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APPENDICES

APPENDIX A

MAIN PARAMETERS FOR TRANSPORT & VEHICLE EMISSION MODEL

Table 1 Average speeds per type of vehicle and individual vehicle

Unit: km/h

	Passenger car			Bus			Light duty truck
	PC1	PC 2	PC 3	Bus 1	Bus 2	Bus 3	
Entire period	23.4	27.1	26.3	12.2	17.1	17.4	42.3
	25.6			15.7			
Daytime (7:00 to 21:00 hrs.)	21.9	25.2	26.0	13.0	17.5	17.2	42.1
	24.4			15.8			
Night-time (21:00 to 7:00hrs.)	25.7	29.0	26.7	6.0	16.2	18.8	66.0
	27.3			15.2			
Working days	22.9	26.0	24.9	12.0	16.7	17.0	42.8
	24.6			15.4			
Holidays	24.5	29.6	30.5	12.4	17.8	18.5	35.3
	28.3			16.3			

Source: CDM Project, OTP (2004)

Table 2 Driving cycles of Buses

Speed (km/h)	Average speed (km/h)	Maximum speed (km/h)	Average acceleration (km/h/s)	Distance (km)	Time (sec)	Ratio of traveling time%				Number of short trips
						Idling	Acceleration	Constant speed	Deceleration	
0-6	5.0	39.3	1.48	2.27	1643	60.2	15.5	10.3	14.1	9
6-12	9.4	43.5	1.64	2.96	1133	42.1	23.4	14.0	20.5	7
12-20	15.9	47.6	1.83	2.45	556	20.5	32.4	18.9	28.2	4
20-30	24.0	63.6	1.80	2.85	427	12.4	38.4	17.1	32.1	2
30-50	38.3	66.9	1.66	3.78	356	5.1	42.4	21.1	31.5	1

Source: CDM Project, OTP (2004)

Table 3 Driving cycles of Passenger car

Speed (km/h)	Average speed (km/h)	Maximum speed (km/h)	Average acceleration (km/h/s)	Distance (km)	Time (sec)	Ratio of traveling time (%)				Number of short trips
						Idling	Acceleration	Constant speed	Deceleration	
0-10	7.6	61.3	2.30	2.10	1002	55.2	15.7	9.7	19.5	11
10-20	14.9	57.3	2.24	4.77	1151	34.5	26.4	12.0	27.1	10
20-30	24.3	71.4	2.38	3.37	499	17.6	32.3	15.0	35.1	6
30-40	35.2	74.4	2.20	3.39	347	15.6	38.6	12.1	33.7	3
40-60	44.6	90.9	2.17	6.77	547	6.4	39.7	16.8	37.1	2

Source: CDM Project, OTP (2004)

Table 4 Driving cycles of Light duty truck

Speed (km/h)	Average speed (km/h)	Maximum speed (km/h)	Average acceleration (km/h/s)	Distance (km)	Time (sec)	Ratio of traveling time (%)				Number of short trips
						Idling	Acceleration	Constant speed	Deceleration	
0-10	7.9	54.5	2.07	2.29	1042	53.9	18.9	7.3	19.9	19
10-20	15.0	51.4	2.11	3.34	802	27.4	29.2	15.1	28.3	9
20-30	24.0	59.0	1.93	3.86	580	16.6	33.6	17.2	32.6	4
30-40	34.9	77.6	2.00	6.65	685	12.1	37.1	15.3	35.5	3
40-60	48.1	86.4	1.70	9.48	710	7.0	41.5	18.5	33.0	4

Source: CDM Project, OTP (2004)

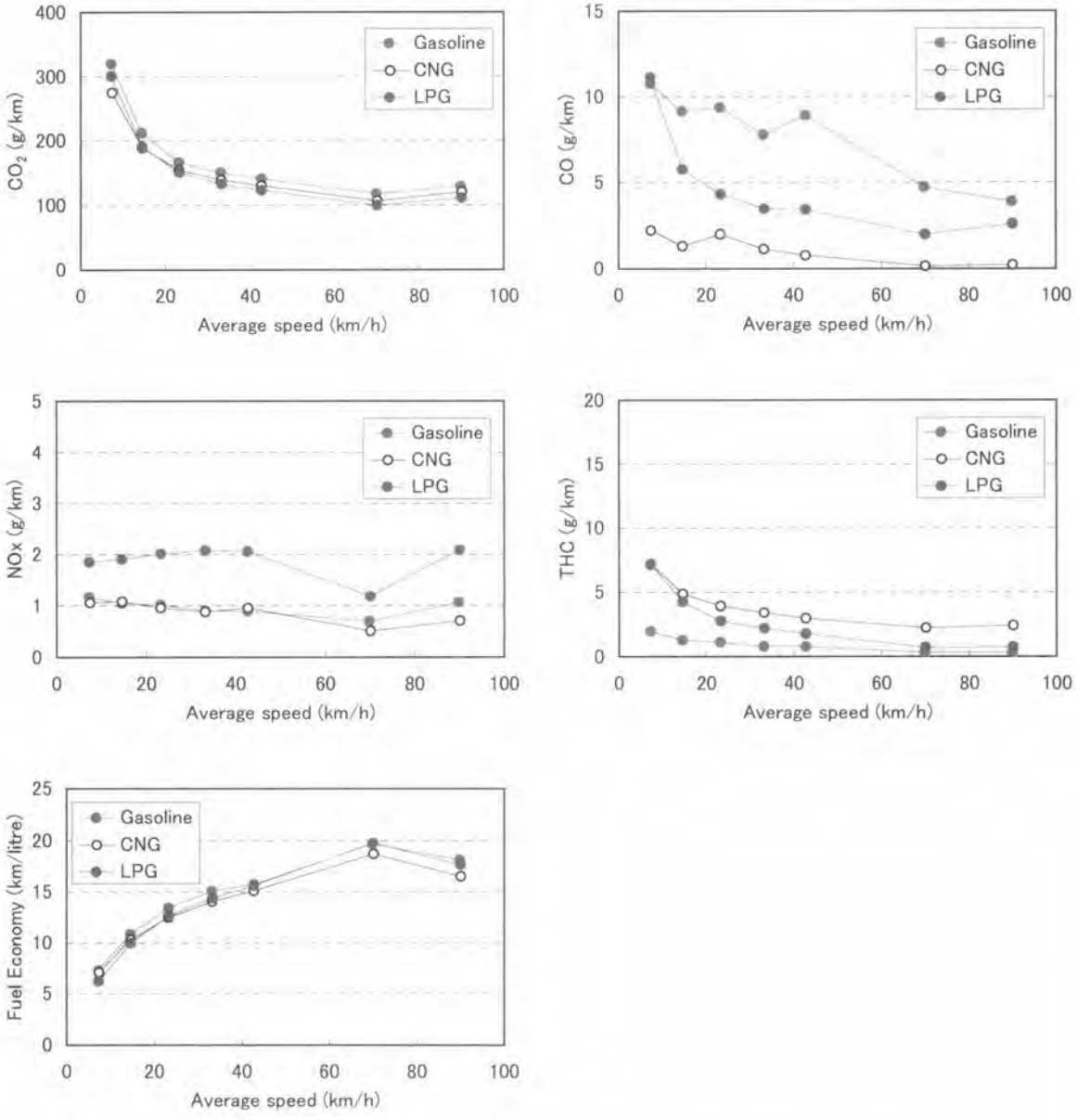

Figure 1 Emission factors (Passenger car by type of fuel)

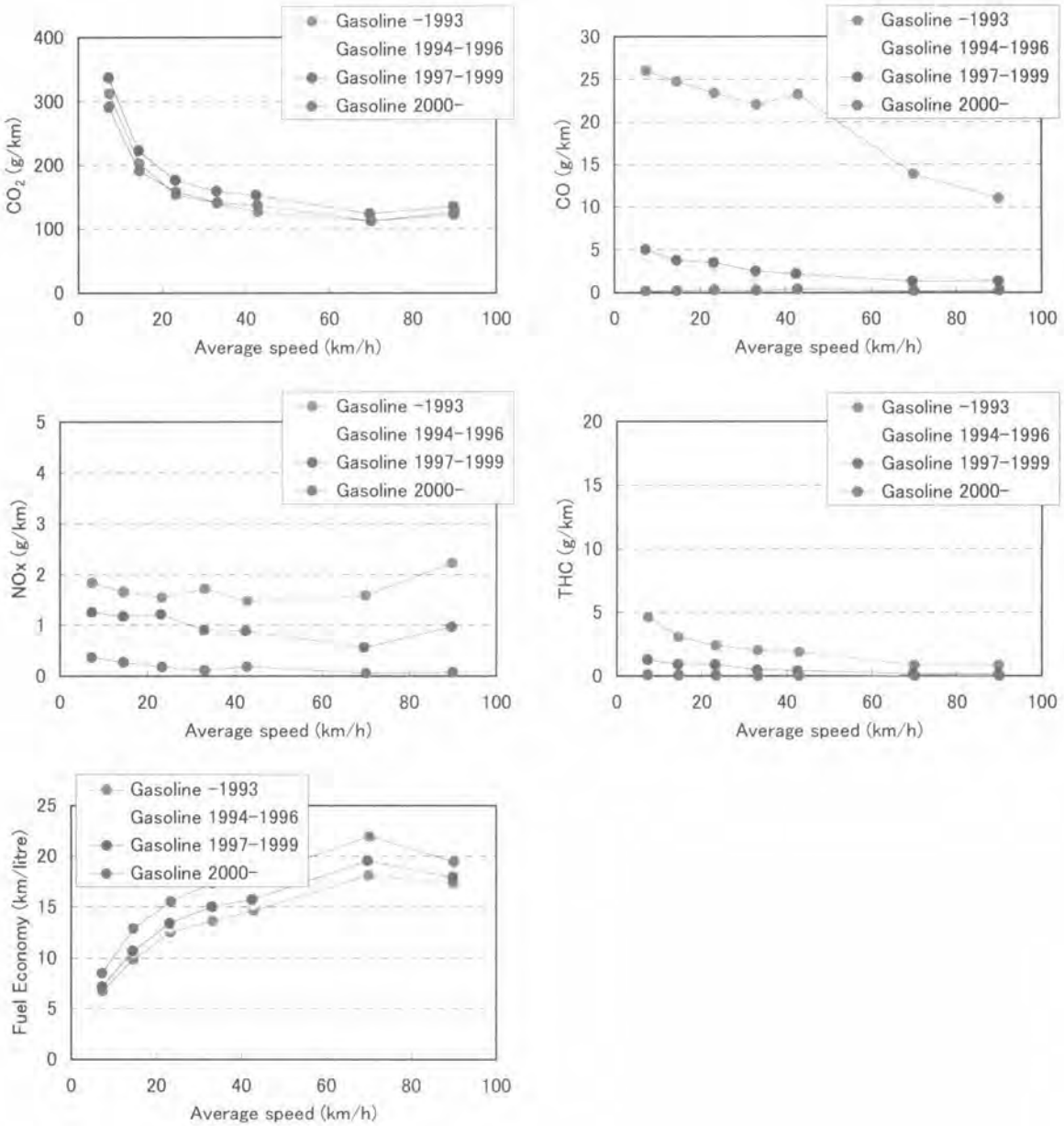

Figure 2 Emission factors (Passenger car by engine age)

