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 (Summary)

February 2010

Japan International Cooperation Agency (JICA)

Chodai Co., Ltd
In Association with
Yachiyo Engineering Co., Ltd

Exchange Rate: April 2009

US$1.00 = Real$2.3001

US$1.00 = ¥95.79

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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

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.

1. INTRODUCTION

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

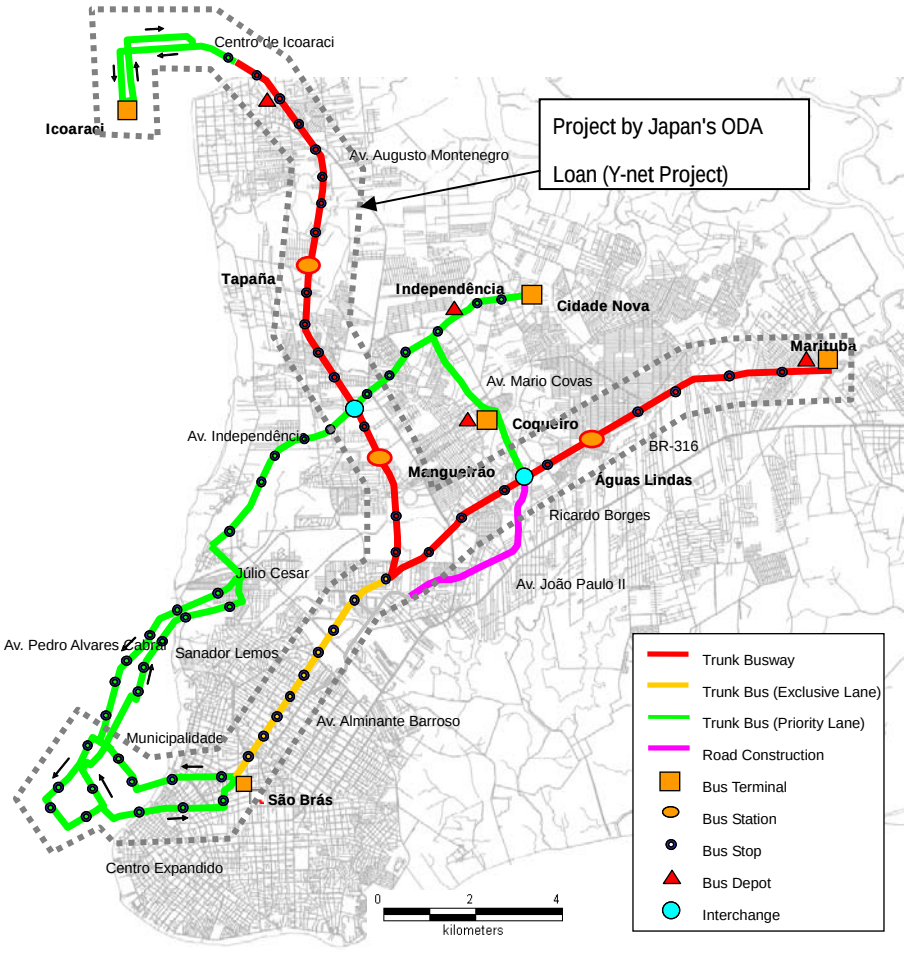


Figure 1.2-1 Location of Projects Selected for Review

2. GENERAL CONDITIONS IN THE STUDY AREA

2.1. SOCIO-ECONOMIC CONDITIONS

As summarized in Table 2.1-1, 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 2.1-1 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

2.2. PRESENT TRAFFIC CONDITIONS

(1) Traffic Volume on Screen Line

Table 2.2-1shows traffic and passenger volumes on two screen lines which are shown in Figure 2.2-1. 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 passenger volumes on two screens are 900 thousand and 820 thousand persons, respectively.

As for the mode composition 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%.

Table 2.2-1 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%

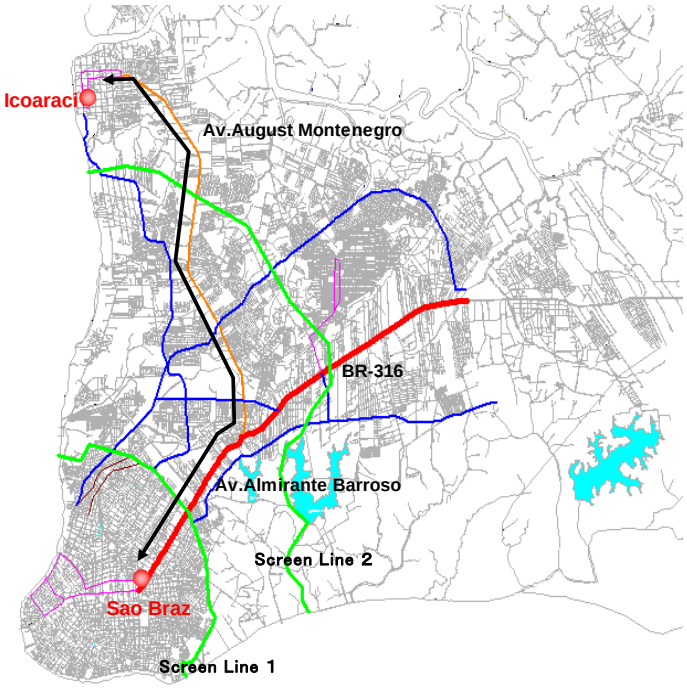


Figure 2.2-1 Two Screen Line Locations

(2) Traffic Volume on Major Arterials

Table 2.2-2 and Table 2.2-3 show the peak hour inbound traffic volume of vehicles and passengers on three arterials of Av. Almirante Barroso, BR-316 and Av. Augusto Montenegro. The inbound traffic on Av. Almirante Barroso totals 45,600 persons (peak ratio of 14.6%), with 87% shared by various buses and 10% by cars and taxis. As compared with other two roads, Av. Almirante Barroso is considerably higher in the passenger volume and share.

