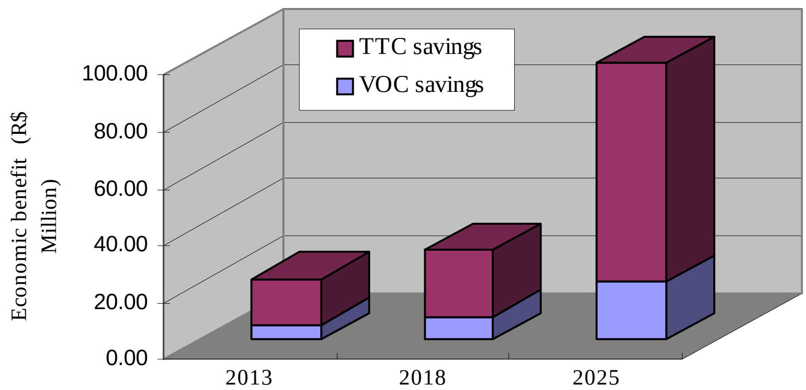


Figure 1.7-1 Generation of Economic Benefits

Table 1.7-2 Economic Benefits by Source

(Million real, 2009 prices)

Year	Savings in vehicle travel cost (VOC)			Savings in traffic time cost (TTC)			Total		
	Passenger car	Bus	Total	Passenger car	Bus	Total	Passenger car	Bus	Total
2013	5.2	0.1	5.2	8.0	8.1	16.1	13.1	8.2	21.3
2028	8.1	0.0	8.1	12.9	10.5	23.5	21.0	10.5	31.5
2025	19.5	0.6	20.1	71.0	5.9	77.0	90.5	6.5	97.1

(Source) JICA study team

(3) Flow of Costs & Benefits and Internal Rate of Return

The economic evaluation of the Av. Joan Paulo II road project was done according to the method of economic evaluation explained in Section 1 of Chapter 9. The main assumptions and preconditions are as follows.

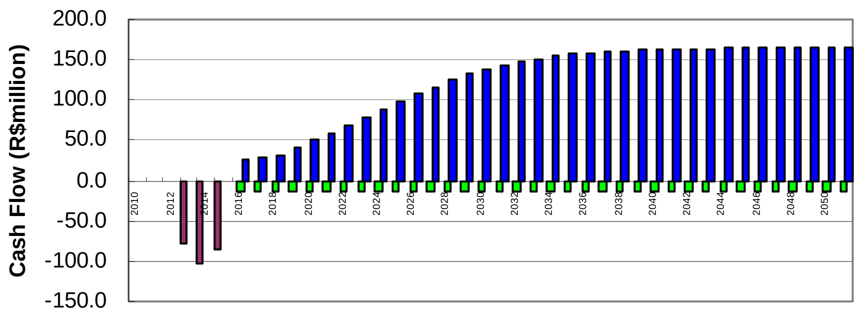
1) The economic life of the road is assumed to be 35 years. The benefits will be measured and compared to the economic cost for the period starting from 2016, when the road will be opened to traffic, until 2051.

2) The land cost is negligible compared to the total project cost, thus the residual value after its service life is not taken into account.

3) For benefits, transport demand was forecast for 3 target years (2013, 2018, 2025), and the years in between were supplemented. However, around 2035, the amount of traffic on the project road is expected to reach the total capacity of the road (48,000 PCUs per day) and it is therefore assumed that the economic benefits will peak from then on.

As shown in Table 1.7-3, if the above economic cost and the economic benefits are compared, then the expected economic internal rate of return (E-IRR) is 16.8%, which far exceeds Brazil's 12% opportunity cost of capital. Thus this project is judged to be economically feasible. The expected net present value (E-NPV) is presumed to be R$118 million real at a discount rate of 12%.

When we look at the results of the sensitivity analysis given in Table 1.7-4, E-IRR falls below 12% if the cost increases by approximately 60% or the when the benefit decreases by 35% or more, so the economic feasibility of this project is strong.



Source: JICA survey team

Figure 1.7-2 Flow of Economic Cost and Benefits

Table 1.7-3 Flow of Economic Cost and Benefits and the Internal Rate of Return

(Million real, 2009 figures)

Year	Project cost	Road maintenance & management cost	Economic benefit	Cash flow
2010	0.0	0.0	0.0	0.0
2011	0.0	0.0	0.0	0.0
2012	0.0	0.0	0.0	0.0
2013	77.0	0.0	0.0	-77.0
2014	102.7	0.0	0.0	-102.7
2015	85.6	0.0	0.0	-85.6
2016	0.0	13.3	27.5	14.2
2017	0.0	13.3	29.5	16.2
2018	0.0	13.3	31.5	18.3
2019	0.0	13.3	40.9	27.6
2020	0.0	13.3	50.3	37.0
2021	0.0	13.3	59.6	46.4
2022	0.0	13.3	69.0	55.7
2023	0.0	13.3	78.4	65.1
2024	0.0	13.3	87.7	74.5
2025	0.0	13.3	97.1	83.8
2026	0.0	13.3	107.1	93.8
2027	0.0	13.3	116.3	103.1
2028	0.0	13.3	124.7	111.4
2029	0.0	13.3	132.0	118.7
2030	0.0	13.3	138.3	125.0
2031	0.0	13.3	143.5	130.3
2032	0.0	13.3	147.9	134.6
2033	0.0	13.3	151.4	138.2
2034	0.0	13.3	154.3	141.1
2035	0.0	13.3	156.6	143.4
2036	0.0	13.3	158.4	145.2
2037	0.0	13.3	159.9	146.6
2038	0.0	13.3	161.0	147.8
2039	0.0	13.3	161.9	148.6
2040	0.0	13.3	162.6	149.3
2041	0.0	13.3	163.1	149.9
2042	0.0	13.3	163.6	150.3
2043	0.0	13.3	163.9	150.6
2044	0.0	13.3	164.1	150.9
2045	0.0	13.3	164.3	151.1
2046	0.0	13.3	164.5	151.2
2047	0.0	13.3	164.6	151.3
2048	0.0	13.3	164.7	151.4
2049	0.0	13.3	164.8	151.5
2050	0.0	13.3	164.8	151.6
2051	0.0	13.3	164.9	151.6

Internal rate of return (E-IRR)	16.8%
Net present value (E-NPV) (discount rate 12%)	117.9 million real

(Source) JICA survey team

Table 1.7-4 Sensitivity analysis of the Internal Rate of Return

(E-IRR:%)

Sensitivity analysis of IRR		Change in costs		
		Base case	20% increase	40% increase
Change in benefits	Base case	16.8	15.2	13.9
	20% reduction	14.4	12.9	11.8
	40% reduction	11.4	10.2	9.2

(Source) JICA survey team

Appendix
Project Design Document

CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

A. General description of project activity

B. Application of a baseline and monitoring methodology

C. Duration of the project activity / crediting period

D. Environmental impacts

E. Stakeholders' comments

Annexes

Annex 1: Contact information on participants in the project activity

Annex 2: Information regarding public funding

Annex 3: Baseline information

Annex 4: Monitoring plan

Revision history of this document

Version Number	Date	Description and reason revision
01	31 August 2009	Initial adoption
02	15 October 2009	Initial adoption ver.2

SECTION A. General description of project activity

A.1. Title of the project activity:

>>
BRT Belém, Brazil: ---
Version 1.1
August 31st 2009
This document describes with the base of the project for the investigation.

A.2. Description of the project activity:

>>
1. Purpose

The metropolitan area of Belem consists of five cities in the northern part of the Federal Republic of Brazil. The five municipalities of Belem, Ananindeua, Marituba, Benevides and Santa Barbara do Para have the aggregated population of about 2.05 million. In recent years, urbanization and population growth have been especially pronounced in Ananindeua.

In 2002, approximately 75% of the peak-hour passengers used bus transport in the metropolitan area of Belem. The public transport by bus had been very important for the metropolitan livelihood but suffering from the growing congestion and severe traffic slowdowns. The public transport system had been inadequately managed and inefficiently operated in the face of the expanding demand. Moreover, the bus fleet in operation were mostly antiquated and regarded as one of the causes of air pollution by their emissions.

The Para state plans the trunk bus system to improve the existing bus operation system, and to improve the traffic congestion in the study area. By introducing the trunk bus system, efficient bus operations and sound urban transport functions will be secured.

2. Salient Features of the Project

The proposed trunk bus system has the following characteristics and function.

1. In general, the conventional bus system is a supplemental transport system to the railway system, however, the trunk bus system is a public transport mode that secures medium transport volume. There are many trunk bus systems in the cities of Brazil.
2. The trunk bus system should be flexible enough to respond to future changes in bus passenger demand.
3. The trunk bus system should be a fast and pleasant transit system so as to encourage private transport passengers to switch to it.
4. Articulated buses should be introduced in order to increase the transport capacity.
5. Bus lanes shall be separated from ordinary traffic lanes as much as possible from a view point to securing functional and effective services and safety.
6. The fare rate system without any additional rate in transferring to other trunk bus lines is introduced for the benefit of passengers.
7. Since the trunk busways are constructed on the median side of existing major roads, an environmental load is alleviated.

3. Project Activity’s contribution to Sustainable Development

The project contributes to sustainable development in a significant manner:

1) The construction of the trunk bus system contributes to the alleviation of traffic congestion in the Belem metropolitan area. In the area, the public transport plays an important role in urban transport, which transports 70% of the daily passenger volume in 2009. The bus passenger volume in the

morning peak on Av. Almirante Barroso is approximately 40,000 persons/hour/direction. The existing bus system is close to line capacity. In comparison of traffic volume in 2009 to that in 2002, vehicles travelling on BR-316 increased substantially, with the respective ratios standing at 1.40. Av. Augusto Montenegro shows the largest increase in the vehicular (ratio of 1.7). The recent economic growth contributes to the increase of traffic volume of passenger car. As a result, the bus operation speed in 2009, compared to that in 2002 slows down by 30% to 40% of the speed. The bus service level is considerably lower. Those cause to prevent the growth of urban activities. The trunk bus system with articulated bus and bus exclusive road/lane secures a higher transport service, and alleviates traffic congestion in the metropolitan area besides. In estimating reduction of total travel time in the area, the expected reduction ratio of 2013 and 2018 to that of 2009 is about 10% and 15%, respectively. The introduction of trunk bus system is indispensable for sustainable development.

2) The air quality conditions will improve substantially after the trunk bus system comes into service. By the introduction of the articulated bus fleet in the trunk bus system and alleviation of traffic congestion due to reduction of existing buses, the CO_2 emissions are estimated to decrease by 62% over the ten-year period of the trunk bus operation.

A.3. Project participants:

>>

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)		No
Japan		No.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

>>

Brazil

A.4.1.2. Region/State/Province etc.:

>>

Para

A.4.1.3. City/Town/Community etc.:

>>

Belém

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

>>

The project is located within the metropolitan area of the city of Belem, Brazil.

The map of the metropolitan area is as follows:

A.4.2. Category (ies) of project activity:

>>

Sectoral scope 7: Transport

A.4.3. Technology to be employed by the project activity:

>>

1. Outline of the Project

The trunk bus system is proposed in the CDM project which is a rapid and mass transit system to improve the public transport system in the Belem municipality. That is a large articulated bus is operated on the exclusive busway constructed on existing major roads. Since the operated number of conventional buses in the existing system will be reduced under the trunk bus system, the traffic congestion is alleviated in the metropolitan area. As a result, GHS will be reduced in the area caused by alleviation of traffic congestion, reduction of conventional bus operation, and replacement of old-conventional bus to new articulated bus in comparison between “without” and “with” project cases. The reduction of GHG results introduction of the trunk bus system, not new technology.

2. Outline of Introduced Trunk Bus System

As can be seen in Figure A.4.1, the bus system in the study area will be formed by three systems, i.e. i) trunk bus system, ii) feeder bus system, and iii) conventional bus system.