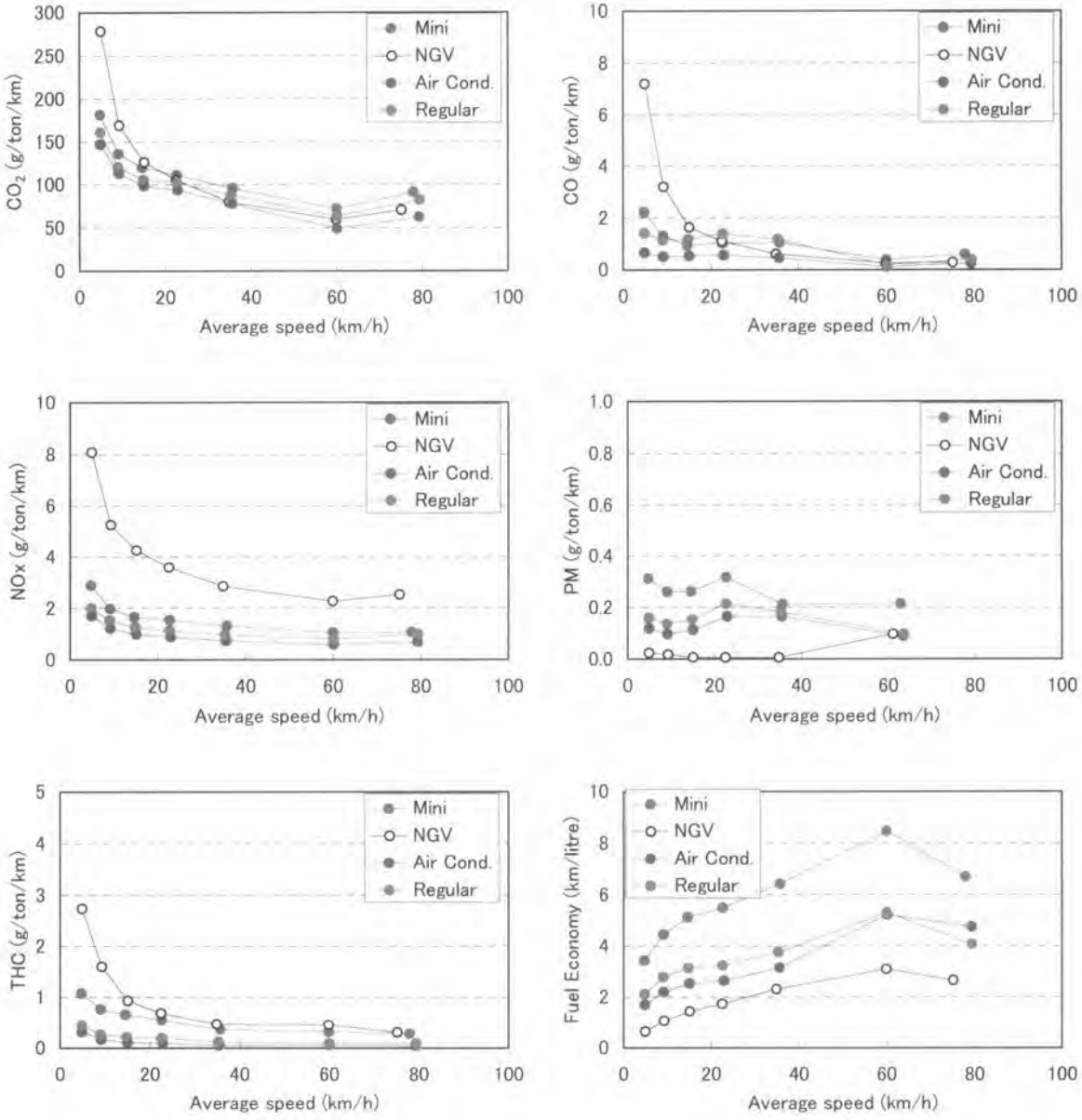

Figure 3 Emission factors (Buses by type)

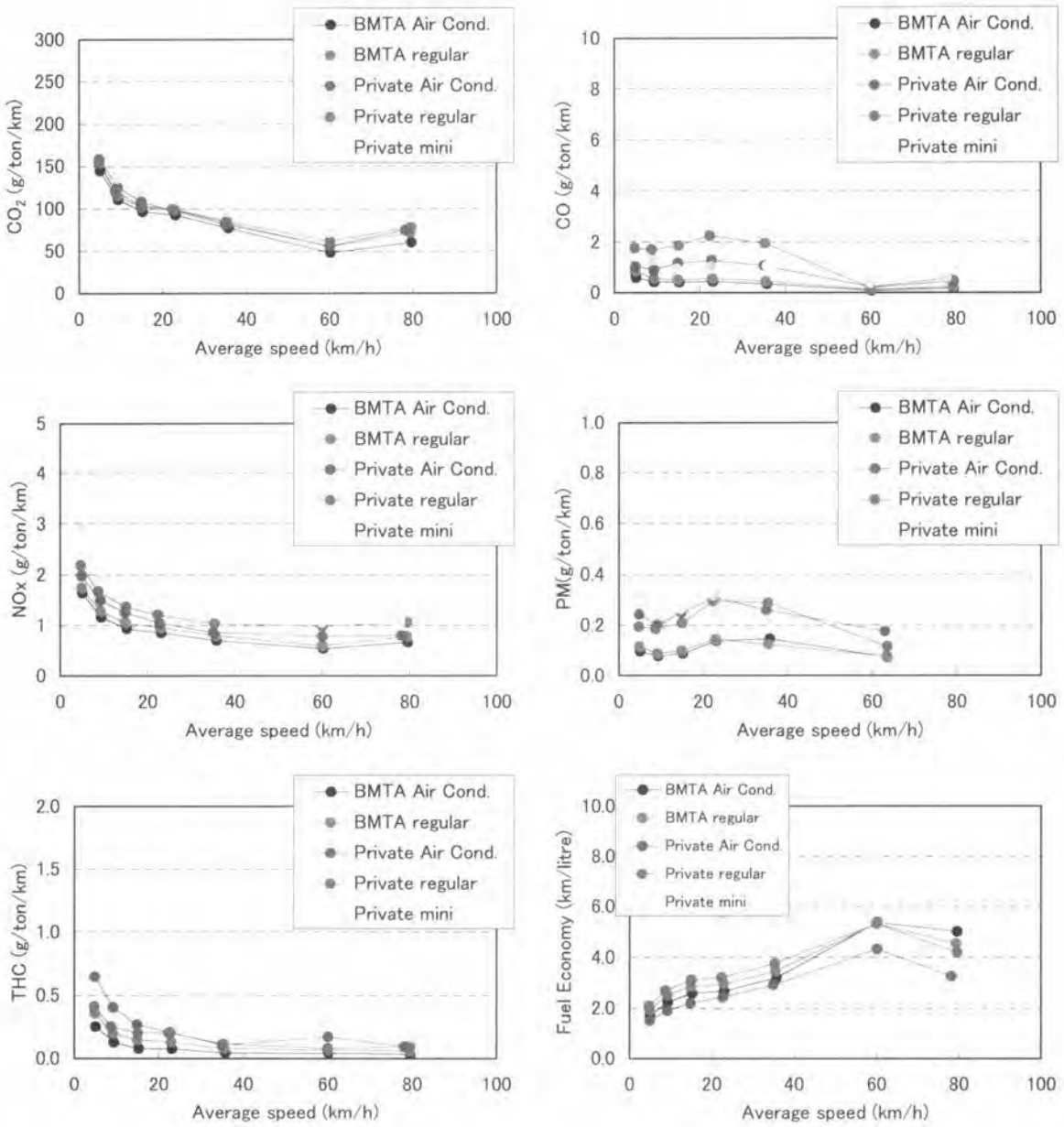

Figure 4 Emission factors (Buses by type of owner)

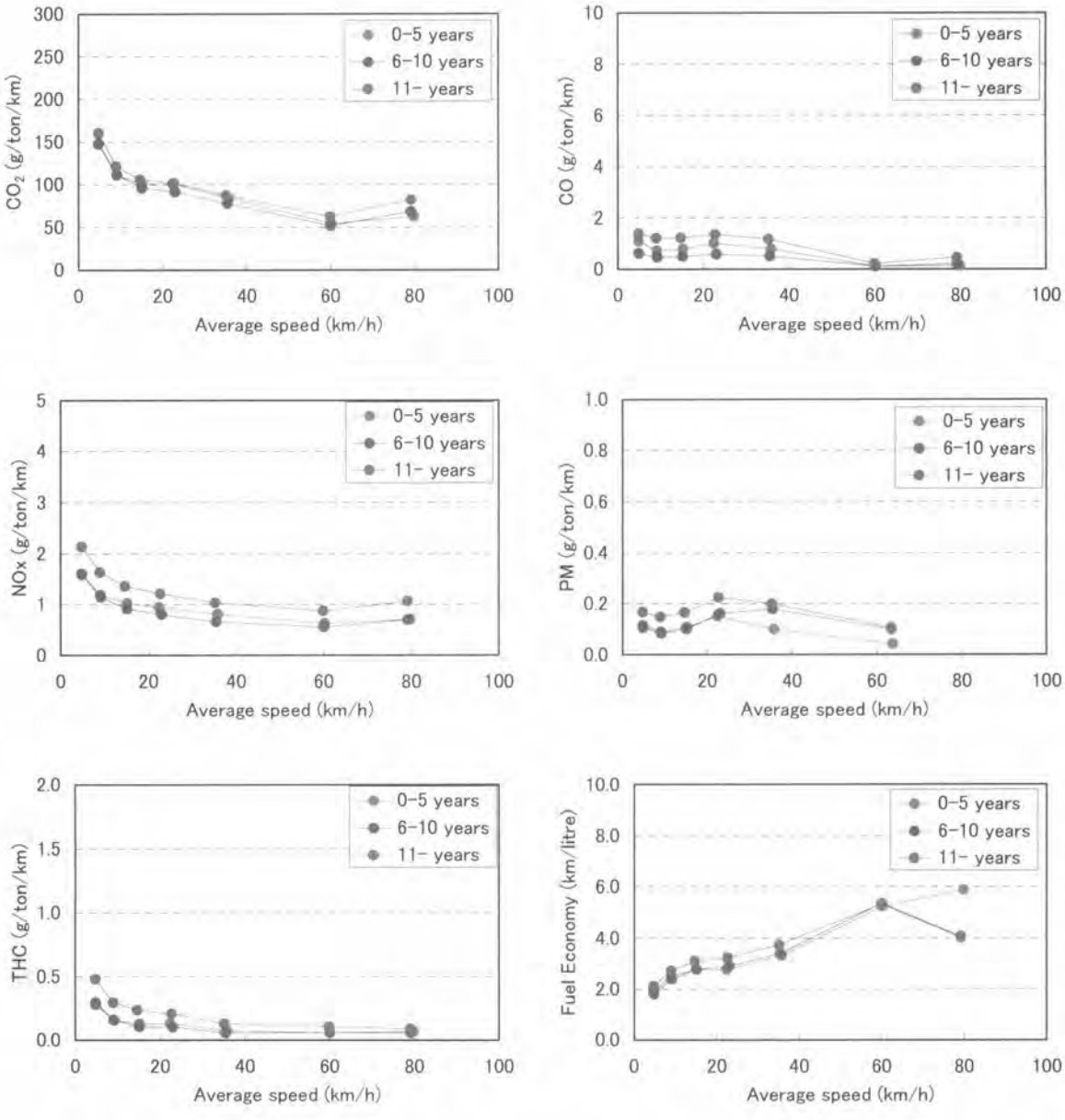

Figure 5 Emission factors (Buses by engine age)