Table 2.2-2 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%	-
Rod.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 2.2-3 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%	-
Rod.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%	-

3. RELATED PROJECT PLANS BY THE PARA STATE

3.1. OUTLINE OF METROPOLIS ACTION PLAN

The Para State proposes “AÇÃO METRÓPOLE” or Metropolis Action Plan, which consists of 1) the bus system project and 2) the road development projects. 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.

3.2. STUDY PROJECTS

The Study projects consist of the trunk bus system and road projects proposed in the Metropolis Action Plan. In the Study, 19 projects are selected from the project list of the Metropolis Action Plan. Their location is shown in Figure 1.2-1.

4. TRAVEL DEMAND FORECAST

4.1. FUTURE SOCIO-ECONOMIC FRAME

Table 4.1-1 shows the summary table for forecast of household motorization and trip production. The future population in 2013, 2018 and 2025 are 2.4 million, 2.7 million and 3.2 million, respectively. The population in 2013, 2018 and 2025 would be larger by 11%, 25% and 49% respectively than the 2009 figure. The growth ratios of GDP per capita in 2013, 2018 and 2025 to the 2009 figure are 1.18, 1.47 and 1.98 times.

Table 4.1-1 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
Total Generated Trips		3,836,788	4,257,379	4,835,785	5,785,070	1.11	1.26

4.2. TRAVEL DEMAND FORECAST

(1) Total number of Trips

Table 4.1-1 shows the total number of trips in the Study area in 2013 and 2018, in which the increase ratio of trips to the 2009 figure are 1.11 and 1.26 times, respectively. These figures are close to the increase ratio of population.

(2) Modal Split

Table 4.2-1 shows future traffic demand forecast by mode. As can be seen, the increase ratio of private mode is close to that of the motorized households. On the other hand, the public mode is close to the non-motorized households in the ratio.

Table 4.2-1 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

5. BASIC PLANNING FOR TRUNK BUS PROJECT

5.1. 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) Capacity and Bus Passenger Demand Volume: a new transport mode should ensure the transport capacity over 20,000 passengers per hour per direction.
2) 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 without the introduction of intelligent technology.
3) Operation and Maintenance: Compared to the railway system, the bus system enables easier operation and maintenance and is more advantageous.
4) Construction Cost: 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 in case of construction on existing road facilities.
5) 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. 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) Operation Experience: The government of Para state and the local government have a lot of bus operation experience, however, they have not experience to operate a railway system. Therefore, it is very easy to introduce the trunk bus system.

5.2. BASIC PLAN OF TRUNK BUS SYSTEM

5.2.1. PURPOSE OF INTRODUCTION OF TRUNK BUS SYSTEM

Trunk bus system is required the following function and conditions.

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

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.

(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) Trunk Bus Exclusive Road

The facility conditions of trunk bus exclusive road are as follows.

a) The trunk bus exclusive road is separated from other vehicle lanes with a separator 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 trubk bus exclusive road, a following bus can overtake with running on a lane in opposite direction.

2) Trunk Bus Exclusive Lane

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.

3) Trunk Bus Priority Lane

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 of the existing road surface without any separators.

d) 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).

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

5.2.3. TRUNK BUS SYSTEM ROUTE PLAN

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 5.2-1.

Table 5.2-1 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

5.2.4. TRUNK BUS SYSTEM OPERATION PLAN

(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) 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.

(3) Bus Fare Payment System

1) Fare System

Bus fare system will introduce a flat rate system. The following fare system is recommended.

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.

2) 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.

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.

5.2.5. TRUNK BUS TERMINAL SYSTEM

(1) 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.

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

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

3) Waiting room for bus passengers

4) Office building for management of bus terminal

5) Office building for bus operation

(2) Trunk Bus Terminal Locations

The following 4 terminals will be planned.

1) Icoaraci Bus Terminal

2) Cidade Nova Bus Terminal

3) Coqueiro Bus Terminal

4) Marituba Bus Terminal

5.2.6. BUS STATION

(1) Characteristics and Functions of Trunk Bus Stations

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 characteristics and functions of the trunk bus stations are as follows.

1) The bus stations are planned at the center of the existing road spaces.
2) The trunk buses and feeder buses are directly connected.
3) 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.
4) At the bus stop segment, two (2) bus lanes should be ensured for bus passing.
5) The bus stops for conventional buses should be ensured near trunk bus stations considering easy transfer.
6) The trunk bus fare should be paid before entrance of the trunk bus stations.
7) Pedestrian bridges should be provided for the bus passengers crossing, considering many passengers will use these facilities.

(2) Location of Trunk Bus Stations

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

1) Avenida Augusto Montenegro in Tapana area
2) Avenida Augusto Montenegro in Mangueirao area
3) Rodoviar BR-316 in Aguas Lindas area

5.2.7. TRUNK BUS STOP SYSTEM

(1) Function

Trunk bus stop facility is only prepared for the trunk bus system and the feeder conventional buses are not directly connected to the trunk bus stops (no integrated system). The 2-lane bus lanes should be prepared at the bus stop sections due to increased transport capacity of the trunk bus system by overtaking other buses. The bus passengers should pay bus fare before entering the bus stops. The width of platform is adopted at 3.0 m due to narrow width on roads, and the platforms are separated according to in-bound and out-bound traffic flows.

(2) Location of Bus Stops

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

1) 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.
2) 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.
3) 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.

5.2.8. OPERATION AND MAINTENANCE FACILITIES (BUS DEPOTS)

(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.

(2) Location of Depots

The operation and maintenance facilities are located near the trunk bus terminals to enhance the function of terminal. The following four (4) depots are selected considering the functions of depots and the trunk bus system.

1) Icoaraci Depot
2) Cidade Nova Depot
3) Coqueiro Depot
4) Marituba Depot

5.2.9. TRUNK BUS FLEETS

(1) Trunk Buses

The following trunk bus fleets are required to ensure the smooth operation of the trunk bus system.

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.

(2) 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.

1) 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.
2) 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.
3) At present, the operation and maintenance system for hybrid articulated buses is not ensured in Brazil.

4) 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.

5) 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.