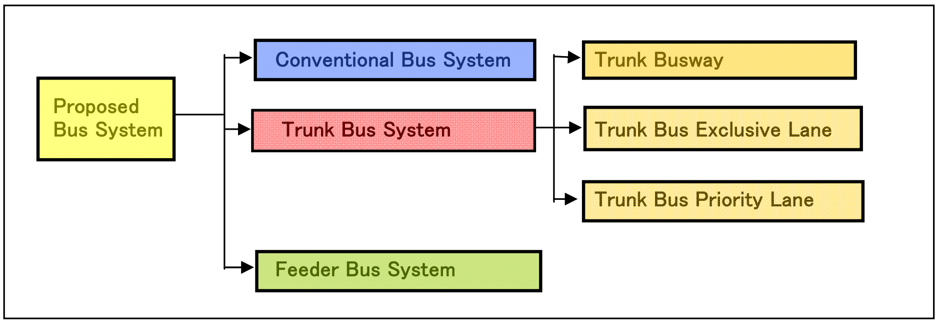


Figure A.4.1. Image of Bus system

1.1. Outline of Trunk Bus System

The trunk bus system is classified into three types, i.e. i) trunk bus exclusive road, ii) trunk bus exclusive lane, iii) trunk bus priority lane.

1.1.1. Trunk Bus Exclusive Road

The facility conditions of the trunk bus exclusive road are following, and the typical cross section of the trunk bus exclusive road is shown in Figure A.4.2.

- ➢ The trunk bus exclusive road is separated from other vehicle lanes with a separator so that other vehicles cannot enter the bus road.
- ➢ The trunk bus exclusive road will be constructed in the center of the existing road with 2-lane bus exclusive road. In case of trouble of a bus on trunk bus exclusive road, a following bus can overtake with running on a lane in opposite direction.

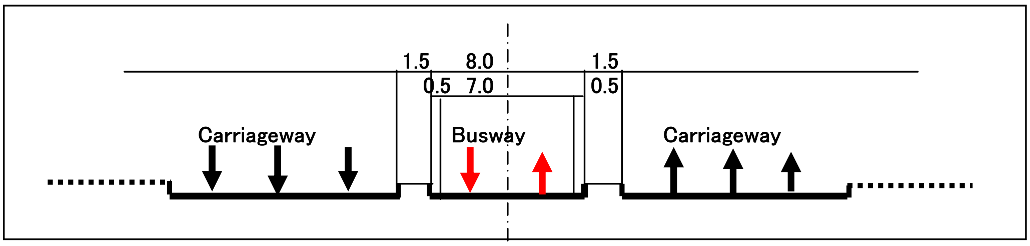


Figure A.4.2. Typical Cross Section of Trunk Bus Exclusive Road

1.1.2. Trunk Bus Exclusive Lane

The road facility conditions of trunk bus exclusive lane are as follows, and the typical cross section of the trunk bus exclusive lane is shown in Figure A.4.3.

- The trunk bus exclusive lane is partially separated from the general vehicle traffic lanes by separator, and general vehicles are excluded from the trunk bus exclusive lane for all day long.
- The trunk bus exclusive lanes are planned at the center side of the existing road, and in-bound and out-bound trunk bus exclusive lane are separated by the central reservation.
- Taxis, private cars, bicycles, motorcycles and pedestrians, etc. are excluded from the trunk bus exclusive lane for all day long.

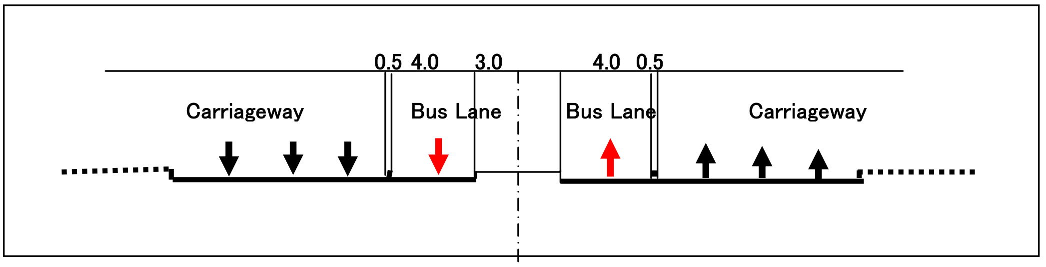


Figure A.4.3. Typical Cross Section of Trunk Bus Exclusive Lane

1.1.3. Trunk Bus Priority Lane

The road facility conditions of trunk bus priority lane are as follows, and the typical cross section of the trunk bus priority lane is shown in Figure A.4.4.

- The trunk buses can use the priority lane in peak hours. In off-peak hours, general vehicle traffic can be used on the priority lane.
- However, general vehicle traffic can use the priority lane in peak hours if it doesn't hinder trunk bus operation.
- The trunk bus priority lane is introduced at the same level as the existing road surface.
- The trunk bus priority lane is introduced at the same level of the existing road surface without any separators.
- The trunk bus priority lane is introduced to the left side of the existing road. Conventional buses will use the right side traffic lane of the existing road (as they do now).

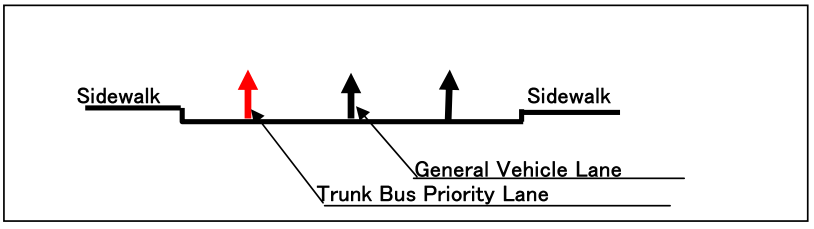


Figure A.4.4. Typical Cross Section of Trunk Bus Priority Lane

1.2. Conventional Bus System

At present, the conventional bus with transport capacity of 60 to 100 passengers is operating on the right side traffic lane of existing road. After introduction of the trunk bus system, the bus routes of the conventional buses will need to be re-routed and the operated number of conventional buses will be reduced.

1.3. Feeder Bus System

The feeder buses are operated in the areas from trunk bus terminals and bus stations to local areas. The feeder bus system requires the following functions or characteristics.

- Small buses with about 50 to 70 transport capacity will be adopted due to the narrow operation routes in the service areas.
- Feeder buses are connected directly to the trunk bus terminals and trunk bus stations introduced by integrated system.

Figure A.4.5. shows the location of trunk busway in trunk bus system.

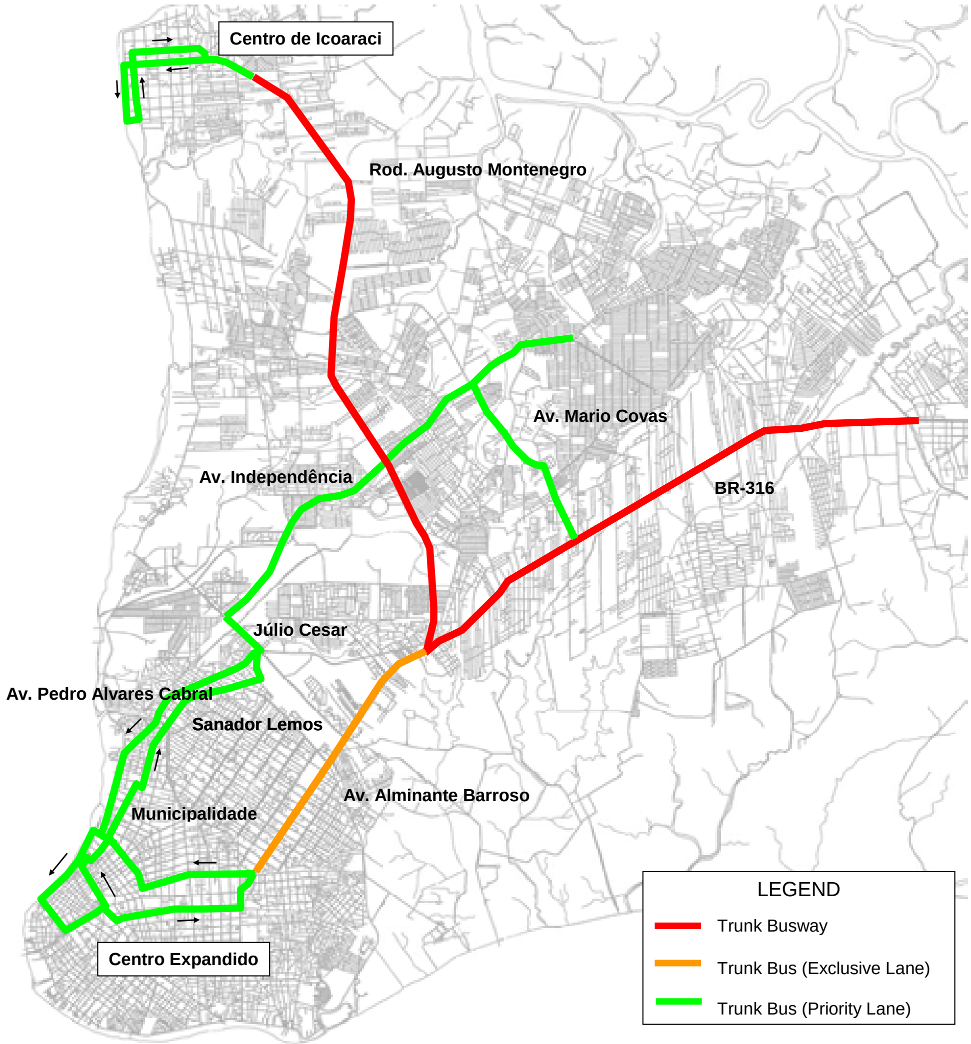


Figure A.4.5. Location of Trunk Busway in Trunk Bus System

2. Trunk Bus Operation System

2.1. Trunk Bus Operation Route System

The trunk bus operation routes are identified based on the bus passenger volume and passenger trip characteristics. In this study, the following two (2) trunk bus operation routes are recommended.

1) Operation route-A: The trunk buses will be operated on the route which is between each trunk bus terminal and San Braz area as a circulation system.
2) Operation route-B: The trunk buses will be operated on the route which is between each trunk bus terminal and Belem central area as a circulation system.

2.2. Express Bus and Normal Bus Operation System
For increasing the transport capacity of the trunk bus system, the following express bus and normal bus operation systems will be introduced.
- Express Bus Operation System: the express bus will stop at the trunk bus terminals and trunk bus stations.
- Normal Bus Operation System: the normal bus will stop at the trunk bus terminals, trunk bus stations, and each trunk bus stop.

3. Bus Fare Payment System
The following fare system of the trunk bus is recommended.
- The bus fare of transfer from /to the trunk bus system is free of charge.
- The bus fare of transfer from / to the trunk bus and the feeder bus is free of charge.
- The bus fare of transfer to others is a separate charge.

4. Trunk Bus Fleets
The following trunk bus fleets are required to ensure the smooth operation of the trunk bus system.
- Articulated buses with transport capacity of 160 passengers are adopted.
- The floor height of buses is adopted at 95 cm from ground level.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

>>
The preconditions for estimation of emission reduction are following.
- The estimated emission for the baseline scenario is converted to CO_2.
- The modes used for estimation consist of passenger car, small bus and large bus in the baseline scenario and feeder bus and articulated trunk bus added in the project implementing scenario.

The emission reduction is estimated by assuming the CDM starting date of 2013 and the crediting period of 10 years. The total emission reduction by the CDM implementation of the trunk bus project is estimated at 360,900 t/CO_{2eq} and the annual average emission is 36,090 t/CO_{2eq}.