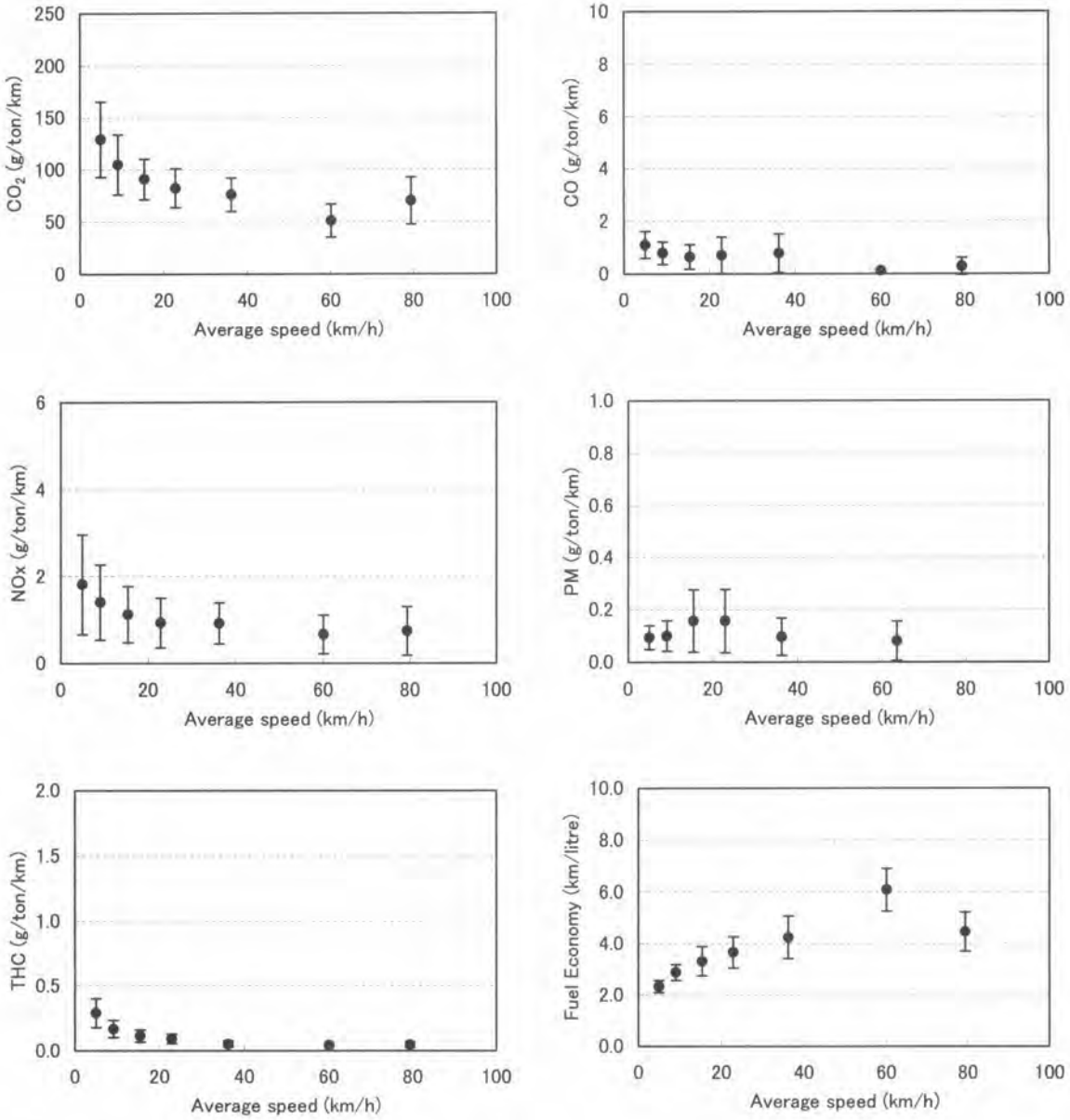

Figure 6 Emission factor (Heavy duty truck)

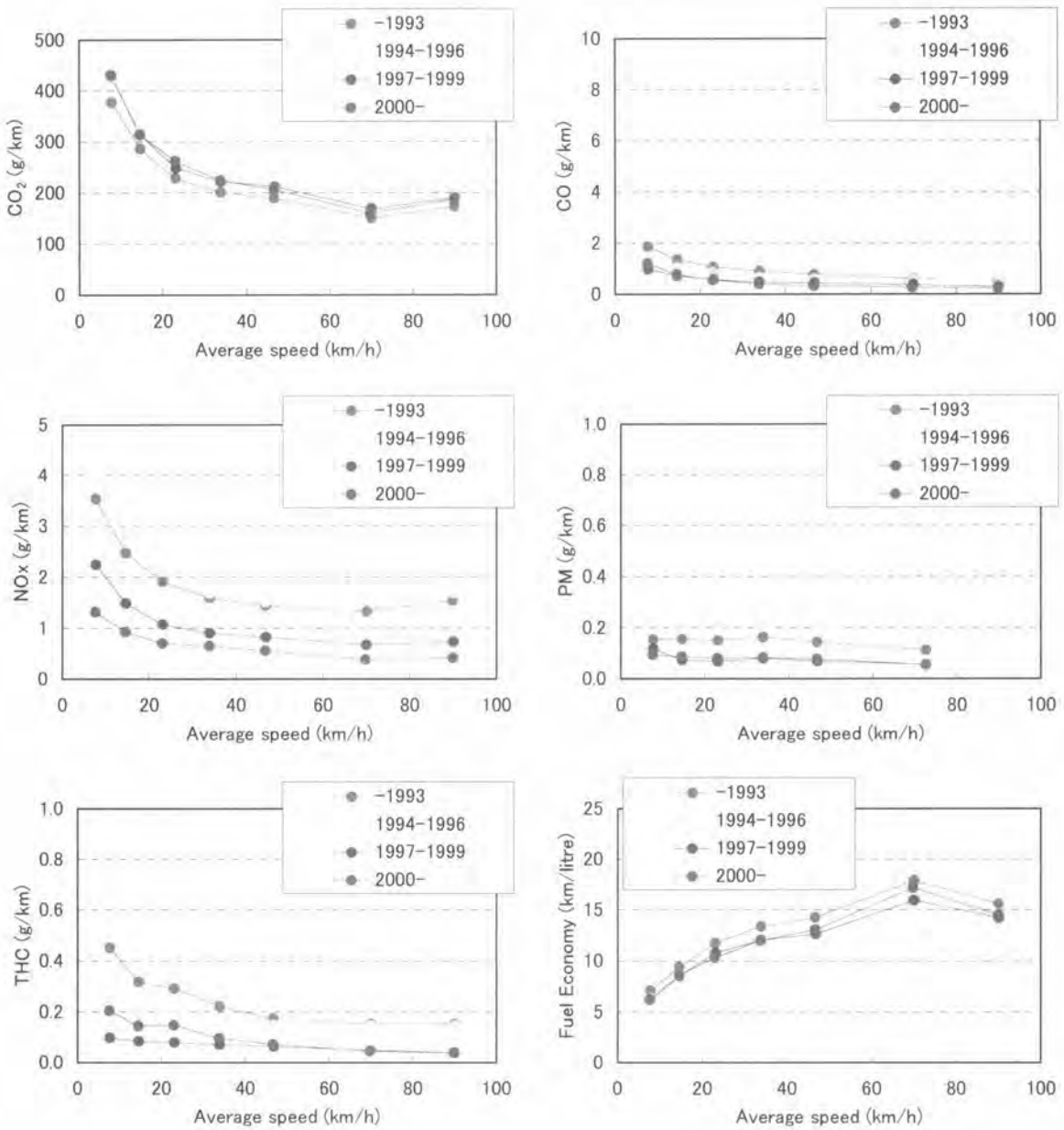

Figure 7 Emission factor (Light duty truck by engine age)

Table 5 Passenger Car Unit (PCU) in each vehicle type.

Vehicle Type	PCU
Motorcycle	0.25
Samlor (Tuk Tuk)	0.7
Taxi	1.0
Private Car	1.0
Minibus	1.5
Regular Bus	2.0
Pickup and Light Truck	1.0
Medium (6-wheel) Truck	2.0
Heavy (10-wheel) Truck, including Truck and Trailer	2.5
Other Vehicle	1.0

Table 6 Link types in transport model (BUAM).

Link Type	Description	
1	General centroid connectors	Walk
2	Non transit walk links	Walk
3	BTS centroid connectors	Walk
4	SRT centroid connectors	Walk

Table 6 (Continued)

Link Type	Description	
5	Centroid connectors for PT -base highway assignment	Walk
6	MRT centroid connectors	Walk
8	One way road	Both
9	Dual carriageway with frontage rods	Both
10	Flyover	Transit
11	Bus only link	Both
12	Minor road	Both
13	Major road	Both
14	Expressway	Transit
15	Ferry link	Transit
16	SRT rail link	Transit
17	BTS-Green line	Transit
18	Walk link to BTS	Walk
19	Expressway On Ramp	Transit
20	Expressway Off Ramp	Transit
21	U-turn	Both
23	Walk link to MRT	Walk
24	MRT-MRT interchange walk link	Walk
25	MRTA-blue line	Transit
26	MRTA-orange line	Transit
29	SRT Mass Transit	Transit
30	Walk links to SRT-MRT	Walk

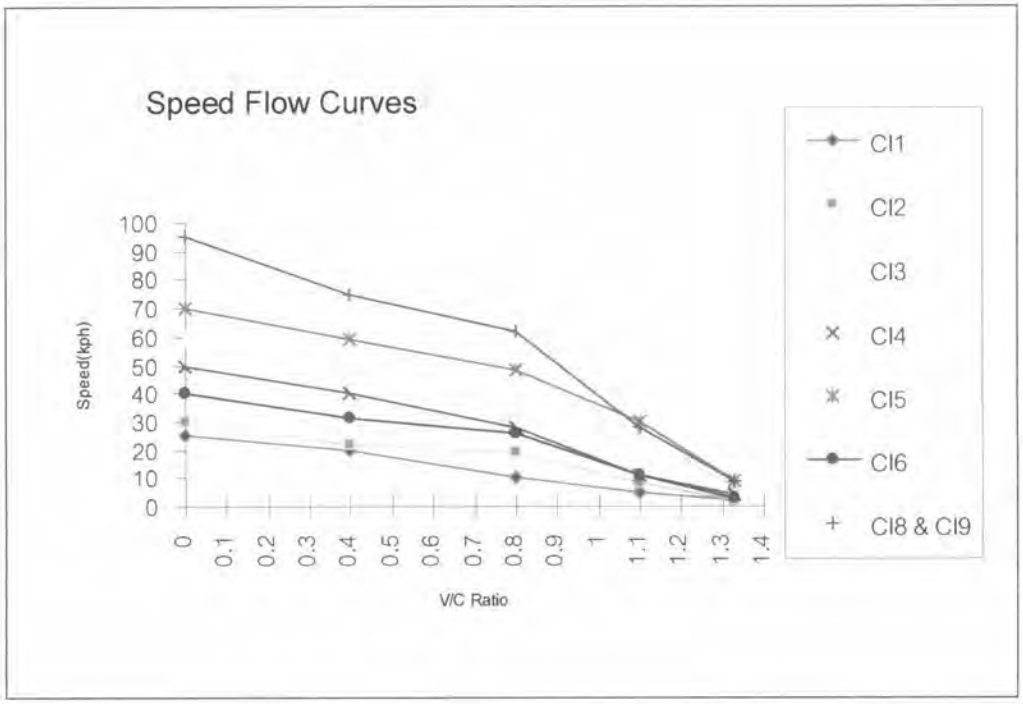

Figure 8 Relationships between Speed and Traffic Volume/Road Capacity Ratio

APPENDIX B

ASSUMPTION OF 4 HIGH-POTENTIAL ALTERNATIVE SOLUTIONS

Solution 1: Implementing NGV bus and rerouting:

The implementing NGV bus and rerouting is an important aspect of accessibility but must also be designed so that the system is easy to understand and use.

The new bus route design aims to include the following features and benefits:

- Develop bus routes for improved directness and connectivity to meet travel needs;
- Propose a trunk and feeder route system;
- Establish major bus transfer points to provide easy connections (including intermodal);
- Lower the overall number of routes (and route duplications) and use design that is easy to understand;
- Increase accessibility both to new roads and local residential areas;
- Implement bus priority to increase bus speed and reliability.

To assist in the route planning, 7 major zones have been defined relative to groups of existing major corridors as follows:

1) Eastern Zone (Bus Zone 1),
2) South-Eastern Zone (Bus Zone 2),
3) Northern Zone (Bus Zone 3),
4) Western Zone (Bus Zone 4),
5) South-Western Zone (Bus Zone 5),
6) Far Eastern Zone (Bus Zone 6), and
7) Central Zone (Bus Zone 7)

Details of the zone boundary and major corridors in the zones are outlined in Figure 1 and Table 1.