6) 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. DEMAND VOLUME ON THE TRUNK BUS SYSTEM

(1) Number of Passengers in Each Year

Table 5.3-1 shows 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		2013		2018（Phase I+II）		2025（Phase I+II）	
		Passengers	Share	Passengers	Share	Passengers	Share
Trunk Bus	Ordinary	34,321	7.7%	34,321	7.7%	39,610	8.1%
	Express	22,757	5.1%	22,757	5.1%	26,397	5.4%
	Sub Total	57,078	12.9%	57,078	12.9%	66,007	13.4%
Conventional Bus		373,005	385,872	385,872	87.1%	425,240	86.6%
Total		406,540	442,950	442,950	100.0%	491,247	100.0%

(2) 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.

(3) Required Operating Service Frequency

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%.

5.3.2. NECESSARY NUMBER OF BUSES

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.

5.4. BASIC FACILITIES PLAN

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; 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.

5.4.1. TRUNK BUSWAY PLANS

(1) Road Cross Section

1) Avenida Almirante Barroso (Trunk bus exclusive lane)

Figure 5.4-1 show the cross section composition of the planned road when the trunk bus exclusive lanes are introduced. Bicycle lanes have been added inside the central median, which has been widened to 4.5~5 m. In the Study, the bicycle lanes are remained in the median.

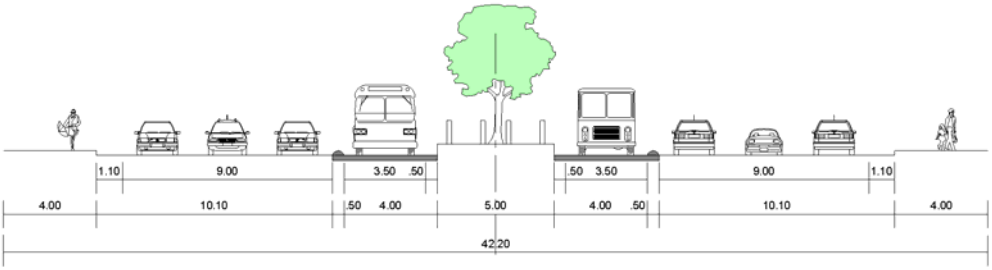


Figure 5.4-1 Planned Cross Sections on Avenida Almirante Barroso

2) Rodovia BR-316 (Trunk bus exclusive road)

The trunk bus exclusive road is constructed inside the existing right of way. Figure 5.4-2 shows the cross section composition of the planned roads.

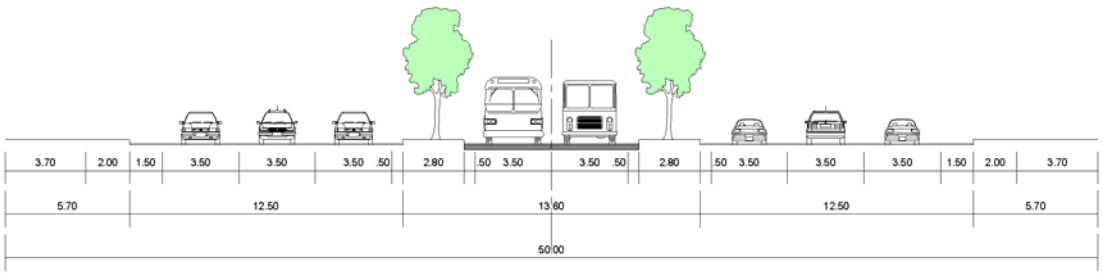


Figure 5.4-2 Planned Cross Sections of Rod. BR-316

3) Avenida Augusto Montenegro (Trunk bus exclusive road)

The bicycle ways currently running alongside the central median of the existing road are transferred to the sidewalk sides. Figure 5.4-3 shows the cross section composition of the planned roads.

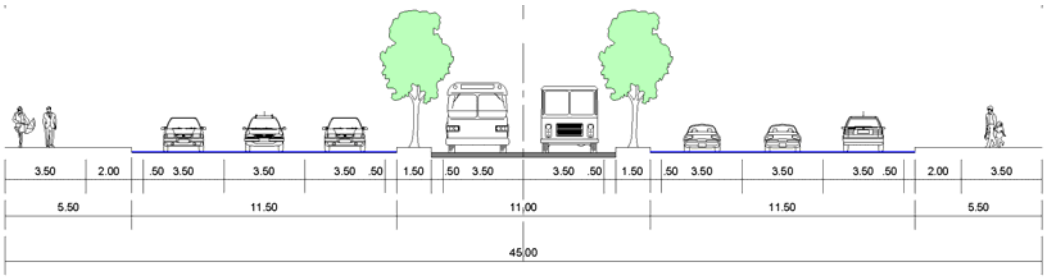


Figure 5.4-3 Planned Cross Section of Av. Augusto Montenegro

4) Avenida Independência (Trunk Bus Priority Lane)

The road construction of three lanes on each side is being advanced on the section west of Av. Augusto Montenegro. Figure 5.4-4 show the cross section compositions when trunk bus priority lanes are introduced.

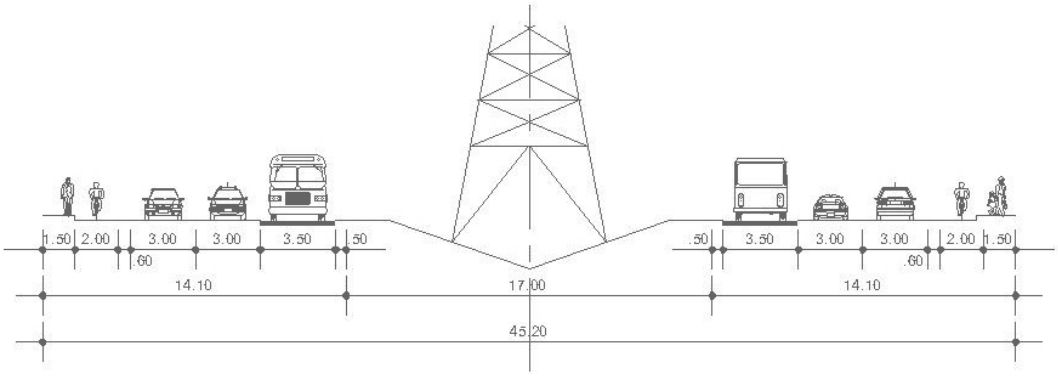


Figure 5.4-4 Planned Cross Section of Av. Independência (West Side)

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.