Table A.4.1. Annual estimation of emission reductions

year	Annual estimation of emission reductions in tonnes of $CO_{2\ eq}$
2013	26,067
2014	30,588
2015	32,336
2016	35,043
2017	36,034
2018	35,972
2019	36,530
2020	40,278
2021	44,185
2022	43,866
Total estimated reductions (tones of CO2 e)	360,900
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tones of CO2 e)	36,090

A.4.5. Public funding of the project activity:

>>

The project activity is partly financed by the Government of Japan through JICA. The funding however is separate from and is not counted towards the financial obligations of the aforesaid party. The relevant documents have been submitted to the validator.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

>>

"Baseline Methodology for Bus Rapid Transit Projects" AM0031

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

>>

The methodology is applicable as the project activity reduces emissions through the construction and operation of a Bus Rapid Transit (BRT) system for urban road based transport.

Table B.1. relates the specific baseline methodology applicability conditions with the proposed project.

Table B.2.1. Applicability Conditions

Applicability condition	Project situation
The project has a clear plan how to reduce existing public transport capacities either through scrapping, permit restrictions, economic instruments or other means and replacing them by a BRT system.	The trunk bus system is introduced on the existing public transport system and composed of trunk bus, feeder bus and ordinary bus (existing bus) served in the area. The trunk bus carries major bus passengers in the system.
Local regulations do not constrain the establishment or expansion of a BRT system.	The proposed project strictly conforms to the regulations on the national, state and municipal levels.
Fuels used in the baseline and/or project case are unblended gasoline, diesel, LNG or CNG. Projects using bio-fuels either in the baseline or project case are not eligible to use this methodology.	The proposed BRT system uses diesel and do not use bio fuels. When the possibility of hybrid buses is examined, the analysis utilizes emission factors publicly announced by bus manufacturers. The project is a trunk bus system and excludes from monitoring and analysis passenger cars, taxis, buses unrelated to the project and other vehicles. Those vehicles other than trunk buses are taken into account only when the baseline emissions are estimated. In the baseline transport system, 90% of the public transport (buses) uses diesel. Bio fuels are not used at all. 28.1% of passenger cars use ethanol-mixed gasoline and other bio fuel mixtures. IPCC now publishes the emission factors of vehicles that use fuels containing alcohol. It is therefore possible to calculate the emissions of such bio gasoline cars for the baseline analysis.
The BRT system as well as the baseline public transport system and other public transport options are road-based.	The baseline public transport system, the proposed BRT system and other possible public transport options all concern road transport only.
The BRT system partially or fully replaces a traditional public transport system in a given city. The methodology cannot be used for BRT systems in areas where currently no public transport is available.	The trunk bus system will gradually replace the present public transport system. The present system is operating in the metropolitan area of Belem where the proposed project will directly influence.
The methodology is applicable if the analysis of possible baseline scenario alternatives leads to the result that a continuation of the current public transport system is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity (i.e. the baseline scenario)	The baseline scenario assumes that the present system will continue to operate in the future.

All applicability conditions for using the methodology are thus fulfilled.

B.3. Description of the sources and gases included in the project boundary:

>>

The project boundary is defined by the passenger trips completed on the BRT project that is part of the public and private road-based passenger transport sector of Belém. The physical delineation is determined by the outreach of this project. The project boundary includes all anthropogenic emissions by sources of GHGs under the control of project participants.

Table B.3.1. Emissions Sources Included in the Project Boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Mobile source emissions of different modes of road transport for passengers which use BRT system (buses, passenger cars, motorcycles, taxis)	CO_2	Yes	Main source
		CH_4	Yes	
		N_2O	Yes	
Project Activity	BRT bus emissions (feeder and trunk routes)	CO_2	Yes	Main source
		CH_4	Yes	
		N_2O	Yes	

The most important GHG in mobile sources is clearly CO_2[1]. Road transport emits significant amounts of other pollutants such as carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs), sulfur dioxide (SO_2), particulate matter (PM) and oxides of nitrate (NO_x), which cause or contribute to local or regional air pollution problems. The methodology however only includes the direct GHGs listed above. Figure B.3.1. shows the emission sources included or excluded in the project boundary.

Emission sources not considered in the Methodology

Emissions caused by remaining transport system (taxis, cars, conventional public transport)

Emissions caused by freight, ship, rail and air transport

Emission sources considered in the Methodology

Upstream emissions included as leakage
- Construction emissions caused by the project
- Reduced life-span of buses due to scrappage
- Well-to-tank emissions of fuels used by project and baseline

Direct project and baseline emissions
Emissions caused by passengers transported in the BRT project

Downstream emissions included as leakage
Congestion change provoked by project resulting in (inter alia):
- Increased vehicle speed
- Rebound effect

Other emission included as leakage
Change of baseline factors monitored during project and included as leakage:
- Change of road factors of taxis provoked indirectly by project
- Change of load factor of remaining conventional bases provoked indirectly by project

Figure B.3.1. Project Boundary

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

>>

IDENTIFICATION OF THE BASELINE

Steps followed to identify the baseline are:

[1] According to IPCC, 2000, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Chapter 2: Energy; CO_2 is responsible for over 97% of the CO_2-equivalent emissions from the transportation sector.

- Step 1: Identify all alternatives
- Step 2: Analyze options using the latest version of the "Tool for the demonstration and assessment of additionally"
- Step 3: If step 2 results in more than one possible scenario, the baseline scenario is the one with the lowest emissions.

Step 1: Identification of Alternatives

The baseline alternatives assessed are:
1. A continuation of the current public transport system;
2. The project proposal (BRT system) not implemented as a CDM project activity;
3. Rail or water-based systems;
4. Comprehensive re-organization of the transport system;

Step 2: Analysis of Alternatives

The following analyses are made according to "The Combined Tool to Identify the Baseline Scenario and the Demonstration of Additionality.

ALTERNATIVE 1: A continuation of the current public transport system;

Identification of Alternatives 1
- Conditions of existing public transport system: In the Belem metropolitan area, the public transport plays an important role in urban transport, which transports 1.7 million passengers/day, equivalent to 70% of the daily passenger volume in 2009. The existing bus system is close to line capacity.
- Traffic congestion in the area: The increment of line capacity on the existing bus system is limit in the number of operated buses. Besides, since passenger cars will be increase in future, the traffic congestion on major roads will be worse and the bus operation speed will be worse at the same time. These traffic conditions are affected on civil life.
- Alternative 1 proposed complies with all applicable legal and regulatory requirements. Continuation of the current transport mode complies with legal requirements. The implementation of this project is not conditioned by Brazil, Para or Belém s not a compulsory implementation following as financial means have to be secured independently for each phase on part of the District.

Investment Analysis
- Need of Public Investment: As long as the existing bus transport system should continue, it would not be possible to expand the capacity of public transport. It will be necessary to invest in the construction of roads for bus operation as well as roads for passenger car traffic.
- The road construction will have to be implemented by the public sector. However, the investment cost is higher than that of the trunk bus system.
- The expansion of transport capacity in the existing bus system will have to be implemented by private bus companies. The expansion of transport capacity for the growing demand will necessitate the opening up of new bus lines. Bus companies will have to wait the completion of new road construction and then start new bus routes with appropriate addition to their fleet.

Barrier Analysis
The continuation of the existing bus system will face the following barriers.
- The bulk of the required investment will be on the road construction. It will be difficult to obtain a soft loan to finance the entire cost of construction. The State Government of Para does not have the financial capacity to borrow sufficient fund from elsewhere for the investment requirement.

- The present bus operation is nearing the limit of line capacity. Additional investment in the bus fleet has low marginal efficiency of capital. Private bus companies will be hardly attracted to the additional investment.

However, the continuation of the existing bus system will point out the following advantages.

- It is clearly understood among the metropolitan population at large that the transport demand is nearing the limit of the available public transport capacity.
- Private bus companies will readily go along with the continuation of the existing bus system because they will not be required to do anything, even re-routing the existing bus lines.
- The employees of the bus companies will not be adversely affected by the continuation of the existing bus system.

For those who concern themselves with metropolitan public transport operation and management, the continuation of the existing system would be the most welcome option. They would neither be required to embark on the high risk venture of restructuring the transport system nor be challenged by the resistance of the vested interests in the transport sector. The continuity of the present system has the most realistic appeal and thus offers the most appropriate baseline scenario.

ALTERNATIVE 2: The project proposal (BRT system) not implemented as a CDM project activity;

Identification of Alternative 2

- The proposed trunk bus system is not applied for CDM registration, but its project components, including the expected impacts on the public transport services and on the entire urban transport in the metropolitan area of Belem, are exactly the same as the trunk bus system proposed as a CDM project activity (as discussed in detail in B.5).
- Alternative 2 complies with all applicable legal and regulatory requirements. Its proposal on the continuity of the current transport mode conforms to the legal requirements. The implementation of the project components in this alternative is not subject to the legal conditions required respectively by the Federal Government, the State Government of Para and the Municipal Government of Belem.

Investment Analysis

- Procurement of Fund: The State Government of Para is requesting a soft loan from the Yen Credit Facility of Japan. With the soft loan financing available, it is possible to procure the fund for project implementation without obtaining CDM registration.

Barrier Analysis

- Need of Own Capital: The prospective soft loan from Japan does not cover the costs of land acquisition and system operation. Such costs must be met by force account of the State Government. Because there is a possibility of budget shortage, the expected revenue from the CDM registration will be of substantive importance.
- Resistance from the transport sector: The introduction of the trunk bus system involves the partial abolition of the existing bus lines and the consolidation of the retained lines. This will adversely affect the revenues of individual bus companies. Details will be discussed in B.5.

Because there remains a possibility of budget shortage regarding the domestic currency portion of the investment requirement, Alternative 2 is judged not appropriate.

ALTERNATIVE 3: Rail or water-based systems;

The introduction of a railway system or a water-based system of public transport to the metropolitan area of Belem involves significant problems and constraints.

Identification of Alternative 3

- There is no railway in metropolitan Belem. Water transport is operated on Guama River that flows through the metropolitan area of Belem, ferrying passengers and freight to and from the nearby islands. The present scale of operation is too limited to develop a water-based public transport system out of it for metropolitan Belem.
- If a railway system should be established, it would be necessary to enact a new set of laws and regulations to control its orderly development and management.
- The relevant laws and regulations are already established for the water-based transport.

Investment Analysis

- The required investment in an urban railway system would greatly exceed the estimated cost of the proposed trunk bus system which will run on the available arterial roads.
- The construction cost varies substantially between LRT, monorail and regular railway. A rough estimate from the past rail-based projects is in the range of US$30 to 50 million per kilometer. The investment will be huge compared to a trunk bus system.
- For a water-based system, it would be necessary to develop a network of channels appropriate for regular water transport services. The investment cost of channels would be too huge to contemplate the possibility of a water-based system for metropolitan Belem.
- Considering the large cost of construction, the development of a rail-based system will require the commitment of public investment, with the private sector possibly bearing the cost of operation.
- The required initial investment in a railway system would be too large for the private sector to shoulder. Even the operation of railway services could be beyond the capacity of private operators.

Barrier Analysis

- System Flexibility: Compared to a bus system, a railway system requires a technically advanced management of its daily operation. The allocation of railway cars, operation control, scheduling of service frequency and so forth need the IT system facilities.
- Operation and Maintenance: The management of a railway system requires the expertise gained from experience in addition to the technical mastery of information technology. Both the public and the private sectors in metropolitan Belem lack this experience.
- Conditions of the Existing Roads: The roads in the central part of Belem are invariably very narrow. It is extremely difficult to introduce an LRT or monorail system into the CBD of Belem.
- Construction Cost: The railway construction cost is very large compared to a trunk bus system proposed on the existing arterial roads. It would be very difficult to procure sufficient fund for its development.
- The present bus operators will protest against the introduction of a railway system and it would be necessary to develop and manage a system which ensures the coexistence of rail and bus services.
- The introduction of a railway system will adversely affect the employees of the present bus operators.

Alternative 3 of a rail- or water-based system is clearly infeasible in introduction of the system, investment and protest of existing bus companies in the metropolitan area of Belem. The baseline scenario based on such a system is neither realistic nor credible.