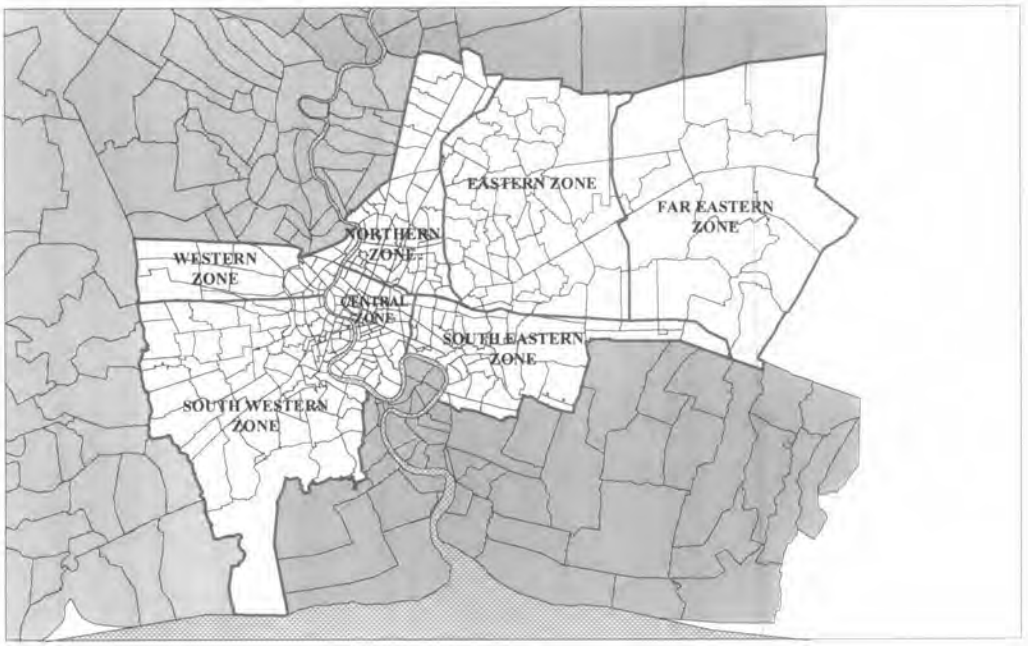

Figure 1 Map of 7 Bus Operation Zones

Table 1 Detail of 7 Bus Operation Zones in Bangkok

Zone No.	Bus Operation Zones	Zone Boundary	Major Corridors in the Zones
1	Eastern Zone	Rama IX Rd. Motor Way Rom Klao Rd. Ram Kham Haeng Rd. Suwintha Wong Rd. Nimit Mai Rd. Boundary of Bangkok Khlong Song Khlong Bang Bua Khlong Lat Phrao	Rama IX Rd. Ram Kham Haeng Rd. Lat Phrao Rd. Ram Inthra Rd.

Table 1 (Cont) Detail of 7 Bus Operation Zones in Bangkok.

Zone No.	Bus Operation Zones	Zone Boundary	Major Corridors in the Zones
2	South Eastern Zone	Asok-Din Daeng Rd. Rama IX Rd. Motor Way Boundary of Bangkok Chao Phraya River	New Phetcha Buri Rd. Sukhumvit Rd. Sri Nakharin Rd. Rama IV Rd.
3	Northern Zone	Liapkhlongprapa Rd. Pracha Chun Rd. Khlong Bang Khen Chao Phraya River Ratcha Withi Rd. Din Daeng Rd.Rama IX Rd. Khlong Lat Phrao Khlong Bang Bua Khlong Song Boundary of Bangkok	Wiphawadi Rangsit Rd. Phahon Yothin Rd. Lat Phrao Rd. Ratchada Phisek Rd. Rama IX Rd. Chaeng Watthana Rd. Ngam Wong Wan Rd.
4	Western Zone	Chao Phraya River New road Boundary of Bangkok	Pin Klao-Nakhon Chai Sri Rd. Charan Sanit Wong Rd. Phra Pin Klao Rd.
5	South Western Zone	Chao Phraya River Taksin – Phetkasem Rd. Boundary of Bangkok	Phetcha Kasem Rd. Rama II Rd. Somdet Phrachao Taksin Rd.
6	Far Eastern Zone	Nimit Mai Rd. Suwintha Wong Rd. Ram Kham Haeng Rd. Rom Klao Rd. Motor Way Boundary of Bangkok	Suwinthawong Rd.

Table 1 (Cont) Detail of 7 Bus Operation Zones in Bangkok.

Zone No.	Bus Operation Zones	Zone Boundary	Major Corridors in the Zones
7	Central Zone	Chao Praya River Ratcha Withi Rd. Din Daeng Rd. Asok-Din Daeng Rd.	Phaya Thai Rd. Rama III Rd. Rama IV Rd. Ratcha Prarop Rd. Ratcha Damri Rd.

Table 2 Proposed Major Bus Transfer Points

Zone No.	Major Transfer Point	Roads around major transfer points
1	Lam Sali Junction	Lat Phrao Rd. Sri Nakharin Rd. Ram Kham Haeng Rd. Puang Siri Rd.
2	Khlong Toei	Ratchada Phisek Rd. Sunthorn Kosa Rd. Kasemrat Rd. Thang Rot Fai Kao Rd. Rama IV Rd.
2	Ekamai	Sukhumvit Rd. Soi Sukhumvit 42 Rama IV Rd.
3	Mo Chit	Phahon Yothin Rd. Kamphaeng Phet Rd. Rama VI Rd. Pradiphat Rd.
3	Bang Sue	Thahan Rd. Taechawanit Rd. Pracha Rat Sai 2 Rd. Pracha Rat Sai 1 Rd.

Table 2 (Cont) Proposed Major Bus Transfer Points.

Zone No.	Major Transfer Point	Roads around major transfer points
5	BSTC	Ratchada Phisek Rd. Thoet Thai Rd. Wut Thakat Rd. Tak Sin-Phetcha Kasem Rd.
7	Victory Monument	Ratcha Withi Rd. Rama VI Rd. Sri Ayutthaya Rd. Phaya Thai Rd.
7	World Trade Centre/Siam	Ratcha Damri Rd. Phetcha Buri Rd. Phaya Thai Rd. Rama I Rd.
7	Asok	Asok Rd. Phetcha Buri Rd. Na Na Nua Rd. Sukhumvit Rd.
7	Silom	Silom Rd. Nara Thiwat Ratcha Nakharin Rd. Sathon Nua Rd. Rama IV Rd.
7	Ratcha Dam Noen Klang	Pracha Thipatai Rd. Phra Sumen Rd. Ratcha Dam Noen Klang Rd.

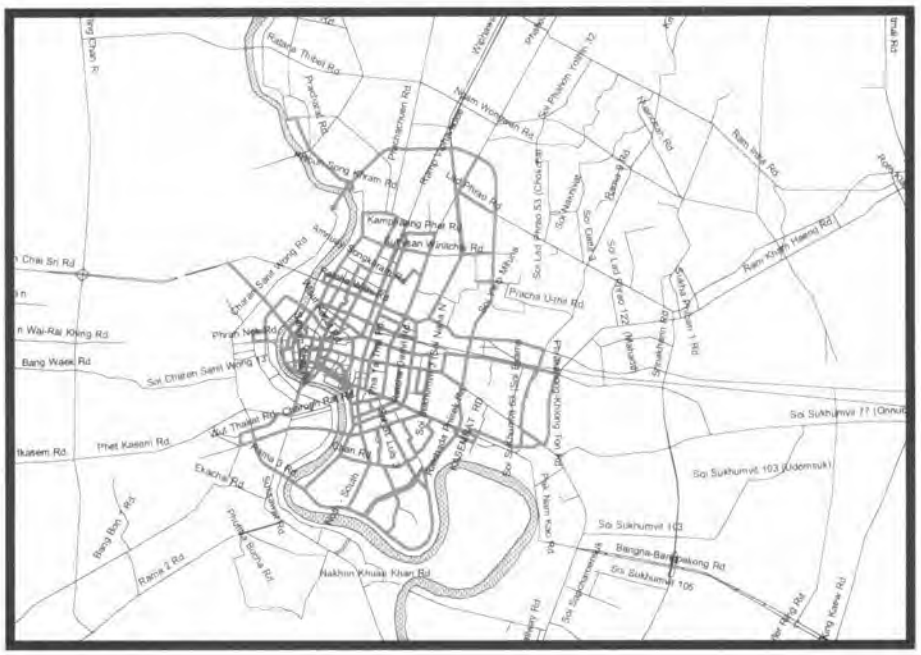

Figure 2 New bus network (Center area)

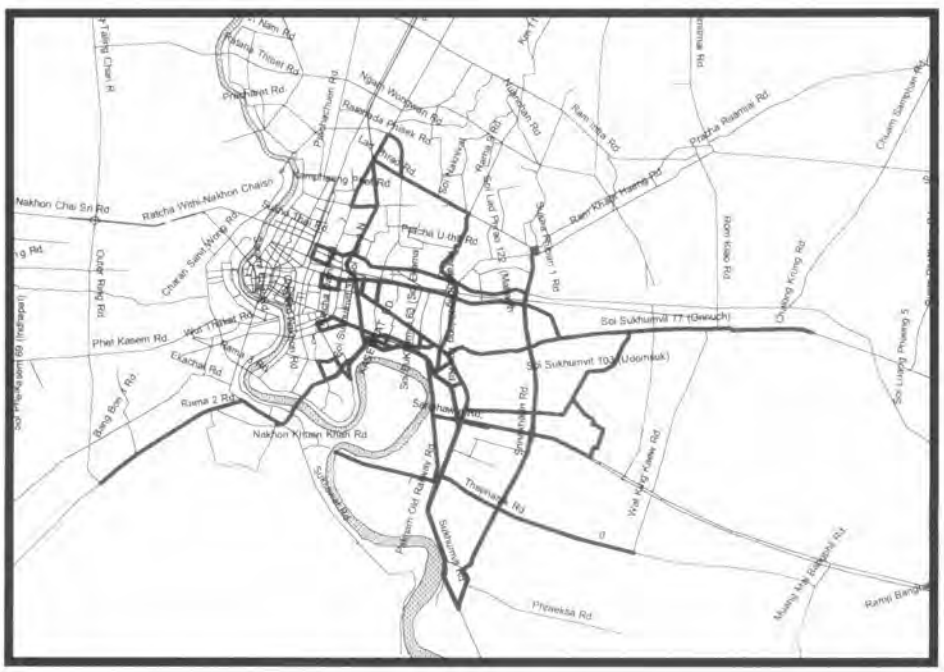

Figure 3 New bus network (Southeast area)

Figure 4 New bus network (Northeast area)

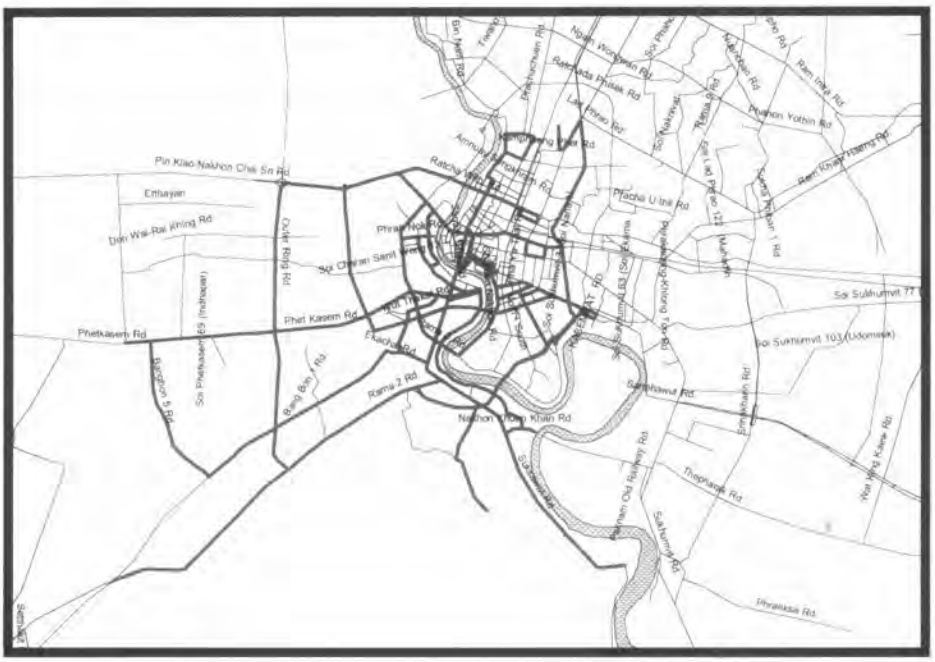

Figure 5 New bus network (West south area)