(2) Pavement Design

The 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.

5.4.2. CONSTRUCTION PLAN FOR TRUNK BUS TERMINALS AND STATION FACILITIES

The followings show the basic ideas of the facilities plan of the bus terminals and stations. Figure 5.4-5 shows the plan of Marituba bus terminal. Figure 5.4-6 shows the plan of bus stations.

1) 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.

2) 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.

3) 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.

4) 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.

5) 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.

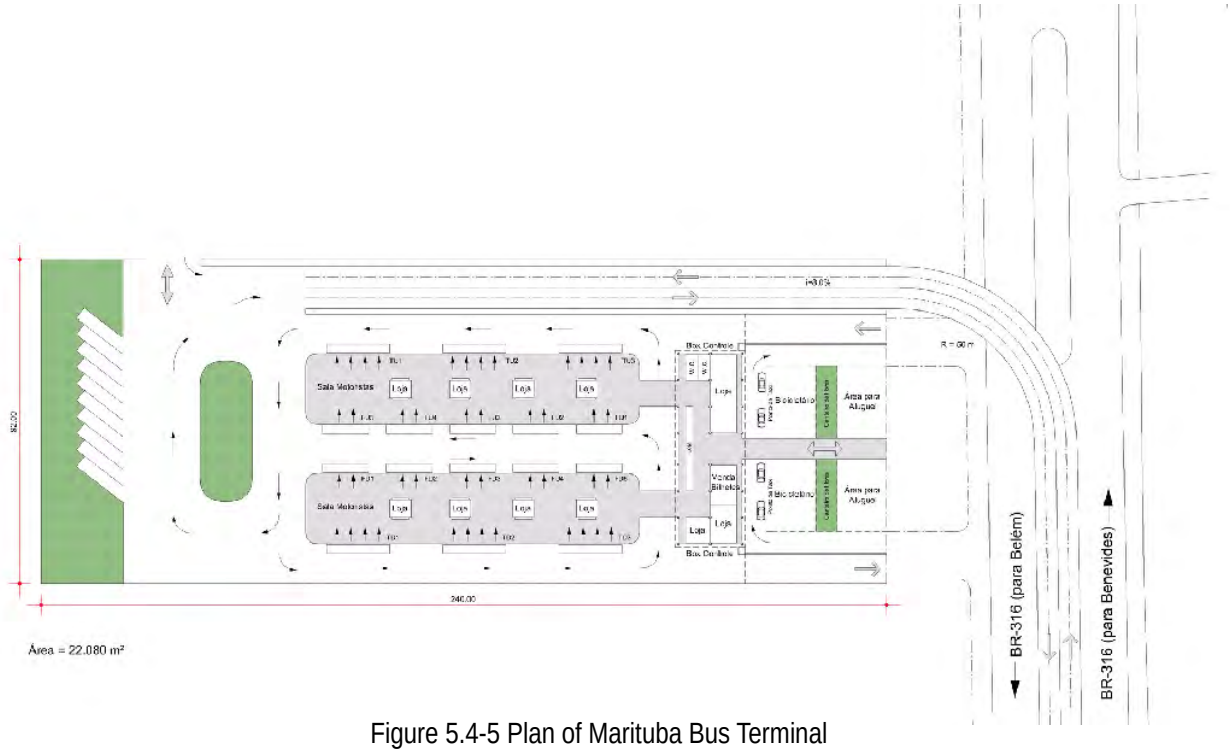


Figure 5.4-5 Plan of Marituba Bus Terminal

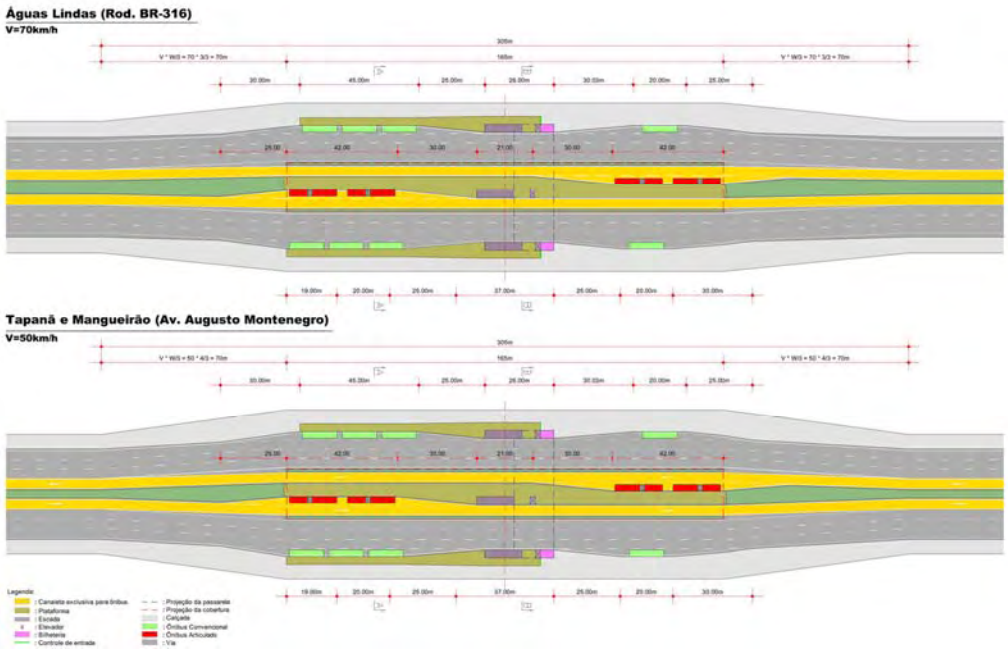


Figure 5.4-6 Plan of Bus Station

5.4.3. PLAN FOR TRUNK BUS STOP FACILITIES

Figure 5.4-7 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 Barosso, while enough space for one bus (Type I-2) is provided on other roads.