ALTERNATIVE 4: Comprehensive re-organization of the transport system;

Alternative 4 that reorganizes the existing bus transport system involves significant problems and constraints. This scenario proposes the comprehensive reorganization of the public transport services that exist at present. The present metropolitan transport operation is provided by many bus companies vying for passengers. The restructuring aims to integrate such ill-coordinated bus services of individual companies under a centrally managed bus operation center. Bus companies are required to reorganize themselves into a unitary system which dispatches buses in timely response to localized demands with the introduction of a uniform fare scale and the rerouting of present bus lines.

Identification of Alternative 4

- As already mentioned, the present public transport system in metropolitan Belem is nearing its line capacity. That is to say, the public transport capacity could be hardly expanded or upgraded by such efforts as institutional reorganization of the system, re-arrangement of bus lines, increase of service frequency, improvement of operation and management and so on.
- Even if some improvement could be attained by comprehensive reorganization, it would be a short-lived success and the limit of transport capacity would be reached before long.
- The present bus services are administered respectively by the metropolitan municipalities and the bus lines are operated by the licensed private companies. In the metropolitan area of Belem, a good number of bus companies are servicing some 160 lines and trying to make profits out of their respective operations. Accordingly, the bus lines show concentrations on those roads with large passenger demand, while the service level is low on the other roads with low demand. The tendency among the bus companies is to run their fleets as long as possible to earn enough fares, regardless of the reduced passenger occupancy per vehicle operated hour. The result has been the unnecessary increase of the bus fleets and the traffic congestions in the metropolitan road network.
- Alternative 4 complies with all applicable legal and regulatory requirements. Its proposal on the continuity of the current transport mode conforms to the legal requirements. The implementation of the project components in this alternative is not subject to the legal conditions required respectively by the Federal Government, the State Government of Para and the Municipal Government of Belem.

Investment Analysis

- The proposed comprehensive reorganization of the transport system does not require a sizable amount of public investment.
- The cost of reorganization will be shouldered by private bus companies.

Barrier Analysis

- Alternative 4 is to be carried out essentially on the organizational and managerial plane. The organizational restructuring, however well planned in the design stage, carries the risk of facing the resistance and non compliance when put into actual operation.
- The re-arrangement of bus lines requires an integrative plan to allocate buses according to the presences and sizes of passenger demand. This would directly affect the profit earning opportunities of individual bus companies. It would not be easy to formulate and implement a comprehensive reorganization plan against such vested interests.
- The Limit of Transport Capacity Expansion: The present public transport system is approaching the limit of line capacity and the institutional reorganization alone will not provide a solution to meet the increasing demand.
- Alternative 4 does not require large public investment. However, the expected effects of the comprehensive reorganization would be marginal in the economic sense as well as in the possible capacity expansion. There would be no justifiable incentive for the bus companies to invest in the reorganization.

Alternative 4 that reorganizes the existing public transport system is constrained by the expected difficulty of adjusting the interests of bus companies competing for fares and thus it would not be feasible. It is judged unrealistic to choose Alternative 4 for the baseline scenario.

It is concluded from the foregoing analysis that Alternative 1 is the most suitable baseline scenario for the proposed trunk bus system. The other alternatives are all judged not feasible, requiring no further analysis from Step 3 and on.

KEY STEPS TO DETERMINE THE BASELINE

The baseline methodology involves two main steps:

1. Determination of emissions per passenger transported per vehicle category. This is calculated exante, including the usage of a fixed technology change factor. The baseline emission factor is adapted to potential changes in trip distance and type of fuel used by passenger cars if the surveys indicate that changes in trip distance or type of fuel used would lead to lower baseline emission factors.
2. Baseline emissions: These are calculated ex-post based on the passengers transported by the project and their modal split. Core baseline parameters used for calculating the baseline emission factors are reviewed through an annual survey, with changes only being applied if the baseline emissions factors would be lower than original factor.

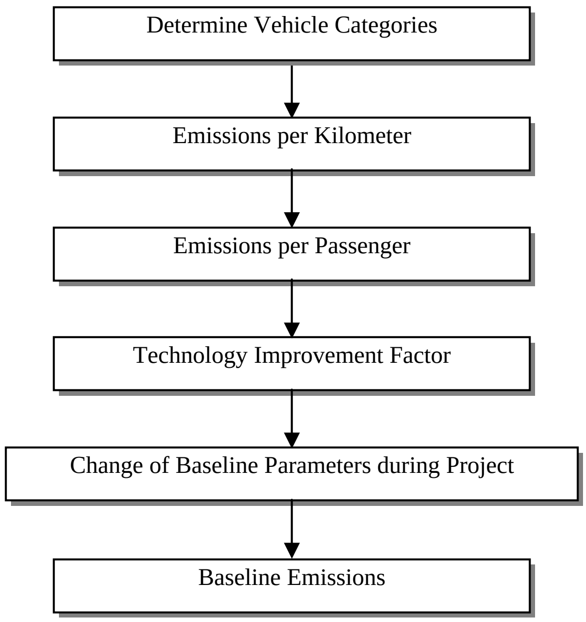


Figure B.4.1. Determination of Baseline Emissions

Key data, variables and parameters are listed in Annex 3.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

>>

The additionality of the project is determined using the "Tool for the demonstration and assessment of additionality (version 05.2)" of 26 August 2008 as shown below.

STEP 1. IDENTIFICATION OF ALTERNATIVES TO THE PROJECT ACTIVITY CONSISTENT WITH CURRENT LAWS AND REGULATIONS

Potential alternatives are such that achieve in comparable circumstance similar mobility targets of involved actors.

Sub-step 1a: Define alternatives to the project activity

The potential alternatives are:
1. A continuation of the current public transport system;
2. The project proposal (BRT system) not implemented as a CDM project activity;
3. Rail or water-based systems;
4. Comprehensive re-organization of the transport system;

As discussed in B4, Alternative 3 that uses rail- or water-based transport means are judged totally infeasible in view of the technical difficulty of introducing such a new system into the metropolitan area of Belem, the huge investment requirement, the expected resistance from the bus companies and so on. There is no justifiable need to continue the analysis of this alternative any further.

As shown in B4, Alternative 4 that reorganizes the present public transport services faces the difficult requirement of persuading the private bus companies and satisfying their conflicting individual vested interests. It is unrealistic to expect that this alternative would serve as the baseline. The alternative is judged infeasible as the baseline scenario for the proposed trunk bus system.

Following Section B.4., the only viable potential alternatives analyzed thus in the further steps are a continuation of the current public transport system (Alternative 1) and the project proposal not implemented as a CDM project activity (Alternative 2).

Sub-step 1b. Enforcement of applicable laws and regulations

All alternatives proposed comply with all applicable legal and regulatory requirements. Continuation of the current transport mode complies with legal requirements. The implementation of this project is not conditioned by Brazil, Para or Belém s not a compulsory implementation following as financial means have to be secured independently for each phase on part of the District.
The potential alternatives 3 and 4 have been analyzed and have been excluded as being non-viable in chapter B.4. (identification of the baseline).

STEP 2: INVESTMENT ANALYSIS

The proposed project consists of the infrastructural investment by the State of Para in the construction of exclusive trunk busways with bus terminals and stops, on the one hand, and the bus operation managed by a public consortium, on the other. The State Government does not expect any direct revenue from its infrastructural investment. The proposed project is basically the same as TransMilenio in Bogota. The fare revenue from the new trunk bus system would be used solely to cover the operational cost of bus services, but not the cost of operating and managing the infrastructure. In other words, the direct revenue from the project is zero.

STEP 3: BARRIER ANALYSIS

Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity

Alternative 1 is analyzed in the following Sub-step 3b as the alternative without CDM approval that would not be prevented by barriers. Alternative 2 faces two important barriers against its implementation as follows.

Barrier of Investment

- The State Government is requesting the soft loan from Japan to implement the infrastructural development necessary for the trunk bus project. With the soft loan, it would be possible to finance the project implementation without CDM application and approval. However, the soft loan from Japan does not cover the cost of land acquisition, project operation and others. The State Government has to finance such local currency cost components.
- The procurement of fund for the local currency components is the barrier for the project implementation regarding Alternative 2.

Effect of Existing Bus Company

1) Existing bus companies are affected by introduction of the trunk bus system. When the trunk buses are operated on major roads in Belem metropolitan area, passengers of the existing buses divert to the trunk buses.
2) Ideally speaking, the existing ordinary bus lines that would compete with trunk bus on the same routes should be discontinued, because the removal of competitors will ensure the efficient operation of the latter. It must be noted, however, that there is no easy straight answer to the question as to which lines should be discontinued and why. The solution must be sought by carefully judging a variety of factors. There is no set way to address the issue, as exemplified by the experiences of the cities that introduced a similar trunk bus system. They dealt with the issue step by step in their own way, but most of their decisions involved the eventual discontinuation of competing bus lines. The trunk bus system proposed for the metropolitan area of Belem will necessitate the discontinuance of some existing bus lines in accordance with the expected shift in passenger demand.
3) The bus company operated on merging and discontinuance bus lines are directly affected.
4) The State Government of Para and the participating municipalities jointly set up a public consortium for the control and management of the trunk bus system. The public consortium covers all of the currently operating bus lines and the new trunk and the feeder bus system.
5) The issues for existing bus company are handled by the public consortium. Since the new trunk bus operation company authorized by bidding will operates the trunk buses, it is necessary to merge together with the existing bus companies and new bus company in order to continue the existing bus companies.

The barrier analysis shows the difficult prospect of procuring fund for local currency components and the objection from bus companies on the trunk bus introduction. Alternative 2 without CDM application and approval is judged infeasible.

Sub-step 3 b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity)

Continuation of the Present Transport System (Alternative 1): The continuation of the present transport system has no investment barrier. The bus companies would not resist the continuation. They favor Alternative 1 because it would not threaten their present bus operation. The continuity of the present public transport system (Alternative 1) is a feasible alternative because the identified barriers are unlikely to prevent its implementation.

STEP 4. COMMON PRACTICE ANALYSIS

Sub-step 4a. Analyze other activities similar to the proposed project activity

There is no precise definition of what constitutes the trunk bus system. Features of complete trunk bus systems such as TransMilenio include exclusive right-of-way lanes, rapid boarding and alighting, free transfers between lines, pre-board fare collection and fare verification, enclosed stations, clear route maps, modal integration at stations, effective reform of the existing institutional structures for public transit, clean vehicle technologies and excellence in marketing and customer service2.

In Latin America comparable trunk bus system projects have only been realized in few cities including basically[3]:

- Curitiba (1974), and partially Sao Paulo (1975), Goiania (1976) and Porto Alegre (1977) in Brazil
- Quito, Ecuador in 1996
- Bogotá, Colombia, phase I of TransMilenio

Curitiba
The Curitiba project is more than 3 decades old. Widely promoted it was not replicated. The other 3 cities mentioned in Brazil have only implemented the BRT system partially. Brazil also has a GNI which is nearly 80% higher than that of Colombia, thus stressing the concept of "comparable access to finance"4.

Quito
Quito has a similar project called "Trolebus" implemented a decade ago. However this project had a foreign subsidy worth over 70% of the total investment financed through concessional credits by the Government of Spain with an ODA participation[5]. "The system was constructed in two phases thanks to receiving governmental finance from Spain...The finance was concessionary and beneficial for the country (50% ODA and 50% in OECD conditions)[6]".

Bogotá
In Bogotá the first phase of TransMilenio was financed by the national government together with the Bogotá district. However since implementation of this first phase various important factors have changed making the investment barrier significantly higher. The cost increase is significant compared to the cost originally planned.