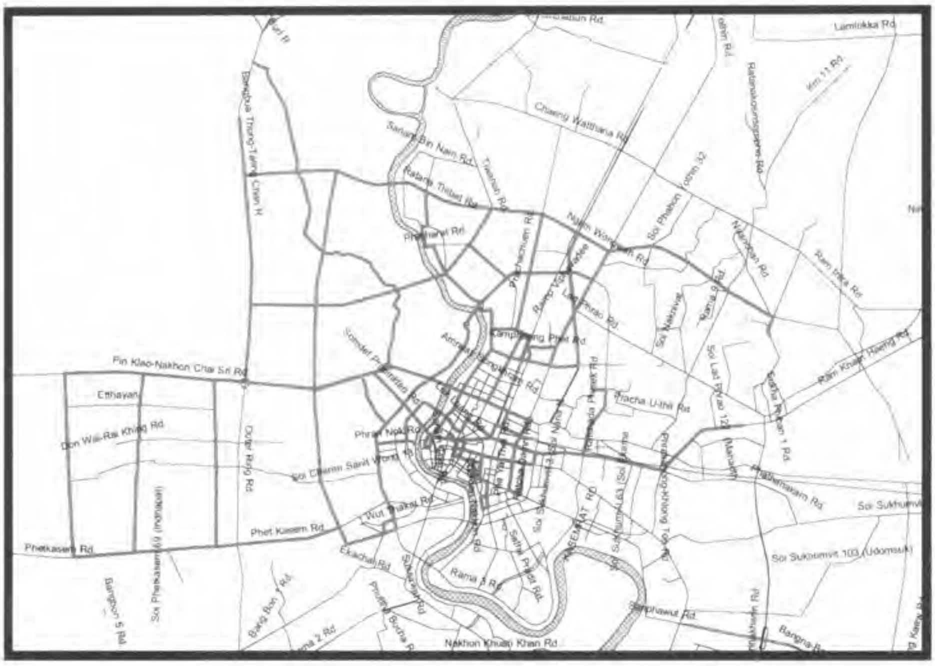

Figure 6 New bus network (North west area)

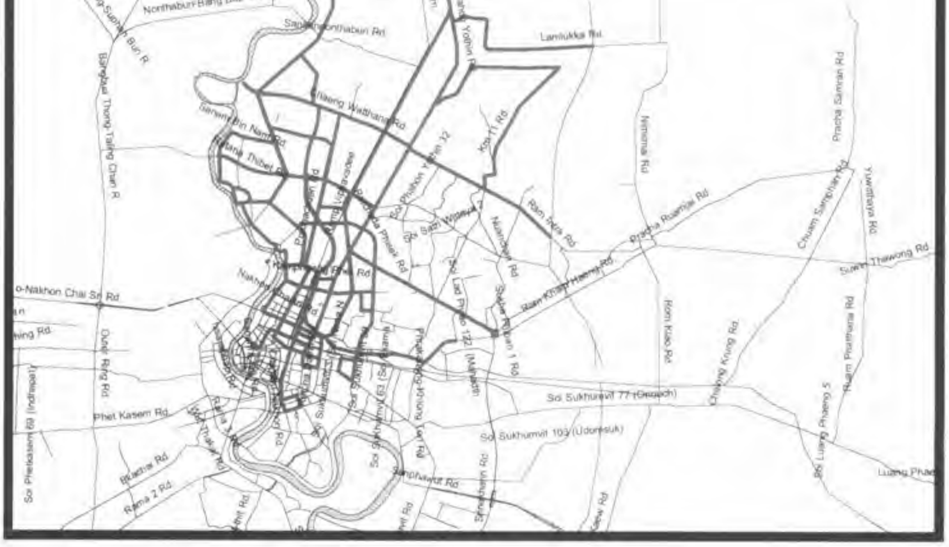

Figure 7 New bus network (North area)

Solution 2: Increasing Mass rapid transit network:

The main concept of increasing mass rapid transit (MRT) network in Bangkok must include area Coverage, Accessibility, and Efficiency in order to be the new alternative transportation mode for people as show in Figure 8.

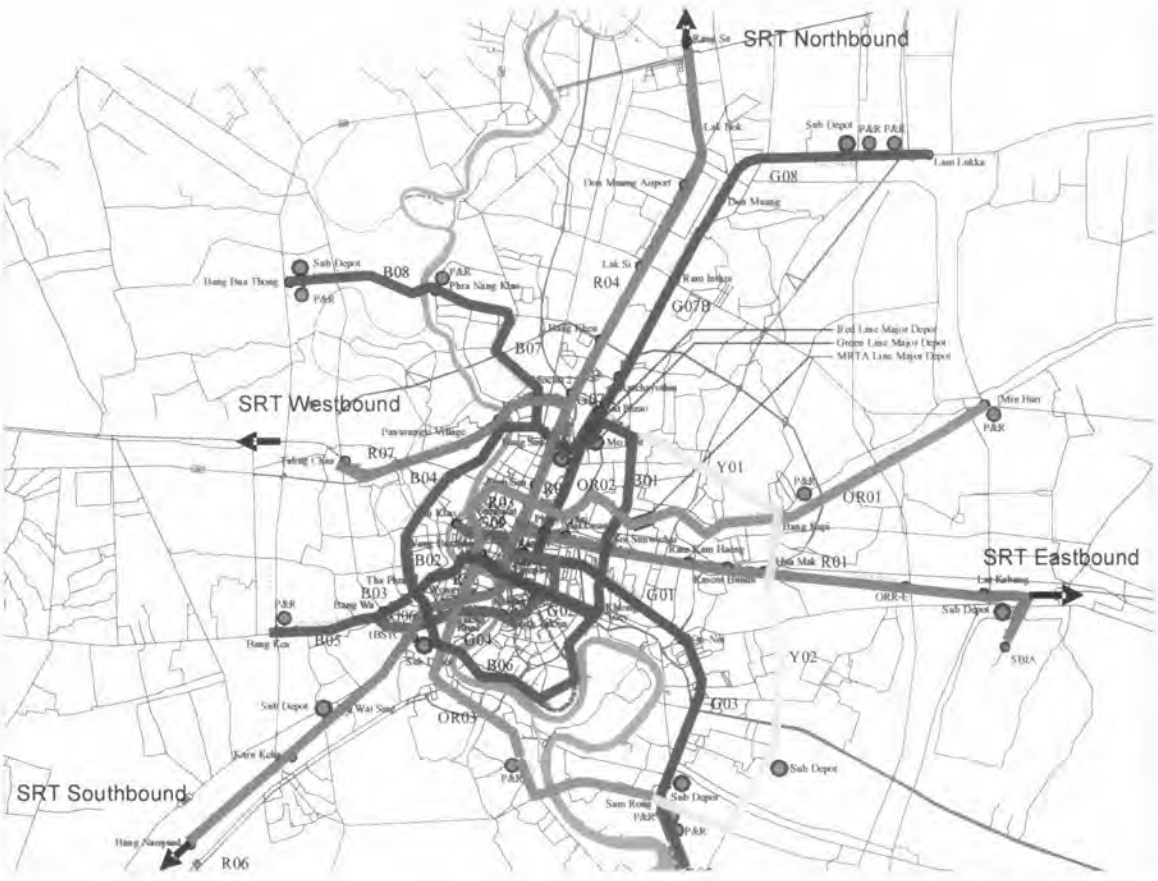

Figure 8 MRT network

The whole network above consisted of Mass Rapid Transit (MRT) project, divided into 7 lines. In the total distance of 291.2 kilometers, 247.5 kilometers were added to the previous routes of 43.7 kilometers. These can be classified, by route patterns, into 3 main categories as shown in picture 3.5, including

1) Circumferential Route: 1 route
    a. Blue line (Ratchada-Jarunsanitwong)
3) North-South Radius Route: 3 routes, including
    b. Red line N-S (Rangsit-Mahachai)

c. Green line N-S (Sapan mai-Bangwa)

d. Purple line (Bangyai-Rajburana)

3) East-West Radius Route: 3 routes, including

e. Red line E-W (Talingchan-Suvarnabhumi)

f. Green line E-W (Prannok-Samutprakan)

g. Orange line (Bangbumru-Bangkapi)

Table 4 Construction for Each Line of Train Sectioning Summary

	Line	Section	Project Owner	Distance (km)
Green 1.1	Light Green	Sukhumvit Line	BMA	9.4
Green 1.2	Light Green	On Nut-Sam Rong	BMA	8.9
Green 1.3	Light Green	Sam Rong-Samut Prakan	BMA	7.9
Green 1.4	Light Green	Rama1-Pran Nok	BMA	6.8
Green 2.1	Dark Green	Silom Line	BMA	14.3
Green 2.2	Dark Green	Mor Chit-Sapan Mai	BMA	12
Green 2.3	Dark Green	Taksin Bridge-Taksin Road	BMA	2.2
Green 2.4	Dark Green	Taksin road-Phetkasem	BMA	4.5
Blue 3.1	Blue	Bang Sue-Hua Lumpong	MRTA	20
Blue 3.2	Blue	Hug Lumpong-Tha Pra	MRTA	6.5
Blue 3.3	Blue	Bang Sue-Tha Pra	MRTA	13.1
Blue 3.4	Blue	Tha Pra-Bang Kae	MRTA	7.7
Purple 4.1	Purple	Bang Sue-Pra Nang Klao	MRTA	11.6

Table 4 (Cont) Construction for Each Line of Train Sectioning Summary

	Line	Section	Project Owner	Distance (km)
Purple 4.2	Purple	Pra Nang Klao-Bang Yai	MRTA	8.1
Purple 4.3	Purple	Bang Sue-Sam Sen	MRTA	4.9
Purple 4.4	Purple	Sam Sen-Raj Burana	MRTA	14.8
Orange 5.1	Orange	Bang Kapi-Sam Sen	MRTA	20
Orange 5.2	Orange	Sam Sen-Bang Bum Ru	MRTA	4
Red 6.1	Red N-S	Bang Sue-Rang Sit	SRT	22.7
Red 6.2	Red N-S	Hua Lampong-Bang Sue	SRT	7.5
Red 6.3	Red N-S	Hua Lampong-BSTC	SRT	6.5
Red 6.4	Red N-S	BSTC-Maha Chai	SRT	28.3
Red 7.1	Red E-W	Phaya Thai-SBIA	SRT	28.5
Red 7.2	Red E-W	Bang Sue-Phaya Thai	SRT	6.1
Red 7.3	Red E-W	Bang Sue-Taling Chan	SRT	14.9

Solution 3: Implementing NGV Bus rapid transit network:

Bus Rapid Transit (BRT) system has been proposed as part of the MRT by selection of these corridors was based on:

- Travel demand (high occupancy corridors),
- Geometric characteristics of roadways,
- The formation of total BRT system networks,
- Other intermodal integration, and
- Amenity and system management issues

According to the above criteria, the proposed BRT network of 9 corridors is shown in Table 5 and Figure 3, respectively.