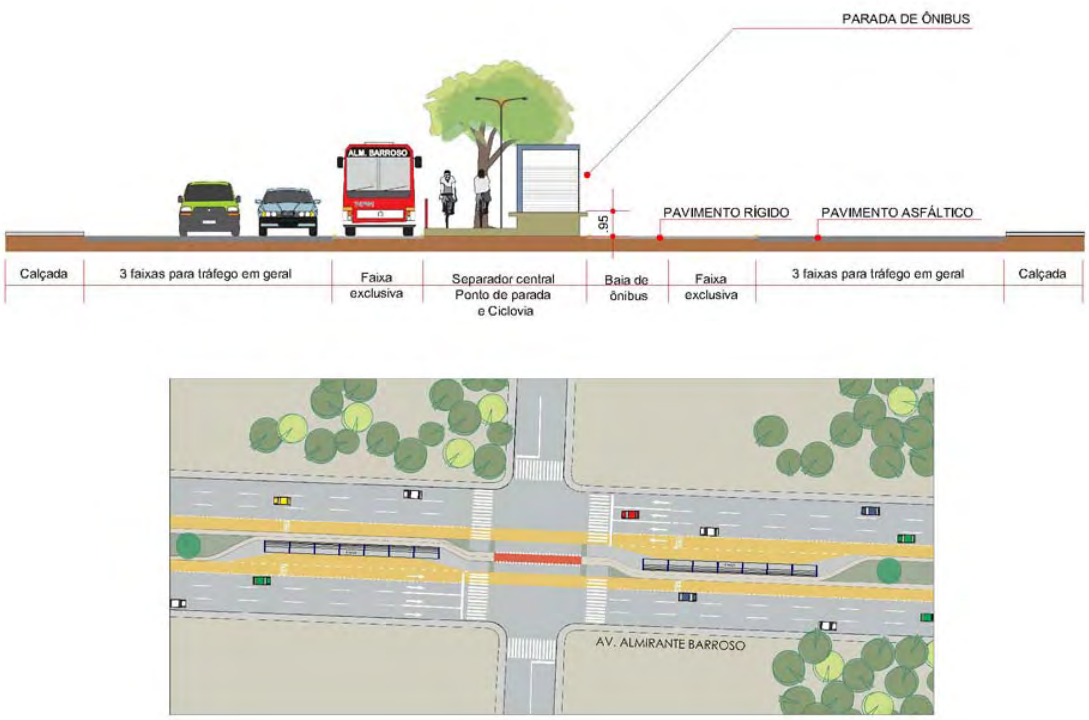


Figure 5.4-7 Bus Stop Plan

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

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:

1) 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
2) Garage function: Overnight parking of buses
3) Cleaning, maintenance and repair functions: Implementation of bus cleaning, simple maintenance and full-scale repairs
4) Service adjustment function: Increasing frequency of services as required according to the level of congestion on buses
5) Bus route maintenance function: Routine inspection and maintenance of bus routes and emergency response to traffic accidents and vehicle breakdowns, etc.
6) Office function: Functioning as bus company offices and rest facilities for drivers and so on

Figure 5.4-8 shows the layout drawing of the necessary trunk bus operation and maintenance facilities. Depots 1~3 manage one bus terminal and one bus station, and depot 4 manages one bus terminal, and these facilities are located in positions that allow immediate measures to be taken in the event of emergencies.

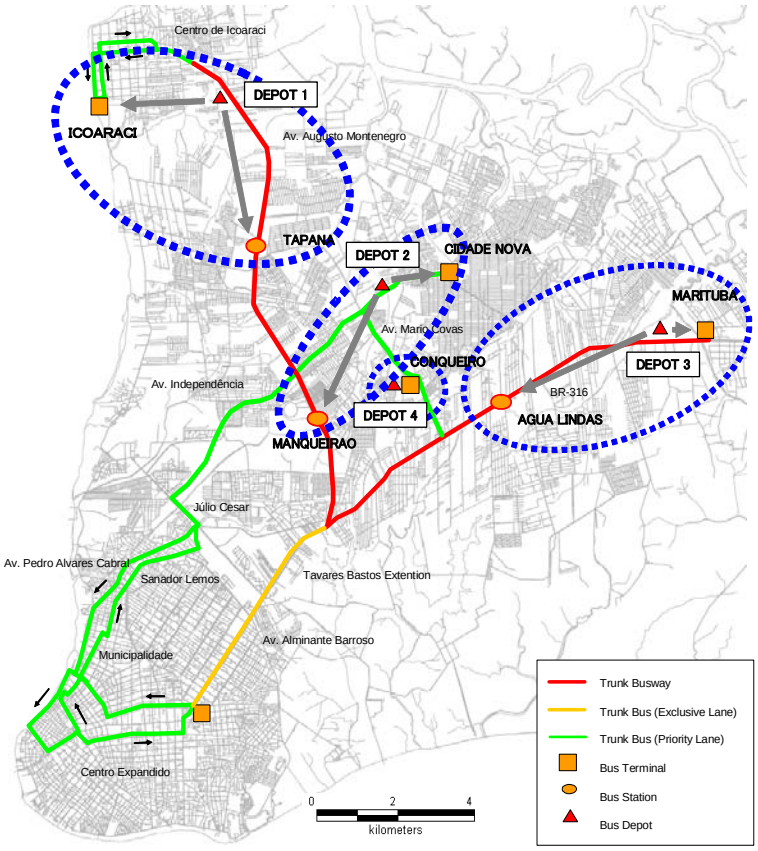


Figure 5.4-8 Layout Plan of Bus Operation and Maintenance Facilities (Depots)

6. PROJECT IMPLEMENTATION PLANNING

6.1. OUTLINE OF 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. 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.

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.