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[2] GTZ, Bus Rapid Transit, version 2.0, 2005

[3] GTZ, Bus Rapid Transit, version. 2.0, 2005; other sources do not include Sao Paulo and Porto Alegre (Darío Hidalgo, Comparación de Alternativas de Transporte Público Masivo – Una Aproximación Conceptual, in Revista de Ingeniería 21, 5-2005)

[4] GNI per capita of Brazil in the year 2000 : 3'650 USD ; in Colombia : 2'050 ; source : World Bank economic indicators

[5] Source: http://www.trolebus.gov.ec/secciones/historia.html

[6] Literal translation from the official website of Trolebus, Quito: http://www.trolebus.gov.ec/secciones/historia.htmln

Overall Assessment

Various cities in South America as well as other regions are now in the process of planning BRT projects comparable to the TransMilenio one. Similar projects under planning but not yet operational as of 1.1.2006 are, e.g., in Colombia in Cali, Cartagena, Pereira or Barranquilla or BRT projects are under planning in Lima (Perú), Guayaquil (Ecuador), Insurgentes in Mexico City (Mexico) or Santiago de Chile (Chile). Noteworthy is that all these projects are finding severe financial constraints and all are considering CDM finance as an important aspect. All above mentioned cities are under negotiation or have closed contracts for carbon finance[7].

The study conducted on the similar project activities elsewhere in Brazil and other countries shows clearly that BRT projects are rather idiosyncratic and not generally implementable. After the successful BRT implementation in Curitiba, similar projects were planned for various cities in various countries, but none reached the stage of implementation except in Quito of Ecuador where the project was ODA-financed and in Bogota of Columbia as Project TransMilenio: Phase 1. The trunk bus project for the metropolitan area of Belem is expected to be financed by the soft loan, but the barrier exists in the requirement to procure fund for local currency components. Similar project activities now under planning and designing all presuppose the CDM financing as an important additional source of fund. Without either soft loan or CDM approval, a BRT project is not generally proposed and rarely considered implementable.

Sub-step 4b. Discuss any similar options that are occurring

As mentioned in the former subchapter the similar projects occurring or under planning without CDM finance are singular and not common practice. Even these singular cases have significant differences compared to the project proposed including:

- Access to ODA finance without CDM (case of Quito)
- Significantly lower investment barriers (in the case of Bogotá TransMilenio phase I) than the current barrier.

The steps realized above clearly show that implementing the trunk bus system project is not the baseline.

B.6.	**Emission reductions:**

	B.6.1. Explanation of methodological choices:

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As mentioned in Section B.1, the CDM application uses AM0031, entitled “Baseline Methodology for Bus Rapid Transit Projects.” It is discussed in Section B.2 that AM0031 is applicable to the proposed trunk bus system in metropolitan Belem. The emission reduction is calculated according to the steps indicated in AM0031.

Key steps for calculating an emission reduction are as follows.

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[7] See Guayaquil: http://www.cordelim.net/cordelim.php?c=456 Colombian projects:

http://www.cecodes.org.co/cambio_climatico/ocmcc.htm#7 (with other cities negotiations for CDM are being realized basically on behalf of CAF and the World Bank), Insurgentes see PPD presented with the proposed NM0158; Santiago de Chile: PDD Transsantiago published on the website of DNV:

http://www.dnv.com/certification/climatechange/Projects/ProjectList.asp?whichpage=33&pagesize=10&Country=&DontCreate=True; The BRT project in Lima has prepared the PIN financed through the World Bank; see National Strategy Study for the CDM Peru, 2003

Step 1: Determination of Baseline Emissions

$$BE_y = \sum_i \left(EF_{P,i,y} \times P_{i,y} \right)$$

Where:

BE_y	Baseline emissions in year y (CO_2e)
$EF_{P,i,y}$	Transport emissions factor per passenger in vehicle category i in year y (grams per passenger)
$P_{i,y}$	Passengers transported by the project (BRT) in year y that without the project activity would have used category i, where i= Z (buses, public transport), T (taxis), C (passenger cars) or M (motorcycles)[8] (millions of passengers).

Step 2: Project activity emissions

Alternative B: Use of Specific Fuel Consumption and Distance Data

$$PF_y = \left[\left(EF_{KM,TB,y} \times DD_{TB,y} \right) + \left(EF_{KM,FB,y} \times DD_{FB,y} \right) \right]$$

Where:

PE_y	Project emissions in year y (tCO2e)
$EF_{KM,TB,y}$	Transport emissions factor per distance for trunk buses in year y (gCO_2e per kilometer)
$DD_{TB,y}$	Total distance driven by trunk buses in year y (million kilometers)
$EF_{KM,FB,y}$	Transport emissions factor per distance for feeder buses in year y (gCO_2e per kilometer)
$DD_{FB,y}$	Total distance driven by feeder buses in year y (million kilometers)

Step 3: Total Leakage

$$LE_y = LE_{UP,y} + LE_{LF,Z,y} + LE_{LF,T,y} + LE_{CONG,y}$$

Where:

LE_y	Emissions leakage in year y (CO_2e)
$LE_{UP,y}$	Leakage emissions due to upstream processes in year y (tCO_2e)
$LE_{LF,Z,y}$	Leakage emissions from change of load factor in buses in year y (tCO_2e)
$LE_{LF,T,y}$	Leakage emissions from change of load factor in taxis in year y (tCO_2e)
$LE_{CONG,y}$	Leakage emissions from reduced congestion in year y (tCO_2e)

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

Emission reductions

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y	Emission reductions in year y (tCO_2e)
BE_y	Baseline emissions in year y (CO_2e)
PE_y	Project emissions in year y (CO_2e)
LE_y	Emissions leakage in year y (CO_2e)

[8] NMT and IT are not included as emissions are 0 for this category in the baseline

B.6.2. Data and parameters that are available at validation:

>>

Data / Parameter:	**$SEC_{x,c}$**
Data unit:	litter per kilometres
Description:	Specific energy consumption of fuel type x in vehicle category passenger car (x= gasoline, alcohol and diesel)
Source of data used:	Arpel, 2005, Measurement of In-Service Vehicle Emissions in Sao Paulo, Santiago and Buenos Aires
Value applied:	0.117
Justification of the choice of data or description of measurement methods and procedures actually applied :	Vintage 2005; see arguments chapter E.4. 2.1. why this value is considered as conservative; original data was taken from the report including only gasoline fuelled vehicles in the three cities; the value taken is the average means of each city; emissions reported in gr. CO_2 were converted to liters gasoline based on EF_{CO2}
Any comment:	

Data / Parameter:	**$SEC_{D,ZS}$**
Data unit:	litter per kilometres
Description:	Specific energy consumption of fuel type diesel in vehicle category small bus
Source of data used:	STT and IPCC
Value applied:	0.175
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC factors according to vehicle age and technology in 2006;
Any comment:	

Data / Parameter:	**$SEC_{D,ZL}$**
Data unit:	litter per kilometres
Description:	Specific energy consumption of fuel type diesel in vehicle category large bus
Source of data used:	STT and IPCC
Value applied:	0.455
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC factors according to vehicle age and technology in 2006;
Any comment:	

B.6.3. Ex-ante calculation of emission reductions:

>>

Step 1: Determination of Baseline Emissions

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
$EF_{P,C,y}$	1385	1389	1392	1396	1399	1403	1408	1414	1420	1425
$EF_{P,Z,y}$	5265	5486	5534	5693	5666	5562	5458	5636	5821	5654
$P_{C,y}$	1.81	1.90	1.99	2.09	2.18	2.27	2.44	2.60	2.77	2.93
$P_{Z,y}$	2.91	2.96	3.01	3.06	3.11	3.16	3.23	3.31	3.38	3.45
BE_y	49427	52328	53840	56313	57221	57457	58355	61800	65383	65679

Where:

$EF_{P,i,y}$ Transport emissions factor per passenger in vehicle category i in year y (grams per passenger)

$P_{i,y}$ Passengers transported by the project which in absence of latter would have used transport type i, where i= Z (buses, public transport), T (taxis), C (passenger cars), M (motorcycles), NMT (non-motorized transport) and IT (induced transport, i.e. would not have travelled in absence of project) (millions).

Step 2: Project activity emissions

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
$EF_{KM,TB,y}$	9.6	9.6	9.5	9.4	9.4	9.3	9.3	9.3	9.3	9.3
$DD_{TB,y}$	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640
$EF_{KM,FB,y}$	6.1	6.0	5.9	5.7	5.6	5.4	5.4	5.4	5.5	5.5
$DD_{FB,y}$	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015
PE_y	21975	21740	21505	21270	21035	20800	20803	20806	20810	20813

Where:

$EF_{KM,TB,y}$ Transport emissions factor per distance for trunk buses in year y (gCO_2e per kilometer)

$DD_{TB,y}$ Total distance driven by trunk buses in year y (million kilometers)

$EF_{KM,FB,y}$ Transport emissions factor per distance for feeder buses in year y (gCO_2e per kilometer)

$DD_{FB,y}$ Total distance driven by feeder buses in year y (million kilometers)

Step 3: Total Leakage

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
$LE_{UP,y}$	2385	959	935	789	1152	1685	2022	1715	1388	2001
$LE_{LF,Z,y}$	0	0	0	0	0	0	0	0	0	0
$LE_{CONG,y}$	-1000	-1000	-1000	-1000	-1000	-1000	-1000	-1000	-1000	-1000
LE_y	1385	0	0	0	152	685	1022	715	388	1001

Where:

$LE_{UP,y}$ Leakage emissions due to upstream processes in year y (tCO_2e)

$LE_{LF,Z,y}$ Leakage emissions from change of load factor in buses in year y (tCO_2e)

$LE_{CONG,y}$ Leakage emissions from reduced congestion in year y (tCO_2e)

Emission reductions

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	total
BE_y	49427	52328	53840	56313	57221	57457	58355	61800	65383	65679	577803
PE_y	21975	21740	21505	21270	21035	20800	20803	20806	20810	20813	211555
LE_y	1385	0	0	0	152	685	1022	715	388	1001	5349
ER_y	26067	30588	32336	35043	36034	35972	36530	40278	44185	43866	360900

B.6.4. Summary of the ex-ante estimation of emission reductions:

>>

year	Annual estimation of emission reductions in tonnes of $CO_{2\ eq}$
2013	26,067
2014	30,588
2015	32,336
2016	35,043
2017	36,034
2018	35,972
2019	36,530
2020	40,278
2021	44,185
2022	43,866
Total estimated reductions (tones of CO2 e)	360,900

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1. Data and parameters monitored:

>>

Data / Parameter:	**TC_{TB} and TC_{FB}**
Data unit:	Liters
Description:	Fuel consumption trung(TC_{TB}) and feeder buses(TC_{FB})
Source of data to be used:	Public Consortium Each operator of feeder and/or trunk buses reports monthly the fuel consumed to Public Consortium (contractual obligation)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be monitored ex-post
Description of measurement methods and procedures to be applied:	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.
QA/QC procedures to be applied:	All values reported will have been controlled with site-visits at each operator by staff of Public Consortium The software automatically calculates specific consumptions and highlights out-of-normal range values. Out-of-normal range values are defined in the monitoring values and have been established based on average recorded values per operator plus an upper and a lower boundary of ±10% respective to the average recorded value per operator for trunk and for feeder units. In case of out-of-normal range values an explanatory note is given which is recorded in the software.
Any comment:	All buses use diesel fuel Calculation of project fuel consumption based on relation project passenger to total passengers of Public Consortium.