Table 5 Details of BRT corridors

Route No.	Origin - Destination	Route Length	Connection with Rail Systems (existing and future) and Expressway
1	Taling Chan – Phatthana Kan	26.6	MRT Green line
2	Rang Sit – Din Daeng	27.0	Commuter train – Red line 1st Stage Expressway
3	Min Buri – Samut Prakan (via Srinakharin Rd.)	28.2	MRT Orange line
4	Min Buri – Rama V Rd.	30.5	Commuter train – Red line MRT Blue line MRT Green line
5	Rama II – Wong Wien Yai	14.6	MRT Purple line MRT Green line Commuter train – Red line
6	Western Outer Ring Rd. – Kaset Junction	20.1	MRT Purple line Commuter train – Red line
7	Khlong Prapa – Phitsanu Lok Rd.	27.0	2nd Stage Expressway
8	Phra Samut Chedi – Pracha Thipok	24.6	MRT Purple line MRT Green line Commuter train – Red line
9	Pak Kret – Bang Kapi	28.9	Commuter train – Red line MRT Green line
Total Route Length		**227.5**	

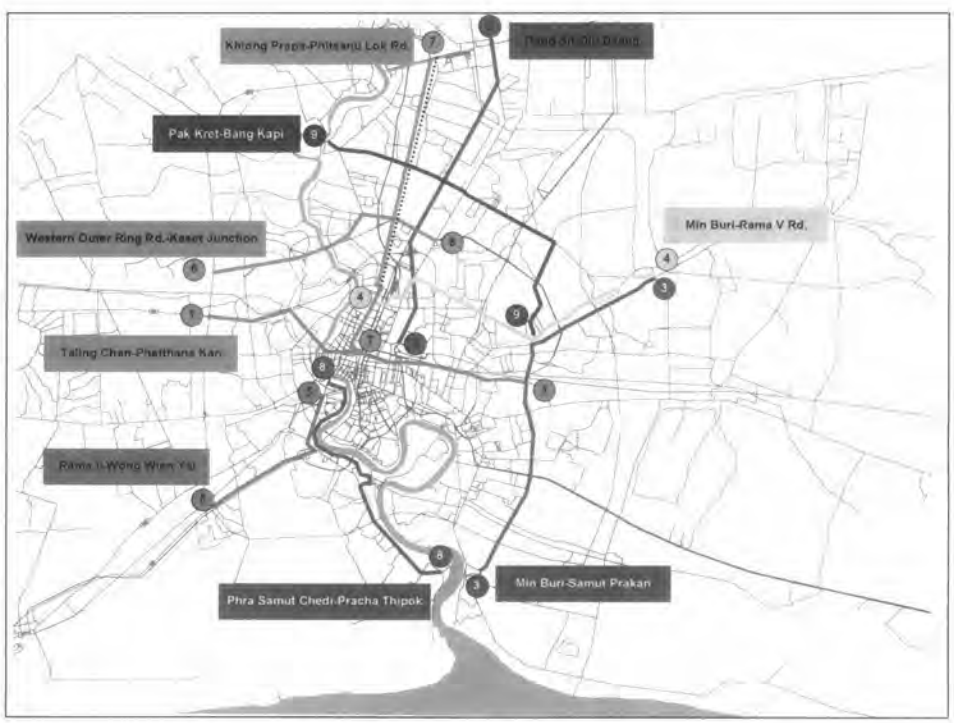

Figure 9 NGV Bus rapid transit network

Solution 4: Improve fare structure of public transport:

The existing fare structure which is not consistent among the various modes viz. Mass rapid transit, air-condition bus service and non-air-conditioned bus service. The Mass rapid transit and air-conditioned public bus service currently used a distance based fare structure while the non-air-conditioned service uses a flat fare structure. It is expected that there will be a flat fare structure in all the modes wherein the Mass rapid transit will have a fare of 30 baht, air-conditioned bus at 15 baht and non-air-conditioned would be 8 baht.

APPENDIX C

EXPERTS & FOCUS GROUP QUESTIONNAIRE

National Research Center for Environmental and Hazardous Waste Management

Expert's Opinions on Air Emissions from Transport Sector in Bangkok Urban City

This questionnaire is a part of the research study of a Ph.D. student at the National Research Center for Environmental and Hazardous Waste Management, Chulalongkorn University. On the mitigate air emissions from transport sector in Bangkok urban city. The results of this study will be use as references to clarify root cause and priority problem of air emissions from transport sector in Bangkok urban city. Your cooperation in answering this questionnaire is greatly appreciated.

Part I: General information of respondent.

1. Gender	☐ Male	☐ Female		
2. Age	☐ 30-39 years	☐ 40-49 years	☐ 50-59 years	☐ More than 60 years
3. Education	☐ Bachelor Degree	☐ Master Degree	☐ Doctor Degree	
4. Occupation	☐ Government Employee	☐ State Enterprise	☐ Private Company Employee	
	☐ Faculty / Program	☐ Other, identify:		
5. Position				
6. Company name				

Part II: Influential criteria for selection of main root cause of air emissions from transport sector.

Example 1 : If you think that criterion 1 is more important than criterion 2 as much as 5 times, the answer is

Criterion 1	9	8	7	6	**5**	4	3	2	1	2	3	4	5	6	7	8	9	Criterion 2

Example 2 : If you think that criterion 2 is more important than criterion 1 as much as 7 times, the answer is

Criterion 1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	**7**	8	9	Criterion 2

Example 3 : If you think that criterion 1 and criterion 2 has the same importance, the answer is

Criterion 1	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Criterion 2

After you understand the process of answering, please answer the following questions;

Table I : Comparison among main root cause of air emissions from transport sector, (Man, Method, Material and Machine).

Criteria																		**Criteria**
Man	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Method
Man	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Material
Man	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Machine
Method	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Material
Method	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Machine
Material	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Machine

Note:

Man: concerned with the people activities cause the air emissions (e.g. lack of driving motive, emotion, inconsistency & careless etc.)

Method: concerned with the methods cause the air emissions (e.g. lack of advanced technology, lack of integrated transport & land use planning, and poor traffic management etc.)

Material: concerned with the materials cause the air emissions (e.g. low or poor quality of fuel, less alternative fuel, poor standard setting etc.)

Machine: concerned with the machines cause the air emissions (e.g. poor maintenance, old engine or model, more fuel consume etc.)

Scale 1 = same importance, 2 = slightly more important, 3 = weekly more important, 4 = weekly to moderately more important, 5 = moderately more important, 6 = moderately to strongly more important, 7 = strongly more important, 8 = greatly more important, 9 = absolutely more important

Part III: Influential criteria and selection of Priority problem or root cause of air emissions from transport sector.

There are eight factors of four criteria and fifteen problems in this questionnaire. To clearly understand each problem, please consider the details of each factor and problem in the table.

Table II : Definition of factors and qualitative criteria.

Criteria	**Factors**	**Indicators**
Man	Knowledge	How much do they have knowledge and training everybody equally?
	Attitude & Emotion	How much do they need to change attitude & emotion?
Method	Implementation	How much do they limit funds and support? How much do they encourage other problems?
	Regulations & Standard	How much do they accept the regulation & standard? How much do they lack of effective plan, operation and enforcement?
Material	Alternatives	How much do they benefit from alternative fuels or energy? How much do they need to change the existing fuels or energy?
	Composition	How much do they lack of the competition and innovation in products?
Machine	Model & Specification	How much do they used in different of model and engine?
	Age	How much do they used in different of age engine?

Example 3 : To evaluate the main criteria of root cause of problems, for example;

- The cause from man of "knowledge and attitude & emotion", an expert may only be able to state that he is 1) 90% sure that its knowledge is extreme importance, 2) 70% absolutely sure that its attitude & emotion is moderate.
- The cause from method of "implementation and regulation& standard", an expert may only be able to state that he is 1) 90% sure that its implementation is extreme importance, 2) 50% sure that its regulation & standard is poor.
- The cause from material of "alternatives and composition", an expert may only be able to state that he is 1) 80% absolutely sure that its alternatives is importance, 2) 60% sure that its composition is indifferent.
- The cause from machine of "model & specification and age of engine", an expert may only be able to state that he is 1) 80% sure that its model & specification is importance, 2) 70% absolutely sure that its age is moderate.

These statements may be expressed using a table such as table III.

Table III : Example Questionnaire of problem or root cause of air emissions from transport sector.

Problems	**Criteria**	**Factors**	**Evaluation Grades**				
			Poor	**Indifferent**	**Moderate**	**Importance**	**Extreme importance**
Problem 1	Man	Knowledge					90
		Attitude & Emotion			70		
	Method	Implementation					90
		Regulations & Standard	50				
	Material	Alternatives				80	
		Composition		60			
	Machine	Model & Specification				80	
		Age of engine			70		

After you understand the process of answering, please answer the following questions;

Table IV : Questionnaire of problem or root cause of air emissions from transport sector.

Problems	Criteria	Factors	Evaluation Grades				
			Poor	Indifferent	Moderate	Importance	Extreme importance
Less strengthen quality monitoring	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Lack of Advanced technology to measure effectiveness	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Lack of integrated transport & land use planning	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Poor public transport	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Weak implementation and commitment to enforce emission standard specification	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					

Table IV : Questionnaire of problem or root cause of air emissions from transport sector. *(Continue)*

Problems	Criteria	Factors	Evaluation Grades				
			Poor	Indifferent	Moderate	Importance	Extreme importance
Weak inspection technology	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Poor vehicle maintenance	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Old engine of Model	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Poor and Low quality to control pollution from engine	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Large engine made more fuel consume	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					

Table IV : Questionnaire of problem or root cause of air emissions from transport sector. *(Continue)*

Problems	Criteria	Factors	Evaluation Grades				
			Poor	Indifferent	Moderate	Importance	Extreme importance
Weak demand management	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Lack of pricing mechanism	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Less alternative fuel	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Poor quality of fuel such as poor standard setting and composition	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Poor pollutant contents reduction of fuel	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					

Table IV : Questionnaire of problem or root cause of air emissions from transport sector. *(Continue)*

Problems	Criteria	Factors	Evaluation Grades				
			Poor	Indifferent	Moderate	Importance	Extreme importance
Low public Awareness and bad attitude	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Inconsistency & careless	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Poor regulation and maintain inventory	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Not sufficient of training	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					
Limited of funding from transport sector for emotion	Man	Knowledge					
		Attitude & Emotion					
	Method	Implementation					
		Regulations & Standard					
	Material	Alternatives					
		Composition					
	Machine	Model & Specification					
		Age of engine					

National Research Center for Environmental and Hazardous Waste Management

Expert's Opinions on Air Pollution prevention from Transport Sector in Bangkok Urban City

This questionnaire is a part of the research study of a Ph.D. student at the National Research Center for Environmental and Hazardous Waste Management, Chulalongkorn University. On the mitigate air pollution prevention from transport sector in Bangkok urban city. The results of this study will be use as references to clarify alternative solutions of air pollution prevention from transport sector in Bangkok urban city. Your cooperation in answering this questionnaire is greatly appreciated.

Part I: General information of respondent.

1. Gender	☐ Male	☐ Female		
2. Age	☐ 30-39 years	☐ 40-49 years	☐ 50-59 years	☐ More than 60 years
3. Education	☐ Bachelor Degree	☐ Master Degree	☐ Doctor Degree	
4. Occupation	☐ Government Employee	☐ State Enterprise	☐ Private Company Employee	
	☐ Faculty / Program	☐ Other, identify:		
5. Position				
6. Company name				

Part II: Influential criteria for selection of alternative solutions for air pollution prevention from transport sector.

Example 1 : If you think that criterion 1 is more important than criterion 2 as much as 5 times, the answer is

Criterion 1	9	8	7	6	**5**	4	3	2	1	2	3	4	5	6	7	8	9	Criterion 2

Example 2 : If you think that criterion 2 is more important than criterion 1 as much as 7 times, the answer is

Criterion 1	9	8	7	6	5	4	3	2	1	2	3	4	5	6	**7**	8	9	Criterion 2

Example 3 : If you think that criterion 1 and criterion 2 has the same importance, the answer is

Criterion 1	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Criterion 2

After you understand the process of answering, please answer the following questions;

Table I: Comparison among main criteria of alternative solutions for air pollution prevention from transport sector, (Environment Impacts, Implement Impacts, Economic Impacts, and People & Public Impacts).