6.2. PROJECT PACKAGING PROPOSED 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 (¥21.4 billion), implemented by the State of Para
2) Package 2: Purchase of bus fleets (¥5.9 billion, implemented by a private bus company
3) Package 3: Construction of bus yards (¥0.9 billion), implemented by a private bus company
4) Package 4: Relocation Compensations for land and buildings (¥0.4 billion), 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

(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 6.2-1. 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 Table 6.2-2 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 6.2-1 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 6.2-2 Summary of 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

6.3. PROJECT IMPLEMENTATION

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

Table 6.3-1 Implementation Plan of the Project Financed by Japan's ODA Loan (Tentative)

No.	Working Items	Period Month	2009	2010	2011	2012	2013
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					

7. FRAMEWORK OF IMPLEMENTATION AND OPERATION

7.1. FINANCIAL CAPACITY OF THE STATE GOVERNMENT OF PARA

The Government of the State of Para has requested JICA to execute the trunk bus system project. 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.

7.1.1. 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. RLR is approximately R$7,312 million real in 2008, and 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.

7.1.2. 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. 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.

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. MANAGEMENT OF PROJECT IMPLEMENTATION

7.2.1. ORGANIZATIONS FOR PROJECT IMPLEMENTATION

The SEPE is the primary organization in charge of project implementation for the trunk bus system. 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 three divisions. Out of those divisions, Nucleus of Administration of Metropolitan Transport (NGTM) is directly responsible for the project implementation for the trunk bus system.

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. The division is currently staffed with 16 personnel. The division consists of two units respectively in charge of the following activities.

1) The unit directly and indirectly coordinates and manages the implementation of the Metropolis Action Plan.

2) 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.

7.3. TRUNK BUS OPERATION AND MANAGEMENT

7.3.1. MANAGEMENT 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.

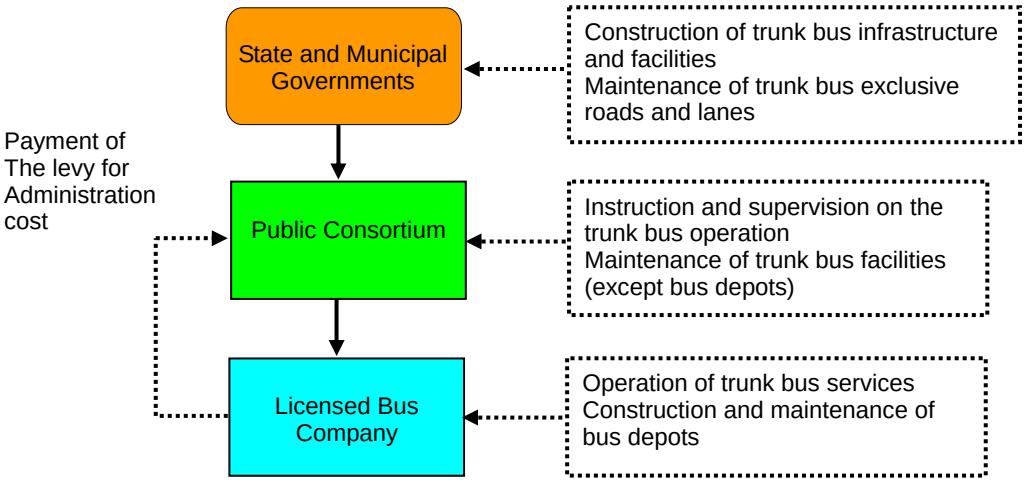


Figure 7.3-1 Organizational Structure for Trunk Bus Operation

7.3.2. FUNCTIONAL ROLES OF STATE AND MUNICIPAL GOVERNMENTS

The state and the municipal governments take the following measures.

1) The state government allocates its budget for the acquisition of land to construct facilities necessary for trunk bus operation.

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.

7.3.3. PUBLIC CONSORTIUM

(1) Organizational Model of the Public Consortium

1) 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.

2) Progress of Model

Under the leadership of NGTM of SEPE, a model suitable for metropolitan Belem has already developed. The outline of the model in the preliminary stage is completed in April 29, 2009, and is approved in the Para state and municipality assembries. The model of public consortium will be completed until March 2010.

3) Participants

The consortium is to be established by the participation of the State Government of Para and the governments of five municipalities in the metropolitan area of Belem (Belem, Ananindeua, Marituba, Benevides and Santa Barbara do Para).

4) Mandated Functions

The public transport service in inclusive of the public consortium covers all of the currently operating bus lines and the new trunk and the feeder bus system. The administration of conventional bus lines will be wholly transferred from the respective municipal authorities to the consortium.

5) Personnel

The consortium headed by the president consists of three departments, respectively responsible for planning, operation and management, and general management and finance. The total number of personnel would be around 500.

(2) 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 2010 to the end of 2013 when the trunk bus system is to start the operation.

7.3.4. FUNCTIONAL ROLES OF LICENSED 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. 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.

7.4. EXECUTING ENTITIES OF CONSTRUCTION, OPERATION AND MANAGEMENT

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 7.4-1 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.

Table 7.4-1 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 Governments1	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

8. ENVIRONMENTAL AND SOCIAL CONSIDERATION

8.1. SUMMARY OF FINDINGS

The present Study carried out preliminary environmental assessment on those trunk bus projects selected for updating and Japan's 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 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 shows following.

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 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.

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 (in case of 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.

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.

8.2. SOCIAL CONSIDERATION

Table 8.2-1 shows the number of dwelling units and the ground areas of buildings to be expropriated for the development of trunk bus facilities. The trunk bus system project do not involve any resettlement of dwelling units, requiring no relocation of inhabitants. However, the project would require the land acquisition totaling 197,000m2 and the estimated amount of R$16.8 million for compensation payments. As for the components for Japan's ODA Loan, their Phase 1 implementation would require the land acquisition totaling about 112,000m2 and the estimated amount of R$9.17 million for compensation payments.

Table 8.2-1 Removal Requirements of Buildings for Trunk Bus Facilities

No.	Facility and Location	Dwelling Unit	Area of Expropriation I (m^2)		Phase of Expropriation	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 & commercial use	None
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 Lingas	0	3,290	1,325	[I]	Public function & commercial use	None
Subtotal		0	6,535	3,275			
Grand Total			197,384	10,218			

8.3. PUBLICATION OF INFORMATION AND COMMUNITY PARTICIPATION

8.3.1. PUBLIC 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.

8.3.2. **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. 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.