Data / Parameter:	**DD_{TB} and DD_{FB}**
Data unit:	Kilometer
Description:	Distance driven trunk (DD_{TB})and feeder buses (DD_{FB})

Source of data to be used:	Public Consortium Based on actual distance driven and not on distance paid to operator (latter is slightly minor)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be monitored ex-post
Description of measurement methods and procedures to be applied:	Based on measurements by operator and GPS. Recording frequency is monthly.
QA/QC procedures to be applied:	Data is used only for quality control of fuel used (see above)
Any comment:	---

Data / Parameter:	**P_{PJ}**
Data unit:	Passengers
Description:	Passengers transported by BRT
Source of data to be used:	Public Consortium 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.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be monitored ex-post
Description of measurement methods and procedures to be applied:	Mechanical control at stations (turn-pikes) Records are based upon entry points of passengers in trunk stations. Recording frequency is monthly.
QA/QC procedures to be applied:	Operations department cross-checks data with fares paid
Any comment:	---

B.7.2. Description of the monitoring plan:

>>

The monitoring plan has two aims: to ensure the environmental integrity of the project activity and to ensure that the data monitoring requirements are closely aligned with the current practice of the project operator.

The monitoring methodology has ex-ante determined emission factors per passenger transported for all modes of transport. The total baseline emissions are derived by applying to these emission factors the activity level (passengers per mode transported) of the project. The methodology thus focuses on the emissions per passenger of different modes of transport in absence of the project. All data used to calculate these values are thus monitored ex-ante. For calculating the total baseline emissions and the emission reductions the number of passengers using the project and the traffic mode they would have used in absence of the new transport system is monitored (public transport, taxis, passenger cars, Non-Motorized Transport and induced traffic).

The monitoring methodology for the project is based on measuring the total emissions of the new transport system. From a methodological viewpoint data is basically derived from measurements.

The monitoring methodology for leakage depends basically on elements calculated ex-ante project based on pre-established factors and on measurements during project execution (for reduced life-span and load factor). Data is derived basically from planning/modelling sources, fixed parameters derived from the international literature and from periodic surveys.
A special unit is in charge of managing all data in relation to the CDM project including responsibility for data collection, quality assurance, reports and data storage. The area in charge of the CDM project is the "environment area" inside the operations department. The unit is under direct supervision of the CEO of Public Consortium.

QA and QC is assured by a special monitoring software containing inter alia how to proceed with key measurements and survey, how to screen data for quality and how to handle potential errors. Staff in charge has been trained. The software elaborated for monitoring includes:

- Baseline, leakage and project default data
- All data required to be monitored
- Identification of person entering data
- Track record of all changes
- Statistical check of data
- Automatic calculations of data based on PDD formulas
- Calculation of local environmental impact

A monitoring manual has been developed defining all responsibilities and procedures. 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. The monitoring manual can be reviewed by the validator.

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

>>

Date of completion : 31/08/2009

Contact Person : Mr. Norikazu Motegi, Chodai co., ltd.

Name of person/entity determining the baseline and monitoring methodology: Mr. Norikazu Motegi, Chodai co., ltd.

The entity is also a project participant listed in Annex I of this document.

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

>>
01/01/2013

C.1.2. Expected operational lifetime of the project activity:

>>
10 Years 0 month

C.2. Choice of the crediting period and related information:

>>
A Fixed crediting period of 10 years has been selected for the project activity.

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

>>
Not Applicable.

C.2.1.2. Length of the first crediting period:

>>
Not Applicable.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
01/01/2013

C.2.2.2. Length:

>>
10 Years 0 month

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

The trunk bus system proposed in the present Study is to be operated on the existing arterial roads. In this respect, it is arguably suggested that the system will be unlikely to add some adverse impact of appreciable magnitude upon the present roadside environment. The State Secretariat of Environmental Management (SEMA) is aware that the proposed system will bring only a minor impact on the roadside environment. While the present Study was going on, the secretariat in fact decided to apply the PCA (Environmental Control Plan) procedures for environmental licensing (LI: Installation License), which is less complicated than the EIA (environment impact assessment) procedures. The procedure of LI is currently underway and LI will be obtained on December 2009. The outline of environmental impact should be included in the contents of PCA, and the findings of the JICA preliminary survey is summarized below.

The conclusion at this stage is that the implementation of the trunk bus system will bring impacts of some adverse import on the environment but that the impacts will be of the kinds effectively actionable by appropriate measures. The outline of the scoping is as follows.

1) Air quality (Vehicle emission): Although the traffic volume would increase temporarily during the construction period, the vehicle emission conditions will improve substantially after the trunk bus system comes into service. By the introduction of the articulated bus fleet, the CO2 emissions are estimated to decrease by 62% over the ten-year period of the trunk bus operation. The emissions of methane (CH4) and nitrous oxide (N2O) are converted to CO2 in the estimation.
2) Soils and Deposits: The former occupant of the site for the Marituba trunk bus terminal was a ceramic manufacturer (ceramic tiles, drainage pipes, etc.) who went out of business in June 1999. The site is now largely an open space with a few iron bars remaining from the former factory structure. The conclusion of the present preliminary study is as follows. Although the possibility of contamination is judged slight, it would be necessary to carry out an investigation in accordance with the TOR issued by the State Secretariat of Environment, when the D/D is completed after the signing of the yen loan agreement.
3) Debris: The construction debris, especially of asphalt pavement origin, will be enormous. The state government has the dumping ground properly licensed under the prevailing environmental regulations. The debris can be transported to this dumping site. In order to control noises and dusts of debris transportation, it is necessary to establish a logistics plan. The logistics planning would not be very complicated because the dumping ground is in short distance from the road construction sites.
4) Noise/ Vibration: The roadside noise level will be substantially reduced in the end by the trunk bus system which serves to reduce the service frequency of the existing fleet of conventional buses with its use of more efficient articulated buses. The vibration hazards caused by the traffic will be of minor consequence, because the trunk bus routes are proposed in the median part of the arterial roads with the concrete surface pavement of trunk busways. Therefore, construction machinery and heavy vehicles must be properly operated and maintained to lower the noise as much as possible. The overloading of vehicles must be strictly controlled.
5) Stink: It is caused by the inadequacy of drainage structures or lack of proper maintenance thereof. The proposed development of trunk bus routes includes structures to drain surface water and thus the present drainage capacity of the arterial roads will be improved greatly by the project implementation. During the D/D stage, it is necessary to put together a plan for draining.

6) Water Quality: The present preliminary study expects that the discharges of used water and sewage at such facilities as construction yards (as applicable to the period of construction), bus terminals and stations and bus depots require effective drainage structures. The currently operated two bus terminals are provided with a simplified sewage and drainage system. The trunk bus terminals and bus depots are expected to be provided with similar drainage structures.
7) Topography/ Geology: Some sections of the arterial roads where trunk bus routes will be developed suffer from occasional flooding and inadequate drainage during the rainy season. The drainage capacity of the roads will be upgraded by the development of trunk bus routes which includes new structures to drain surface water. During the D/D stage, it is necessary to put together a plan for draining.
8) Involuntary Resettlement: Because the development of trunk bus routes is proposed on the existing roads, the implementation does not call for sizable land acquisition and resettlement of local inhabitants. However, the land appropriation at some sites for bus terminals and stations, bus depots and the interchange will require small-scale relocation.
9) Local Economy (employment, livelihood, etc.): The present preliminary study expects that the introduction of trunk bus services will adversely affect the present operators and their employees of conventional buses and minibuses. The start of trunk bus operation will necessitate the discontinuance and consolidation of the existing bus lines. The specific planning on the future network of bus lines will be done in the later stage. The state and the municipal governments intend to absorb the employees of bus companies as many as possible into the new trunk bus system.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

The conclusion at this stage is that the implementation of the trunk bus system will bring impacts of some adverse import on the environment but that the impacts will be of the kinds effectively actionable by appropriate measures. Such measures are suggested in Table D.2 1

Table D.2.1. Basic Policy for Environmental Management Planning

Environmental Hazard	Rating	Measures to Avoid or Alleviate Adverse Impacts	Environmental Monitoring
1. Air quality	B	➢ Vehicles transporting construction materials and equipment should be careful to cover up the cargo with tarpaulin in order not to scatter dusts along the way. Mixing equipment should be adequately walled up not to let the dust fly out.	➢ Air quality measurement is regularly conducted in the vicinity of construction sites
3. Soils and Deposits	B	➢ The construction of the Marituba terminal requires an environmental license, and it is reasonable to suppose that no untoward violation would occur at the site. The ceramic factory in question was closed down more than 10 years ago and no apparent trace of illegally committed soil contamination was found during the present Study (cf. 8.3.4 of the text) ➢ After the D/D is completed, it would be necessary to carry out soil analysis according to the terms of reference provided by the State Secretariat of Environmental Management (SEMA).	➢ Patrolling in the vicinity of construction sites are increased during the rainy season, checking and detecting the presence of exceptional deposits in ditches and river streams as early as possible.

4. Debris	B	➢ The construction debris of asphalt pavement will be transported to the dumping ground which the state government established properly with the environmental license. ➢ During the drafting of D/Ds, it is necessary to prepare a logistics plan for debris transportation, although the proximity of the dumping ground to the project sites will make it a relatively simple task.	➢ Constant surveillance to prevent unlawful debris transportation and dumping during construction
5. Noise/ Vibration	B	➢ In adherence to the noise level standards of Brazil, construction machinery and heavy vehicles must be properly operated and maintained to lower the noise as much as possible. The overloading of vehicles must be strictly controlled. ➢ When the project implementation is over, the trunk bus operation is expected to improve the traffic flow considerably, because it would reduce the number of ordinary buses in operation. The articulated bus type produces less noise than the existing buses. It is estimated that the roadside noise level would be appreciably lower with the trunk bus operation than the "without" situation. Therefore, it is judged unnecessary at this stage to take any special countermeasure. ➢ The vibration caused by the motorized traffic would be reduced significantly because the trunk busways, exclusive and priority lanes would be provided with concrete pavement. Therefore, it is judged unnecessary to take any countermeasure.	➢ Noise level measurement is regularly conducted in the vicinity of construction sites. Vibration is regularly measured near the cultural heritages.
7. Stink	B	➢ The trunk bus system includes new structures to drain road surface water for busways, exclusive and priority lanes. The system would greatly upgrade the drainage capacity of the arterial roads. The roadside areas would be freed from the recurrent drainage problems during and after the project implementation.	➢ Not applicable
8. Topography/ Geology	B	➢ During the D/D drafting, it is necessary to put together a plan for draining the locations likely to collect water during the construction.	➢ Not applicable
14. Involuntary Resettlement	B	➢ The trunk bus system needs no involuntary resettlement of inhabitants, but requires the acquisition of land totaling 197,000 m2. ➢ Adequate compensations should be paid for land acquisition. Details are described in 8.3 of the text.	➢ To be described in land acquisition plan

15. Local Economy (employment and livelihood)	B	➢ During the construction, the transportation of materials, equipment and debris will cause traffic congestions in some locations. In order to contain the excess of interferences to local economic activities, it is necessary to draw up a logistics plan for construction related transportation with provision of appropriate detours. ➢ During the construction on BR-316, Av. Joao Paulo II would be used as a detour for the motorized traffic, thereby avoiding the excessive concentration on Av. Almirante Barroso. ➢ According to the simulation analysis, the construction works on the other roads would cause congestions of limited scale and spread compared with BR-316. The information on construction logistics and the availability of appropriate detours must be examined in advance in order to put the plan into effect. The issue must be analyzed in more precision at the stage of D/D drafting. ➢ The trunk bus system will adversely affect the present ordinary bus and minibus operators. The state and the municipal governments are considering the option of absorbing their employees as many as possible into the trunk bus system. The details will have to be examined during the stage of D/D drafting.	➢ Not applicable
18. Present Social Infrastructure and Services	B	➢ Ditto	➢ Not applicable

Grade A: Grave adverse impacts expected
Grade B: Some adverse impacts expected
Grade C: Not ascertained (the situation would call for further study during the later stage, unless otherwise indicated by new findings)
Grade D: Negligible impacts, requiring neither IEE nor EIA procedures

SECTION E. Stakeholders' comments

>>

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

>>

The State Secretariat of Strategic Projects (SEPE) institutionalized the Surveillance Commission (Comissao de Fiscalizacao) for the currently on-going road upgrading and rehabilitation projects. A commission is manned by the representatives of local inhabitants to watch over social and environmental impacts of the on-going public works. The Local Community Affairs Team of NGTM is to provide operational support and coordination to the commission activities.