Criteria																		**Criteria**
Environment Impacts	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Implement Impacts
Environment Impacts	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Economic Impacts
Environment Impacts	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	People & Public Impacts
Implement Impacts	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Economic Impacts
Implement Impacts	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	People & Public Impacts
Economic Impacts	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	People & Public Impacts

Note:

Environment Impacts: concerned with the air pollution, (e.g. emission reduction, etc.).
Implement Impacts: concerned with the best practices, (e.g. less barriers to implementation etc.).
Economic Impacts: concerned with the benefit and cost, (e.g. investment cost etc.)
People & Public Impacts: concerned with the affects of people and public, (e.g. stakeholders etc.).
Scale 1 = same importance, 2 = slightly more important, 3 = weekly more important,
4 = weekly to moderately more important, 5 = moderately more important,
6 = moderately to strongly more important, 7 = strongly more important,
8 = greatly more important, 9 = absolutely more important

Part III: Influential criteria and selection of best solutions to air pollution prevention from transport sector.

There are eight factors of four criteria and ..... alternative solutions in this questionnaire. To clearly understand each solution, please consider the details of each factor and solution in the table.

Table II : Definition of factors and qualitative criteria.

Criteria	Factors	Indicators
Environment Impacts	Emission reduction	How much do they reduce the air emission?
	Air quality	How much do they need to have more air quality?
Implement Impacts	Best practices	How much do they possible to implementation? How much do they encourage with the other solutions?
	Barriers to implementation	How much are they politically accepted? How much do they need to change the existing institutional practices?
Economic Impacts	Investment cost	How much do they limit funds and support?
	Break even	How much do they meet break even and when?
People & Public Impacts	Fairness	How much do they treat everybody equally?
	Acceptability	How much do they accept the various of people and stakeholders? How much do they need to change the existing situation?

Example 3 : To evaluate the main criteria of alternative solutions, for example;

- The environment impacts of "emission reduction and air quality", an expert may only be able to state that he is 1) 90% sure that its emission reduction is extreme importance, 2) absolutely sure that its air quality is moderate.
- The Implement Impacts of "best practices and barriers to implementation", an expert may only be able to state that he is 1) 90% sure that its best practices is extreme importance, 2) 50% sure that its barriers to implementation is poor.
- The Economic Impacts of "investment cost and break even", an expert may only be able to state that he is 1) 80% absolutely sure that its investment cost is importance, 2) 60% sure that its break even is indifferent.
- The People & Public Impacts of "fairness and acceptability", an expert may only be able to state that he is 1) 80% sure that its fairness is importance, 2) 70% absolutely sure that its acceptability is moderate.

These statements may be expressed using a table such as table III.

Table III : Example Questionnaire of problem or root cause of air emissions from transport sector.

Alternative Solutions	**Criteria**	**Factors**	**Evaluation Grades**				
			Poor	**Indifferent**	**Moderate**	**Importance**	**Extreme importance**
Solution 1	Environment Impacts	Emission reduction					90
		Air quality			70		
	Implement Impacts	Best practices					90
		Barriers to implementation	50				
	Economic Impacts	Investment cost				80	
		Break even		60			
	People & Public Impacts	Fairness				80	
		Acceptability			70		

After you understand the process of answering, please answer the following questions;

Table IV : Questionnaire of the selection of best solutions to air pollution prevention from transport sector.

Alternative Solutions	Criteria	Factors	Evaluation Grades				
			Poor	Indifferent	Average	Good	Excellent
Solution 1	Environment Impacts	Emission reduction					
		Air quality					
	Implement Impacts	Best practices					
		Barriers to implementation					
	Economic Impacts	Investment cost					
		Break even					
	People & Public Impacts	Fairness					
		Acceptability					
Solution 2	Environment Impacts	Emission reduction					
		Air quality					
	Implement Impacts	Best practices					
		Barriers to implementation					
	Economic Impacts	Investment cost					
		Break even					
	People & Public Impacts	Fairness					
		Acceptability					
Solution 3	Environment Impacts	Emission reduction					
		Air quality					
	Implement Impacts	Best practices					
		Barriers to implementation					
	Economic Impacts	Investment cost					
		Break even					
	People & Public Impacts	Fairness					
		Acceptability					
Solution 4	Environment Impacts	Emission reduction					
		Air quality					
	Implement Impacts	Best practices					
		Barriers to implementation					
	Economic Impacts	Investment cost					
		Break even					
	People & Public Impacts	Fairness					
		Acceptability					
.....	Environment Impacts	Emission reduction					
		Air quality					
	Implement Impacts	Best practices					
		Barriers to implementation					
	Economic Impacts	Investment cost					
		Break even					
	People & Public Impacts	Fairness					
		Acceptability					

No. .....

National Research Center for Environmental and Hazardous Waste Management

Focus group on Air Emissions from Transport Sector in Bangkok Urban City

This questionnaire is a part of the research study of a Ph.D. student at the National Research Center for Environmental and Hazardous Waste Management, Chulalongkorn University. On the mitigate air emissions from transport sector in Bangkok urban city. The results of this study will be use as references to clarify root cause and priority problem of air emissions from transport sector in Bangkok urban city. Your cooperation in answering this questionnaire is greatly appreciated.

Part I: General information of respondent.

1. Gender	☐ Male	☐ Female

2. Age	☐ 30-39 years	☐ 40-49 years	☐ 50-59 years	☐ More than 60 years

3. Education	☐ Bachelor Degree	☐ Master Degree	☐ Doctor Degree

4. Occupation	☐ Government Employee	☐ State Enterprise	☐ Private Company Employee
	☐ Faculty / Program	☐ Other, identify:	

5. Position	

6. Company name	

Part II: Root cause of air emissions from transport sector.

Table I : Questionnaire of man (people) problems of air emissions from transport sector.

Problems		Scale				
		1	2	3	4	5
Man (People)						

Table II : Questionnaire of machine problems of air emissions from transport sector.

Problems		Scale				
		1	2	3	4	5
Machine						

Table III : Questionnaire of material problems of air emissions from transport sector.

Problems		Scale				
		1	2	3	4	5
Material						

Table IV : Questionnaire of method problems of air emissions from transport sector.

Problems		Scale				
		1	2	3	4	5
Method						

APPENDIX D

OUTPUTS OF AHP AND FUZZY ANALYSIS

Outputs from AHP and Fuzzy analysis (Priority Problem).

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Poor public	Man	Knowledge	0.292					0.9
transport	0.041	Attitude & Emotion	0.178			0.7		
	Method	Implementation	0.306				0.8	
	0.270	Regulations & Standard	0.289					0.9
	Material	Alternatives	0.162		0.6			
	0.074	Composition	0.246		0.6			
	Machine	Model & Specification	0.303			0.7		
0.512	0.143	Age of engine	0.427					0.9

C.R. = 0.0812

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Lack of integrated	Man	Knowledge	0.263					0.9
transport & land	0.221	Attitude & Emotion	0.210				0.8	
use planning	Method	Implementation	0.347				0.8	
	0.386	Regulations & Standard	0.325				0.8	
	Material	Alternatives	0.045		0.6			
	0.081	Composition	0.089		0.6			
	Machine	Model & Specification	0.102	0.5				
0.478	0.067	Age of engine	0.132	0.5				

C.R. = 0.0804

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Weak vehicle	Man	Knowledge	0.201			0.7		
inspection and	0.224	Attitude & Emotion	0.145			0.7		
maintenance	Method	Implementation	0.228				0.8	
program	0.125	Regulations & Standard	0.129			0.7		
	Material	Alternatives	0.178		0.6			
	0.027	Composition	0.029		0.6			
	Machine	Model & Specification	0.067	0.5				
0.432	0.103	Age of engine	0.167	0.5				

C.R. = 0.0782

Outputs from AHP and Fuzzy analysis (Priority Problem). Continued

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Poor vehicle maintenance	Man	Knowledge	0.207			0.7		
	0.209	Attitude & Emotion	0.199			0.7		
	Method	Implementation	0.281				0.8	
	0.241	Regulations & Standard	0.164			0.7		
	Material	Alternatives	0.134	0.5				
	0.044	Composition	0.056	0.5				
	Machine	Model & Specification	0.175			0.7		
0.424	0.129	Age of engine	0.186		0.6			

C.R. = 0.0745

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Weak implementation and commitment to enfource emission standard	Man	Knowledge	0.169			0.7		
	0.168	Attitude & Emotion	0.148	0.5				
	Method	Implementation	0.217				0.8	
	0.285	Regulations & Standard	0.209			0.7		
	Material	Alternatives	0.087	0.5				
	0.102	Composition	0.094		0.6			
	Machine	Model & Specification	0.177	0.5				
0.411	0.100	Age of engine	0.193			0.7		

C.R. = 0.0726

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
People have low public awareness and bad attitude	Man	Knowledge	0.255				0.8	
	0.280	Attitude & Emotion	0.224			0.7		
	Method	Implementation	0.178		0.6			
	0.241	Regulations & Standard	0.169				0.8	
	Material	Alternatives	0.085	0.5				
	0.066	Composition	0.103		0.6			
	Machine	Model & Specification	0.074	0.5				
0.402	0.084	Age of engine	0.086		0.6			

C.R. = 0.0701

Outputs from AHP and Fuzzy analysis (Priority Problem). Continued

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Poor and low	Man	Knowledge	0.208		0.6			
quality to control	0.187	Attitude & Emotion	0.198			0.7		
pollution from	Method	Implementation	0.221				0.8	
engine	0.288	Regulations & Standard	0.227				0.8	
	Material	Alternatives	0.169		0.6			
	0.134	Composition	0.164			0.7		
	Machine	Model & Specification	0.057	0.5				
0.401	0.053	Age of engine	0.054	0.5				

C.R. = 0.0661

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Less alternative fuel	Man	Knowledge	0.056	0.5				
for vehicle	0.088	Attitude & Emotion	0.064	0.5				
	Method	Implementation	0.165		0.6			
	0.197	Regulations & Standard	0.168		0.6			
	Material	Alternatives	0.228				0.8	
	0.245	Composition	0.257			0.7		
	Machine	Model & Specification	0.201				0.8	
0.397	0.188	Age of engine	0.187			0.7		

C.R. = 0.0620

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Poor quality of fuel	Man	Knowledge	0.064	0.5				
such as poor	0.061	Attitude & Emotion	0.062	0.5				
standard setting	Method	Implementation	0.188		0.6			
and composition	0.212	Regulations & Standard	0.184			0.7		
	Material	Alternatives	0.212				0.8	
	0.229	Composition	0.200			0.7		
	Machine	Model & Specification	0.192			0.7		
0.395	0.156	Age of engine	0.155		0.6			

C.R. = 0.0523

Outputs from AHP and Fuzzy analysis (Priority Problem). Continued

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Large engine made	Man	Knowledge	0.085		0.6			
more fuel consume	0.098	Attitude & Emotion	0.085	0.5				
	Method	Implementation	0.091	0.5				
	0.086	Regulations & Standard	0.095	0.5				
	Material	Alternatives	0.144		0.6			
	0.187	Composition	0.124		0.6			
	Machine	Model & Specification	0.234				0.8	
0.391	0.211	Age of engine	0.229				0.8	

C.R. = 0.0544

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Weak fuel demand	Man	Knowledge	0.055	0.5				
management	0.055	Attitude & Emotion	0.045	0.5				
	Method	Implementation	0.226				0.8	
	0.087	Regulations & Standard	0.212			0.7		
	Material	Alternatives	0.188			0.7		
	0.267	Composition	0.167			0.7		
	Machine	Model & Specification	0.116		0.6			
0.388	0.152	Age of engine	0.104		0.6			

C.R. = 0.0530

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Poor regulation and	Man	Knowledge	0.066	0.5				
maintain inventory	0.088	Attitude & Emotion	0.072		0.6			
for vehicle driving	Method	Implementation	0.221				0.8	
	0.277	Regulations & Standard	0.183			0.7		
	Material	Alternatives	0.113		0.6			
	0.087	Composition	0.114		0.6			
	Machine	Model & Specification	0.095		0.6			
0.385	0.119	Age of engine	0.097	0.5				