8.4. SCHEDULE FOR ENVIRONMENTAL IMPACT ASSESSMENT

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 SEMA.

May 12, 2009:	The project brief submitted to SEMA
May 13, 2009:	Joint Field Survey by SEMA, NGTM and JICA study team (cf. Annex 8.3)
May 14, 2009:	Presentation of the project summary at SEMA (cf. Annex 8.4)
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

9. PROJECT EFFECTS

9.1. FORECAST OF PROJECT EFFECTS

9.1.1. EFFECTS OF INTRODUCING THE NEW TRUNK BUS SYSTEM

(1) Benefits to Travel Time and Distance in the Metropolitan Area of Belem

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 %.

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) Reduction of Peak Hour Traffic Congestion in the Study Area

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. The peak hour congestion level in three ranks (less than 1.0, from 1.0 to less than 1.5 and 1.5 and above) is analyzed and each length by the ranks in the Study area is compared to "with" and "without" projects.

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.

9.1.2. TRAFFIC CONGESTION UNDER CONSTRUCTION OF THE PROJECT

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, i.e., Av. Almirante Barroso, BR-316, Av. Augusto Montenegro, and Centro area 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.

From the analysis, 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. On other major raods, the traffic congestion occurs near those roads. Therefore, it seems that roads with heavy traffic congestion is few in the peak hour with proper measure on the construction.

9.2. ECONOMIC AND FINANCIAL EVALUATION

9.2.1. ECONOMIC EVALUATION

(1) Approach

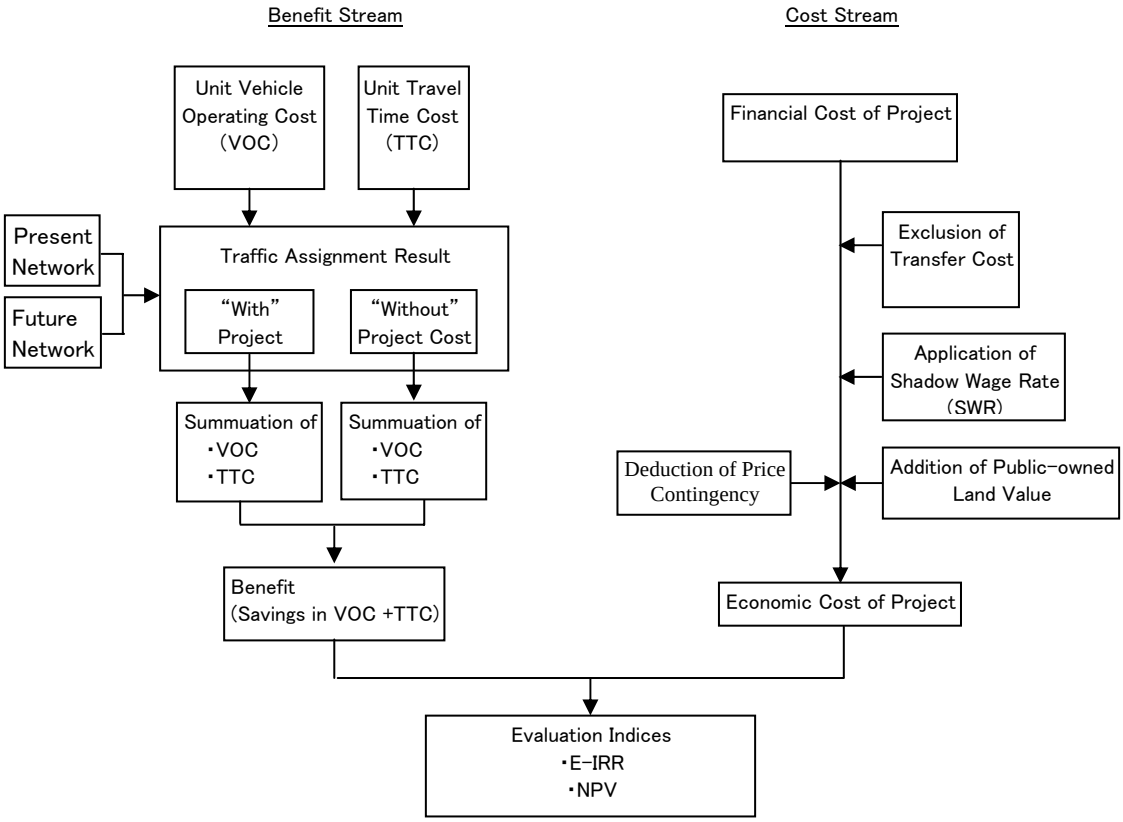
The cost and benefit analysis is applied to the proposed trunk bus project, following the steps indicated in the flow chart of Figure 9.2-1. The purpose of the analysis is to see if the project assures a sufficient benefit worth its cost from the viewpoint of the metropolitan economy of Belem. Therefore, 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

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.

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.

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 railway system to meet the increasing traffic demand.



Source: JICA Team estimates

Figure 9.2-1 Flow Chart of Economic Evaluation

(2) Results of Economic Evaluation

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$451.4 million. 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%.

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 9.2-1 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

Table 9.2-2 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

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) 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.

Table 9.2-3 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 9.2-3 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

Table 9.2-4 shows the sensitivity analysis after deducating government investment in infrastructure. 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.

Table 9.2-4 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 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.

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 9.2-6. 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.

Table 9.2-5 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 9.2-6 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

(3) 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 9.2-7. The vehicle operating cost is expressed in economic price, but the fuel consumption is converted to market price.

Table 9.2-7 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.

9.2.3. CONCLUSION

The conclusion from the foregoing economic and financial analysis can be summed up as follows.

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.

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.

10. CDM PROJECTS

10.1. CDM PROJECTS IN BRAZIL

Table 10.1-1 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. Of the total CDM projects approved by ICGCC and registered by EB, Japanese enterprises are participating in the 23 projects in which major projects are related to electric power projects.

Table 10.1-1 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

10.2. PROCEDURE OF CDM APPLICATION IN BRAZIL

10.2.1. 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 10.2-1.