To facilitate swift and fair handling of complaints, demands and protests from local communities, SEPE drew up for internal use the stipulations regarding the commission, detailing its establishment, purpose, membership, mandate and term of appointment. The executive members of the commission keep the minutes of the deliberations at the meetings and hand them over to the Local Community Affairs Team. NGTM reviews the minutes and decides what to do and swiftly notifies the decisions to the relevant contractor or supervising consultant.

E.2. Summary of the comments received:

>>

The State Secretariat of Strategic Projects (SEPE/Secretaria de Estado de Projetos Estrategicos) hosted five stakeholders' meetings from April 6th to May 14th in 2009, and explained the Action Plan for the Metropolitan Area (Projeto Acao Metropole) and presented the proposal of the trunk bus system. The participation exceeded 300 attendees including the members of the present study team. It was reported that the questions and answers are exchanged regarding well over 40 topics, and reported that there was nobody present who raised an objection to the trunk bus system.
The questions and comments received at these stakeholders' meetings can be summed up into the following issues. The answers and explanations given are summarized in E.3.

- The problem of traffic congestion has been worsening year after year. Does the proposed trunk bus system improve congestion?
- When is the on-going extension of Av. Independencia completed?
- (The speaker was asking the question on behalf of such-and-such an association of residents in a low-income housing estate located near the venue of the stakeholders' meeting.) The presentation covered the issues of large bus services, but nothing was explained on micro bus services. People daily suffer the inconveniences of micro bus services, e.g., bus stops are too few and far between, requiring long walk. Does the proposed project take into account the improvement of micro bus services?
- The importance of the proposed trunk bus system was sufficiently explained to show the urgent need of project implementation. Then, how is the State Government planning to obtain the necessary finance? Is the schedule of implementation now ready to proceed with the project? Is the implementation schedule being worked out?

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

>>

The answers given by the SEPE counterparts to the JICA study team are summarized below in the order of the questions. Some of the issues raised and discussed during the meetings will have to be studied at the D/D stage. The counterpart team is expected to deal with these issues.

- Metropolitan traffic congestions are becoming chaotic, partly because the bus services plying into Belem City have been practically unchecked and uncontrolled, and partly because the private automobile ownerships have been rapidly increasing. If the trunk bus system is introduced, daily commuters by bus will be able to reduce the time required for travel and the entry of buses into the city area will be efficiently controlled. It is estimated that the problem of traffic congestion would be substantially improved by the proposed trunk bus system.
- The extension from Av. August Montenegro passed the stage of tender, and the construction will be completed in May 2010. The crossing of Av. Independencia and Av. August Montenegro will be initially provided with the at-grade intersection, which will be later changed into a grade-separate intersection to go along with the start of trunk bus services.
- Together with the JICA study team, the SEPE counterpart team has been working on the trunk bus system which includes feeder bus services. The issue of micro bus routes (local bus systems) will have to be worked out with the respective municipal bureaus of transport management. SEPE has institutionalized surveillance commissions (COFINS), through the activities of which the complaints and requests of local communities are duly channeled into the planning and implementation of public works.
- The State Government is requesting a yen loan from the Japan. The necessary preparations in Brazil will be completed by the end of FY2009 and the loan agreement will be signed by June 2010. The Phase 1 construction will be completed in 2013 and the trunk bus system will start its operation within the year.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	
Street/P.O.Box:	
Building:	
City:	
State/Region:	
Postcode/ZIP:	
Country:	
Telephone:	
FAX:	
E-Mail:	
URL:	
Represented by:	
Title:	
Salutation:	
Last name:	
Middle name:	
First name:	
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal e-mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The project activity is partly financed by the Government of Japan through JICA. The funding however is separate from and is not counted towards the financial obligations of the aforesaid party. The relevant documents have been submitted to the validator.

Annex 3

BASELINE INFORMATION

Contents:

A.3.1. Baseline Emissions
- A.3.1.1. Determine Vehicle Categories
- A.3.1.2. Determine Emissions per Kilometre for Vehicle Categories
- A.3.1.3. Calculate Emissions per Passenger per vehicle Category
- A.3.1.4. Change of Baseline Parameters during Project crediting period
- A.3.1.5 Determination of Baseline Emissions

A.3.2. Project activity emissions

A.3.3. Leakage
- A.3.3.1. Upstream Emissions
- A.3.3.2. Vehicle Replacement Emissions
- A.3.3.3. Upstream Fuel Emissions
- A.3.3.4. Summary Upstream Emissions
- A.3.3.5. Change of Load Factor
- A.3.3.6. Impact of Reduced Congestion on Remaining Roads
- A.3.3.7. Total Leakage

A.3.4. Emission reductions

A.3.1. Baseline emissions

A.3.1.1. Determine Vehicle Categories

Identify relevant vehicle categories, which include:
- Buses, differentiating large, medium and small buses, if appropriate;
- Passenger cars;
- Taxis;
- Motorcycles.

Criteria for identifying the categories are as follows:

- At a minimum, public transport, non-motorised transport and induced traffic have to be included;
- Conditions to include categories are that there are reliable data on fuel consumption and load factors;
- Only include categories that are relevant for the BRT project. If the project will only generate credits from public transport without modal switch, then passenger cars, taxis and motorcycles need not be included;
- Differentiate relevant fuel types for each category. Diesel, gasoline and gas (CNG or LPG) are listed separately if a minimum of 10% of vehicles of the respective category use such a fuel, while the threshold for zero-emission fuels is minimum 1%. The 10% threshold is justified, as GHG emission differentials between diesel, gasoline and gaseous fuels are less than 20%;
- If electric vehicles are included in the analysis, their emissions can be calculated using GHG grid factors using AMS.I.D;
- In case of a system extension the currently operating system is not included as a vehicle category.

Therefore relevant vehicle categories in this project, which include:
- Buses, differentiating large and small buses,
- Passenger cars;

(not include medium buses, Taxis, and Motorcycle)

A.3.1.2. Determine Emissions per Kilometre for Vehicle Categories

Formula (1): This formula calculates emissions per km for vehicles of different vehicle categories.

$$EF_{KM,i} = \sum_x \left[SEC_{x,i} \times \left(EF_{CO_2,x} + EF_{CH_4,x} + EF_{N_2O,x} \right) \times \left(\frac{N_{x,i}}{N_i} \right) \right] \quad (1)$$

Where:

$EF_{KM,i}$	Transport emissions factor per distance of vehicle category i (gCO_2e per kilometer driven)
$SEC_{x,i}$	Specific energy consumption of fuel type x in vehicle category i (litter per kilometer)
$EF_{CO2,x}$	CO_2 emission factor for fuel type x (gCO_2 per litter)
$EF_{CH4,x}$	CH_4 emission factor for fuel type x (gCO_2e per litter, based on GWP)
$EF_{N2O,x}$	N_2O emission factor for fuel type x (gCO_2e per litter, based on GWP)
$N_{x,i}$	Number of vehicles in vehicle category i using fuel type x
N_i	Total number of vehicles in category i

A.3.1.3. Calculate Emissions per Passenger per vehicle Category

This step calculates emission factors showing the emissions per passenger per average trip for each vehicle category.

Formula (2):

$$EF_{P,i} = \frac{EF_{KM,i} \times TD_i}{OC_i} \quad (2)$$

Where:

$EF_{P,i}$	Transport emissions factor per passenger before project start, where i=C (passenger cars), M (motorcycles) or T (taxis) (grams per passenger)
$EF_{KM,i}$	Transport emissions factor per distance of category i (gCO_2e per kilometer driven)
OC_i	average vehicle occupancy rate of vehicle category i[9] (passengers)
TD_i	average trip distance for vehicle category i (kilometers)

Formula (3):

$$EF_{P,Z} = \frac{EF_{KM,Z,S} \times DD_{Z,S} + EF_{KM,Z,M} \times DD_{Z,M} + EF_{KM,Z,L} \times DD_{Z,L}}{P_Z} \quad (3)$$

Where:

$EF_{P,Z}$	Transport emissions factor in buses for before project start (grams per passenger)
$EF_{KM,Z,S}$	Emissions from small buses (gCO_2e per kilometer)
$DD_{Z,S}$	Total distance driven by small buses (kilometer)
$EF_{KM,Z,M}$	Emissions from medium buses (gCO_2e per kilometer)
$DD_{Z,M}$	Total distance driven by medium buses (kilometer)
$EF_{KM,Z,L}$	Emissions from large buses (gCO_2e per kilometer)
$DD_{Z,S}$	Total distance driven by large buses (kilometer)
P_Z	Passengers transported by buses in the baseline

A.3.1.4. Change of Baseline Parameters during Project crediting period

Formula (4):

$$CD_{i,y} = \frac{TD_{i,y}}{TD_i} \quad (4)$$

Where:

$CD_{i,y}$	Correction factor for changing trip distance in category i for the year y, where i = T(taxis), C (passenger cars) or M (motorcycles)
$TD_{i,y}$	average trip distance in kilometers in category in year y
TD_i	average trip distance in kilometers in category i before project start

Note: The adjustment is only made if $TD_{i.y} < TD_i$ to ensure a conservative approach[10].

A.3.1.5 Determination of Baseline Emissions

Formula (5):

$$BE_y = \sum_i \left(EF_{P,i,y} \times P_{i,y} \right) \quad (5)$$

Where:

BE_y	Baseline emissions in year y (tCO_2e)

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[9] In the case of taxis the driver is not counted and only passengers are included in the occupancy rate

[10] Larger distances would increase baseline emissions per passenger trip. The project emissions of larger trip distances are however fully recorded as project emissions are based on total fuel consumed.

$EF_{P,i,y}$ Transport emissions factor per passenger in vehicle category i in year y (grams per passenger)
$P_{i,y}$ Passengers transported by the project (BRT) in year y that without the project activity would have used category i, where i= Z (buses, public transport), T (taxis), C (passenger cars) or M (motorcycles)[11] (millions of passengers).

Formula (6):

$$EF_{P,i,y} = EF_{p,i} \times IR_{i,t} \times CD_{i,y} \quad (6)$$

Where:

$EF_{P,i,y}$ Transport emissions factor per passenger in vehicle category i in year y (grams per passenger)
$EF_{P,i}$ Transport emissions factor per passenger before project start (grams per passenger)
$IR_{i,t}$ Technology improvement factor at year t for vehicle category i
$CD_{i,y}$ Correction factor for changing trip distance in category i for the year y, where i = T(taxis), C (passenger cars) or M (motorcycles)
t age in years of fuel consumption data used for calculating the emission factor in year y[12]

Formula (7):

$$P_{i,y} = P_y \times S_{i,y} \quad (7)$$

Where:

$P_{i,y}$ Passengers transported by the project which in absence of latter would have used transport type i, where i= Z (buses, public transport), T (taxis), C (passenger cars), M (motorcycles), NMT (non-motorized transport) and IT (induced transport, i.e. would not have traveled in absence of project) (millions).
P_y Total passengers transported by the project monitored in year y (millions)
$S_{i,y}$ Share of passengers transported by the project which in absence of latter would have used transport type i, where i= Z (buses, public transport), T (taxis), C (passenger cars), M (motorcycles), NMT (non-motorized transport) and IT (induced transport, i.e. would not have traveled in absence of project) (%).

A.3.2. Project activity emissions

Alternative B: Use of Specific Fuel Consumption and Distance Data

This alternative uses as a basis fuel efficiency data (i.e. consumption per kilometre driven).