C.R. = 0.0451

Outputs from AHP and Fuzzy analysis (Priority Problem). Continued

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Poor pollutant	Man	Knowledge	0.055	0.5				
contents reduction	0.046	Attitude & Emotion	0.039	0.5				
of fuel	Method	Implementation	0.158		0.6			
	0.167	Regulations & Standard	0.142	0.5				
	Material	Alternatives	0.188			0.7		
	0.241	Composition	0.252				0.8	
	Machine	Model & Specification	0.177		0.6			
0.384	0.185	Age of engine	0.149		0.6			

C.R. = 0.0413

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Old engine of	Man	Knowledge	0.037	0.5				
vehicle model	0.044	Attitude & Emotion	0.039	0.5				
	Method	Implementation	0.199			0.7		
	0.188	Regulations & Standard	0.152		0.6			
	Material	Alternatives	0.054	0.5				
	0.156	Composition	0.063	0.5				
	Machine	Model & Specification	0.212			0.7		
0.380	0.264	Age of engine	0.254				0.8	

C.R. = 0.0404

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Less strengthen	Man	Knowledge	0.052	0.5				
quality monitoring	0.051	Attitude & Emotion	0.044	0.5				
for air emission	Method	Implementation	0.249				0.8	
from vehicle	0.257	Regulations & Standard	0.224			0.7		
	Material	Alternatives	0.062	0.5				
	0.077	Composition	0.046	0.5				
	Machine	Model & Specification	0.103		0.6			
0.342	0.154	Age of engine	0.107		0.6			

C.R. = 0.0389

Outputs from AHP and Fuzzy analysis (Priority Problem). Continued

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Lack of advanced technilogy to measure effectiveness for vehicle inspection	Man	Knowledge	0.216			0.7		
	0.204	Attitude & Emotion	0.204			0.7		
	Method	Implementation	0.261				0.8	
	0.225	Regulations & Standard	0.278				0.8	
	Material	Alternatives	0.146		0.6			
	0.089	Composition	0.114	0.5				
	Machine	Model & Specification	0.082	0.5				
0.339	0.075	Age of engine	0.081	0.5				

C.R. = 0.0375

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
People inconsistency & carelessness	Man	Knowledge	0.199			0.7		
	0.221	Attitude & Emotion	0.241				0.8	
	Method	Implementation	0.183			0.7		
	0.243	Regulations & Standard	0.211				0.8	
	Material	Alternatives	0.186		0.6			
	0.095	Composition	0.177		0.6			
	Machine	Model & Specification	0.165		0.6			
0.321	0.067	Age of engine	0.087	0.5				

C.R. = 0.0372

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Lack of fuel pricing mechanism	Man	Knowledge	0.185			0.7		
	0.116	Attitude & Emotion	0.157		0.6			
	Method	Implementation	0.206				0.8	
	0.249	Regulations & Standard	0.168		0.6			
	Material	Alternatives	0.200				0.8	
	0.202	Composition	0.177		0.6			
	Machine	Model & Specification	0.068	0.5				
0.315	0.064	Age of engine	0.064	0.5				

C.R. = 0.0364

Outputs from AHP and Fuzzy Analysis (Priority Problem). Continued

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Limited of funding	Man	Knowledge	0.162			0.7		
from transport	0.192	Attitude & Emotion	0.161				0.8	
sector for people	Method	Implementation	0.124		0.6			
emotion	0.171	Regulations & Standard	0.115		0.6			
	Material	Alternatives	0.088	0.5				
	0.084	Composition	0.072	0.5				
	Machine	Model & Specification	0.092	0.5				
0.312	0.066	Age of engine	0.063	0.5				

C.R. = 0.0321

Main Problem	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Not sufficiently	Man	Knowledge	0.167			0.7		
trained people	0.177	Attitude & Emotion	0.162		0.6			
	Method	Implementation	0.188			0.7		
	0.165	Regulations & Standard	0.169		0.6			
	Material	Alternatives	0.068	0.5				
	0.088	Composition	0.075	0.5				
	Machine	Model & Specification	0.062	0.5				
0.310	0.054	Age of engine	0.064	0.5				

C.R. = 0.0288

Output from AHP and Fuzzy Analysis (Alternative solutions).

Alternative Solutions	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Implementing NGV	Envi_ImP	Emission reduction	0.436					0.9
bus and rerouting	0.387	Air quality	0.337				0.8	
	Impl_ImP	Best practices	0.325				0.8	
	0.280	Barriers of Implement	0.117				0.8	
	Econ_ImP	Investment cost	0.280			0.7		
	0.235	Break even	0.230			0.7		
	Peop_ImP	Fairness	0.405					0.9
0.551	0.297	Acceptability	0.310			0.7		

C.R. = 0.0764

Alternative Solutions	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Incressing the mass	Envi_ImP	Emission reduction	0.327					0.9
rapid transit	0.302	Air quality	0.261				0.8	
network	Impl_ImP	Best practices	0.204				0.8	
	0.157	Barriers of Implement	0.313			0.7		
	Econ_ImP	Investment cost	0.104		0.6			
	0.056	Break even	0.145	0.5				
	Peop_ImP	Fairness	0.312			0.7		
0.452	0.324	Acceptability	0.335			0.7		

C.R = 0.0712

Alternative Solutions	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Increasing NGV	Envi_ImP	Emission reduction	0.281					0.9
bus rapid transit	0.149	Air quality	0.295				0.8	
network	Impl_ImP	Best practices	0.282			0.7		
	0.221	Barriers of Implement	0.211		0.6			
	Econ_ImP	Investment cost	0.109		0.6			
	0.112	Break even	0.066		0.6			
	Peop_ImP	Fairness	0.298			0.7		
0.347	0.226	Acceptability	0.364			0.7		

C.R. = 0.0704

Output from AHP and Fuzzy Analysis (Alternative solutions). Continued

Alternative Solutions	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Improve fare	Envi_ImP	Emission reduction	0.271				0.8	
structure of public	0.056	Air quality	0.178			0.7		
transport	Impl_ImP	Best practices	0.306			0.7		
	0.289	Barriers of Implement	0.289	0.5				
	Econ_ImP	Investment cost	0.162	0.5				
	0.208	Break even	0.246		0.6			
	Peop_ImP	Fairness	0.303			0.7		
0.309	0.346	Acceptability	0.427				0.8	

C.R. = 0.0691

Alternative Solutions	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Transit frequency	Envi_ImP	Emission reduction	0.125		0.6			
increase	0.128	Air quality	0.134		0.6			
	Impl_ImP	Best practices	0.156			0.7		
	0.226	Barriers of Implement	0.134	0.5				
	Econ_ImP	Investment cost	0.116		0.6			
	0.108	Break even	0.133		0.6			
	Peop_ImP	Fairness	0.238				0.8	
0.304	0.229	Acceptability	0.227			0.7		

C.R. = 0.0542

Alternative Solutions	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Increase feeder	Envi_ImP	Emission reduction	0.125		0.6			
system	0.111	Air quality	0.107		0.6			
	Impl_ImP	Best practices	0.286				0.8	
	0.256	Barriers of Implement	0.249			0.7		
	Econ_ImP	Investment cost	0.142		0.6			
	0.102	Break even	0.143	0.5				
	Peop_ImP	Fairness	0.203		0.6			
0.297	0.287	Acceptability	0.276		0.6			

C.R. = 0.0521

Output from AHP and Fuzzy Analysis (Alternative solutions). Continued

Alternative Solutions	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Promoting use	Envi_ImP	Emission reduction	0.175		0.5			
public transport	0.187	Air quality	0.177	0.5				
	Impl_ImP	Best practices	0.201		0.6			
	0.211	Barriers of Implement	0.237		0.6			
	Econ_ImP	Investment cost	0.046	0.5				
	0.087	Break even	0.083	0.5				
	Peop_ImP	Fairness	0.201				0.8	
0.295	0.224	Acceptability	0.218		0.6			

C.R. = 0.0487

Alternative Solutions	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
With flow bus lane	Envi_ImP	Emission reduction	0.182		0.6			
	0.055	Air quality	0.159		0.6			
	Impl_ImP	Best practices	0.148			0.7		
	0.178	Barriers of Implement	0.117			0.7		
	Econ_ImP	Investment cost	0.116	0.5				
	0.172	Break even	0.182	0.5				
	Peop_ImP	Fairness	0.203		0.6			
0.288	0.211	Acceptability	0.208	0.5				

C.R. = 0.0450

Alternative Solutions	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Contra flow bus	Envi_ImP	Emission reduction	0.173		0.6			
lane	0.052	Air quality	0.146	0.5				
	Impl_ImP	Best practices	0.154			0.7		
	0.188	Barriers of Implement	0.129			0.7		
	Econ_ImP	Investment cost	0.110	0.5				
	0.154	Break even	0.141	0.5				
	Peop_ImP	Fairness	0.207		0.6			
0.276	0.208	Acceptability	0.202	0.5				

C.R. = 0.0403

Output from AHP and Fuzzy Analysis (Alternative solutions). Continued

Alternative Solutions	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Develop more	Envi_ImP	Emission reduction	0.081		0.6			
interchange for	0.102	Air quality	0.112		0.6			
public transport	Impl_ImP	Best practices	0.254			0.7		
	0.214	Barriers of Implement	0.211		0.6			
	Econ_ImP	Investment cost	0.086	0.5				
	0.107	Break even	0.078	0.5				
	Peop_ImP	Fairness	0.216				0.8	
0.275	0.211	Acceptability	0.227		0.6			

C.R. = 0.0390

Alternative Solutions	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Strong enfource	Envi_ImP	Emission reduction	0.056		0.6			
bus lane	0.088	Air quality	0.116		0.6			
	Impl_ImP	Best practices	0.229			0.7		
	0.244	Barriers of Implement	0.227				0.8	
	Econ_ImP	Investment cost	0.154	0.5				
	0.077	Break even	0.143	0.5				
	Peop_ImP	Fairness	0.101	0.5				
0.263	0.165	Acceptability	0.098		0.6			

C.R. = 0.0316

Alternative Solutions	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Adjust tax policy for	Envi_ImP	Emission reduction	0.046	0.5				
public transport	0.052	Air quality	0.044	0.5				
	Impl_ImP	Best practices	0.077	0.5				
	0.089	Barriers of Implement	0.089			0.7		
	Econ_ImP	Investment cost	0.164	0.5				
	0.127	Break even	0.168	0.5				
	Peop_ImP	Fairness	0.228		0.6			
0.262	0.212	Acceptability	0.209				0.8	

C.R. = 0.0302

Output from AHP and Fuzzy Analysis (Alternative solutions). Continued

Alternative Solutions	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Improve public transport parking	Envi_ImP	Emission reduction	0.112	0.5				
	0.087	Air quality	0.098		0.6			
	Impl_ImP	Best practices	0.206				0.8	
	0.219	Barriers of Implement	0.219			0.7		
	Econ_ImP	Investment cost	0.164		0.6			
	0.099	Break even	0.124	0.5				
	Peop_ImP	Fairness	0.152		0.6			
0.261	0.167	Acceptability	0.167		0.6			

C.R. = 0.0277

Alternative Solutions	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
Staff bus service	Envi_ImP	Emission reduction	0.056	0.5				
	0.042	Air quality	0.039	0.5				
	Impl_ImP	Best practices	0.188			0.7		
	0.254	Barriers of Implement	0.228			0.7		
	Econ_ImP	Investment cost	0.154	0.5				
	0.184	Break even	0.255			0.7		
	Peop_ImP	Fairness	0.231			0.7		
0.253	0.144	Acceptability	0.227		0.6			

C.R. = 0.0251

Alternative Solutions	Criteria	Factors		Poor	Indifferent	Moderate	Importance	Extreme importance
School bus service for student	Envi_ImP	Emission reduction	0.046	0.5				
	0.055	Air quality	0.051	0.5				
	Impl_ImP	Best practices	0.206			0.7		
	0.187	Barriers of Implement	0.164	0.5				
	Econ_ImP	Investment cost	0.188		0.6			
	0.077	Break even	0.089	0.5				
	Peop_ImP	Fairness	0.124			0.7		
0.245	0.219	Acceptability	0.122			0.7		

C.R. = 0.0207

BIOGRAPHY

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