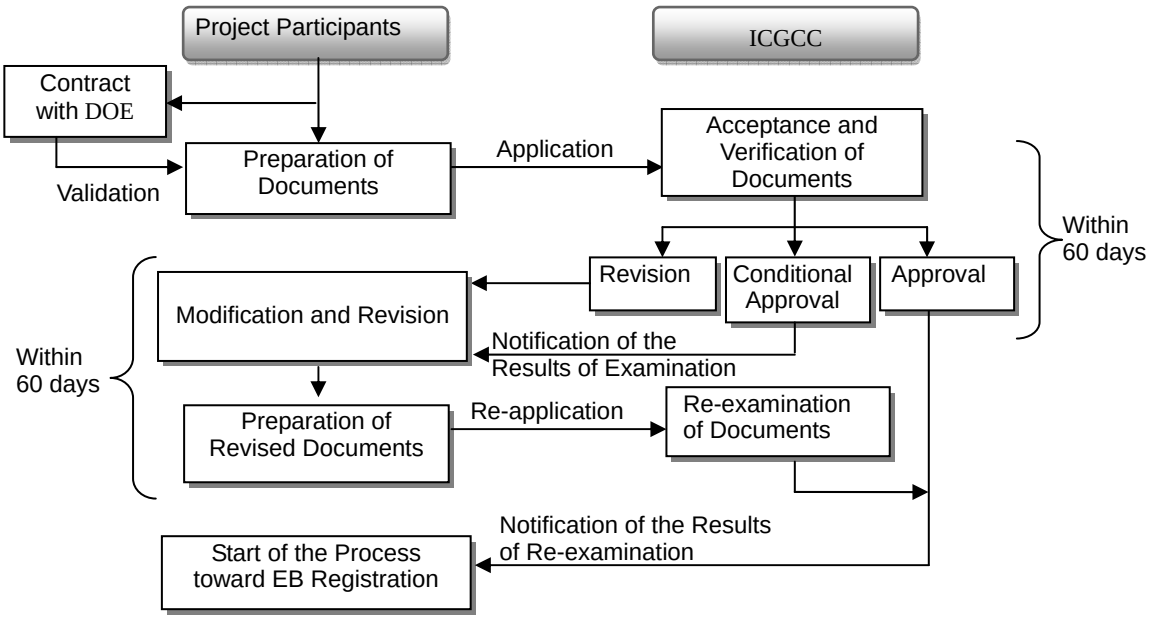


Figure 10.2-1 Procedure of CDM Application and Project Approval

(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
- The project design document (PDD) written in English as stipulated in the EB regulations (cf. 10.6.1)
- The DCP written in Portuguese as stipulated in the ICGCC regulations
- The document as stipulated in Annex III of Resolution No. 1
- Stakeholders' comments
- The validation report by the designated operational entity (in English and Portuguese)
- The declaration of participation
- Declaration of the designated operational entity (DOE)
- Other related information

(3) 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.
- 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 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.

10.3. APPLICABLE ALTERNATIVE APPROVED METHODOLOGIES AND COLLECTION OF RELEVANT INFORMATION

10.3.1. 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.

10.3.2. OUTLINE OF BRT BOGOTA COLOMBIA: TRANSMILENIO PHASES II TO IV

Table 10.3-1 shows the skeleton profile of BRT Bogota Colombia: TransMilenio Phases II to IV in which AM0031 was used.

Table 10.3-1 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）

10.3.3. 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 proposal must indicate a clear plan of action to replace the existing public transport with a new BRT system, proposing specific measures for writing off vehicles, restricting the issue of permits and applying economic disincentives so that the present transport capacity will be reduced and taken over by the new system.
- Local regulations and ordinances in force do not constrain the construction or expansion of the BRT system.
- Both the baseline transport system and the new BRT project should not assume the consumption of mixed gasoline, mixed light oil, mixed LNG (liquefied natural gas) or mixed CNG (compressed natural gas), with additives of less than 3% excepted. AM0031 is not applicable to bio fuels.
- A new BRT project, like the baseline transport system and other options that might be considered, specifically concerns road transport. AM0031 is not applicable to transport systems relying on railways, airways or waterways.

- A BRT system must be proposed to replace the existing public transport system entirely or partially in a given city. AM0031 is not applicable to the introduction of a BRT system into a city lacking developed public transportation.
- The findings of the baseline study satisfactorily explain and justify the validity of choosing the continuation of the present public transport system as the baseline scenario. That is to say, the continuation of the present system to the future is considered as the most logical choice for the calculation of anthropogenic GHGs emissions for the "without-project" situation.

10.4. ANALYSIS OF GHGS EMISSION REDUCTION

10.4.1. RESULTS OF ESTIMATION

- 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.

The total emission reduction by the CDM implementation of the trunk bus project is 360,900 t/CO2eq, as shown in Table 10.4-1. The annual average emission is 36,090 t/CO2eq.

Table 10.4-1 Emission Reduction Estimated during Crediting Period

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

10.4.2. EXPECTED ACQUISITION OF CERTIFIED EMISSION REDUCTIONS (CER)

For the sake of reference, for example, the BRT project in Bogota showed the average credited ratio of 48.2% per annum 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$1 to 3 million as shown in Table 10.4-2.

Table 10.4-2 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

10.4.3. ESTIMATED EMISSION REDUCTION WITH CDM APPROVAL (HYBRID BUS FLEET)

Basic parameters used for estimation are the same as the diesel bus fleet. 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., (a reduction of 90% to the conventional bus type) is used in its stead.

The total emission reduction by the CDM project implementation is 590,821 t/CO2eq, or annual average emission of 59,082 t/CO2eq. This reduction ratio of CO2eq to the Diesel bus fleet is approximately 60%. The CER acquisition over the crediting period could total from US$2 to 11 million, equivalent to approximately double values to the Diesel bus fleet.

10.5. DRAFT PDD

The draft project design document is prepared partly according to the manual by the Ministry of Environment in Japan. The following is the summary description of the PDD (the details of the PDD are presented in the volume on statistics and other information).

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