Formula (8):

$$EF_{KM,j,y} = \sum_x \left[SEC_{j,x,y} \times \left(EF_{CO2,x} + EF_{CH4,x} + EF_{N2O,x} \right) \right] \quad (8)$$

where:

$EF_{KM,j,y}$ Transport emissions factor per distance for project bus category j in year y (gCO_2e per kilometer)
$SEC_{j,x,y}$ Specific energy consumption of fuel type x in project bus category j in year y (litter per kilometer)
$EF_{CO2,x}$ CO_2 emission factor for fuel type x (gCO_2 per litter)
$EF_{CH4,x}$ CH_4 emission factor for fuel type x (gCO_2e per litter, based on GWP)
$EF_{N2O,x}$ N_2O emission factor for fuel type x (gCO_2e per litter, based on GWP)

[11] NMT and IT are not included as emissions are 0 for this category in the baseline

[12] e.g. “t=7” for the year 2007 if the fuel data is from the year 2000

Formula (9):

$$PE_y = \left[\left(EF_{KM,TB,y} \times DD_{TB,y}\right) + \left(EF_{KM,FB,y} \times DD_{FB,y}\right)\right] \qquad (9)$$

Where:

PE_y	Project emissions in year y (tCO_2e)
$EF_{KM,TB,y}$	Transport emissions factor per distance for trunk buses in year y (gCO_2e per kilometer)
$DD_{TB,y}$	Total distance driven by trunk buses in year y (million kilometers)
$EF_{KM,FB,y}$	Transport emissions factor per distance for feeder buses in year y (gCO_2e per kilometer)
$DD_{FB,y}$	Total distance driven by feeder buses in year y (million kilometers)

A.3.3. Leakage

A.3.3.1. Construction Emissions

Formula (10):

$$LE_{CON,y} = \frac{\left(CEM \times EF_{CEM} + ASP \times EF_{ASP}\right) \times DT}{Y} \qquad (10)$$

Where:

$LE_{CON,y}$	Leakage emissions from construction in year y (tCO_2e)
CEM	Cement used in construction (tons per kilometer of trunk lane)
EF_{CEM}	Specific emissions factor for cement (tCO_2e/t cement)
ASP	Asphalt used in construction (tons per kilometer of trunk lane)
EF_{ASP}	Specific emissions factor for asphalt (tCO_2e/t asphalt)
DT	Distance of trunk lanes built in project (kilometers), based on kilometers x number of trunk lanes
Y	crediting years of the project[13]

A.3.3.2. Vehicle Replacement Emissions

Formula (11):

$$LE_{LSP,y} = \frac{\sum_{w=1}^{y} BSCR_w \times EF_{BM} \times \frac{BA_{BL} - BA_{PJ}}{BA_{BL}}}{Y} \qquad (11)$$

Where:

$LE_{LSP,y}$	Leakage emissions from reduced life-span of buses in year y (tCO_2e)
$BSCR_w$	Bus units scrapped by project in year w, where w = 1 to y (NB: if buses are not scrapped the estimated number of retired buses is taken)
EF_{BM}	Emissions factor for bus manufacturing (tCO_2e per bus)
BA_{BL}	Average age when buses are replaced /retired in the baseline scenario (years)
BA_{PJ}	Average bus age of scrapped buses under the project activity (years)
Y	crediting years of the project[14]

A.3.3.3. Upstream Fuel Emissions

Formula (12):

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[13] If the project opts for a 7 year renewable crediting period, total crediting years for the purpose of this formula is taken as 7 years.

[14] If the project opts for a 7 year renewable crediting period, total crediting years for the purpose of this formula is taken as 7 years.

$$LE_{UFP,y} = \left(PE_y - BE_y\right) \times UEF \qquad (12)$$

Where:

$LE_{UFP,y}$	Emission leakage due to upstream fuel production emissions in year y (tCO_2)
PE_y	Project emissions in year y (tCO_2e)
BE_y	Baseline emissions in year y (tCO_2e)
UEF	Upstream emissions multiplier, based on default factor from literature (see appendix) (%)

A.3.3.4. Summary Upstream Emissions

Formula (13):

$$LE_{UP,y} = LE_{CON,y} + LE_{LSP,y} + LE_{UFP,y} \qquad (13)$$

Where:

$LE_{UP,y}$	Leakage emissions due to upstream processes in year y (tCO_2e)
$LE_{CON,y}$	Leakage emissions due to construction in year y (tCO_2e)
$LE_{LSP,y}$	Leakage emissions due to reduced life-span of buses in year y (tCO_2e)
$LE_{UFP,y}$	Leakage emissions due to upstream emissions from fuel production in year y (tCO_2e)

A.3.3.5. Change of Load Factor

Formula (14):

$$ROC_{i,y} = \frac{OC_{i,y}}{CV_{i,y}} \qquad (14)$$

Where:

$ROC_{i,y}$	Average occupancy rate relative to capacity in category i in year y, where i = Z (buses) or T (taxis)
$OC_{i,y}$	Average occupancy of vehicle in category i in year y (persons)
$CV_{i,y}$	Average capacity of vehicle i in year y (persons)

Formula (15):

$$LE_{LF,Z,y} = EF_{KM,Z} \times VD_Z \times N_{Z,y} \times \left(1 - \frac{ROC_{Z,y}}{ROC_{Z,0}}\right) \qquad (15)$$

Where:

$LE_{LF,Z,y}$	Leakage emissions from change of load factor in buses in year y (tCO_2e)
$EF_{KM,z}$	Baseline transport emissions factor per distance for buses (gCO_2e per kilometer)
VD_Z	Annual distance driven per vehicle for buses before the project start, determined ex-ante with Formula 18 (kilometers)
$N_{Z,y}$	Number of buses in the conventional transport system operating in year y
$ROC_{Z,y}$	Average occupancy rate relative to capacity of conventional buses in year y, based on the most recent study of occupancy rates.
$ROC_{Z,0}$	Average occupancy rate relative to capacity of buses before start of project

Formula (16):

$$VD_Z = \frac{\sum_{k=S,M,L} DD_{Z,k}}{\sum_{k=S,M,L} N_{Z,k}} \qquad (16)$$

Where:

VD_Z	Distance driven per bus before the project start (kilometers)

$DD_{Z,k}$ Total distance driven by buses of size k (kilometers)
$N_{Z,k}$ Number of buses in the conventional transport system of size k

Note: If $ROC_{Z,0}$ - $ROC_{Z,y} \leq 0.1$ then $LE_{LF,Z,y} = 0$, i.e., if the occupancy rate of buses is not reduced by more than 0.1 then the project has had no negative effect (leakage).

A.3.3.6. Impact of Reduced Congestion on Remaining Roads

Steps to Address Congestion Impact

Step 1: Calculate additional road-space available

Formula (17):

$$ARS_y = \sum_{w=1}^{y} \frac{BSCR_w}{N_Z} \times SRS - \frac{RSB - RSP}{RSB} \qquad (17)$$

Where:

ARS_y Additional road space available in year y (in percentage)
$BSCR_w$ Bus units scrapped by project in year w, where w = 1 to y (NB: if buses are not scrapped the estimated amount of retired buses is taken)
N_Z Number of buses in use in the baseline
SRS Share of road space used by public transport in the baseline (in percentage)
RSB Total road space available in the baseline (lane-kilometers)
RSP Total available road space in the project (= RSB minus kilometer of lanes that where reduced due to dedicated bus lanes) (lane-kilometers)

If $ARS_y < 0$, then we have a reduced road space in that year, and thus increased emissions due to reduced vehicle speed, but reduced emissions due to a negative "rebound effect".

Formula (18):

This formula is required to determine SRS if no recent and good quality study is available which has calculated this parameter.

$$SRS = \frac{DD_Z}{DD_Z + DD_T + DD_C} \qquad (18)$$

Where:

SRS Share of road space used by public transport in the baseline (in percentage)
DD_Z Total distance driven by public transport buses baseline (kilometers)
DD_T Total distance driven in kilometers by taxis baseline (kilometers)
DD_C Total distance driven in by passenger cars baseline (kilometers)

Step 2: Assess the rebound impact of the additional road space

Formula (19):

$$LE_{TRIPS,y} = ITR \times ARS_y \times TR_C \times TD_C \times EF_{KM,C} \times D_y \qquad (19)$$

Where:

$LE_{TRIPS,y}$ Leakage emissions from additional and/or longer trips in year y (tCO_2e)
ITR Elasticity factor for additional and/or longer trips: the factor is fixed at 0.1
ARS_y Additional road space available (percentage)
TR_C Number of daily trips realized by passenger cars baseline (number)

TD_C Average trip distance for passenger cars (kilometers)
$EF_{KM,C}$ Transport emissions factor per distance of passenger cars before the project start (gCO_2e per kilometer) (see Formula 2)
D_y Number of days buses operate in year y

Step 3: Assess the impact of changing vehicle speed from passenger cars

Formula (20):

$$LE_{SP,y} = TR_C \times TD_C \times \left\lfloor EF_{KM,VP,C} - EF_{KM,VB,C} \right\rfloor \times DW_y \qquad (20)$$

Where:
$LE_{SP,y}$ Leakage emissions from change in vehicle speed in year y (tCO_2e)
TR_C Number of daily trips realized by passenger cars baseline (number)
TD_C Average trip distance driven by passenger cars (kilometers)
$EF_{KM,VP,C}$ Transport emissions factor per distance for passenger cars at project speed (gCO_2 per km)
$EF_{KM,VB,C}$ Transport emissions factor per distance for passenger cars at baseline speed (gCO_2 per km)
DW_y Number of days per year in year y

Formula (21): CORINAR speed emission factor formula:

$$EF_{KM,m,C} = 135.44 - 2.314 \times V + 0.0144 \times V^2 \qquad (21)$$

Where:
$EF_{KM,m,C}$ Transport emissions factor per distance for passenger cars traveling at speed m (gCO_2 per km)
V Vehicle speed (km/h); calculated both for the project speed (VP) and baseline speed (VB)

Step 4: Sum of Congestion Impacts and Determination of Leakage Factor

Formula (22):

$$LE_{CONG,y} = LE_{TRIPS,y} + LE_{SP,y} \qquad (22)$$

Where:
$LE_{CONG,y}$ Leakage emissions from reduced congestion in year y (tCO_2e)
$LE_{TRIPS,y}$ Leakage emissions from additional and/or longer trips in year y (tCO_2e)
$LE_{SP,y}$ Leakage emissions from change in vehicle speed in year y (tCO_2e)

A.3.3.7. Total Leakage

Formula (23):

$$LE_y = LE_{UP,y} + LE_{LF,Z,y} + LE_{LF,T,y} + LE_{CONG,y} \qquad (23)$$

Where:
LE_y Emissions leakage in year y (tCO_2e)
$LE_{UP,y}$ Leakage emissions due to upstream processes in year y (tCO_2e)
$LE_{LF,Z,y}$ Leakage emissions from change of load factor in buses in year y (tCO_2e)
$LE_{LF,T,y}$ Leakage emissions from change of load factor in taxis in year y (tCO_2e)
$LE_{CONG,y}$ Leakage emissions from reduced congestion in year y (tCO_2e)

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

A.3.4. Emission reductions

Formula (24):

$$ER_y = BE_y - PE_y - LE_y \qquad (24)$$

Where:

ER_y	Emission reductions in year y (tCO_2e)
BE_y	Baseline emissions in year y (tCO_2e)
PE_y	Project emissions in year y (tCO_2e)
LE_y	Emissions leakage in year y (tCO_2e)

For BE_y see formula (5), for PE_y formula (9) and for LE_y formula (23)

Annex 4

MONITORING INFORMATION

As included in Section B.7.2.

Appendix - 1

List of Abbreviations

AM	Approved Methodology
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
COP	Conference of the Parties to the UNFCCC
DAC	Development Assistance Committee
DCP	Documento de Concepção de Projeto
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board
GHGs	Greenhouse Gas
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
ICGCC	Interministerial Commission on Global Climate Change
IPCC	Intergovernmental Panel on Climate Change
Meth Panel	Methodologies Panel
PDD	Project Design Document
PFCs	Perfluorocarbons
UNFCCC	United Nations Framework Convention on Climate Change