GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

DEPARTMENT OF ENVIRONMENT

Emission Inspection of In-use Vehicle in Bangladesh

December 2012

CLEAN AIR AND SUSTAINABLE ENVIRONMENT (CASE) PROJECT

(IDA CREDIT No. 4581-BD)

Table of Contents

Abbreviations and Acronyms

AQ Cell	= Air Quality Cell
Bus (CNG)	= Bus run on CNG
Bus (Diesel)	= Bus run on Diesel
CASE	= Clean Air and Sustainable Environment
CNG	= Compressed Natural Gas
CO	= Carbon Monoxide
CO_2	= Carbon Dioxide
DoE	= Department of Environment
HC	= Hydrocarbon
HSU	= Hartridge Smoke Unit
I&M	= Inspection and maintenance
ppm	= Parts per million
%(v)	= Percent by volume
P/O	= Petrol/Octane
QA/QC	= Quality assurance and quality control
SOP	= Standard Operating Procedure
VES	=Vehicle Emission Standards
VOC	= Volatile Organic Compound
Vol	= Volume
WB	= World Bank

For questions or comments regarding the content of this report, please email to
rksaha@gmail.com OR ranamasud2002@yahoo.com OR ashmahmood07@yahoo.com

Executive Summary

Air pollution is one of the serious concerns of public health in major cities of Bangladesh where vehicle emissions constitute one of the largest sources of air pollution. Improper maintenance of vehicles, lack of enforcement mechanisms for the emission standards and inadequate traffic management resulting in very slow traffic speeds are responsible for high emission from the vehicles. In addition, the number of individual vehicles has grown rapidly due to increase in the disposable incomes and also due to lack of good public transport. Up to June 2012, the total population of registered motorized vehicles in the country stands at 1.75 million.

To reduce air pollution as a result of vehicular emissions, several policy initiatives including revision of emission standards in 2005 for new and in-use vehicles were undertaken by the Government. The current emission standards for new vehicles are equivalent to Euro-II for petrol vehicles and Euro-I for diesel vehicles.

A program has been conducted for collecting in-use vehicle emission data from different cities of Bangladesh to analyze the current status of the in-use vehicles emission levels and propose revisions if necessary. Idle CO and HC emissions from the petrol/CNG vehicles and free acceleration smoke from the diesel vehicles were measured.

The data collected in this program showed that more than 71.7% of petrol/CNG 4- wheeled vehicles had idle CO emissions below the current standard (1% max.) and 93% vehicles comply with the HC emission standards (1200 ppm max.) and both the limits simultaneously are met by approximately 66% vehicles .On the other hand 73.5% of diesel vehicles failed to meet the emission standards (65 HSU max.) as well as 78% of motorcycles do not comply with the present emission standards.

High-level of emissions particularly from the diesel vehicles and motorcycles are taking place due to their low levels of engine technology and due to lack of a robust vehicle emission inspection and maintenance (I&M) program and overall ineffective implementation of the vehicle emission standards. We can meet the in-use emission standards through implementation of an Inspection/Maintenance (I/M) program which is especially needed for diesel vehicles for smoke control.

This program also showed that a lot of CNG operated vehicles are plying in Dhaka city (97% of Auto rickshaws, 96% Cars/Taxis, 81% of Jeeps/ micro-buses/St. Wagons 44% Delivery Vans/mini-trucks and 61% Minibus/Buses). It has been seen to be good for air quality as these are found to emit low CO and HC emissions. It was also observed that from the point of emissions, the vehicles plying in Dhaka are better than Chittagong except the buses/minibuses.

1. Introduction

Mortality and respiratory diseases caused by air pollution are believed to be endemic in major cities of Bangladesh. World Bank (2007) estimated about 15,000 premature deaths due to poor air quality in Dhaka city. Vehicle population during the last 7 to 8 years has grown nearly to 2.5 times due to rapid economic growth resulting in growing needs for goods and personal transportation. Hence, the vehicles would remain to be one of the principal contributors to air pollution in Dhaka.

Though several policy initiatives were undertaken by the Government, however, a lack of compliance and enforcement system hinders efforts for emission reduction from mobile sources. Therefore, it is essential to implement inspection and enforcement program: efforts to encourage and promote compliance, respectively for reducing vehicular emissions.

The current emission standards for the in-service petrol/CNG cars, motorcycles, three wheelers, and diesel vehicles were notified by the Department of Environment in the year of 2005. The in-use vehicle emission inspection limits for the vehicles of different categories and period are given in Table-1 and Table-2.

Table 1- Emission Standards for Petrol and CNG Driven Vehicles Registered before September 1, 2004

Vehicle Type	Test	CO (% by volume)	HC (ppm)
1	2	3	4
4-wheeled petrol vehicles	Idle Speed	4.5	1,200
All CNG driven vehicles	Idle Speed	3.0	-
Petrol driven 2-Stroke engine 2 and 3-wheelers	Idle Speed	7.0	12,000
Petrol driven 4-Stroke 2 and 3-wheelers	Idle Speed	7.0	3,000

Note: Idle Speed RPM to be specified by the manufacturer.

Table 2-Emission Standards for Vehicle Registered after September 1, 2004

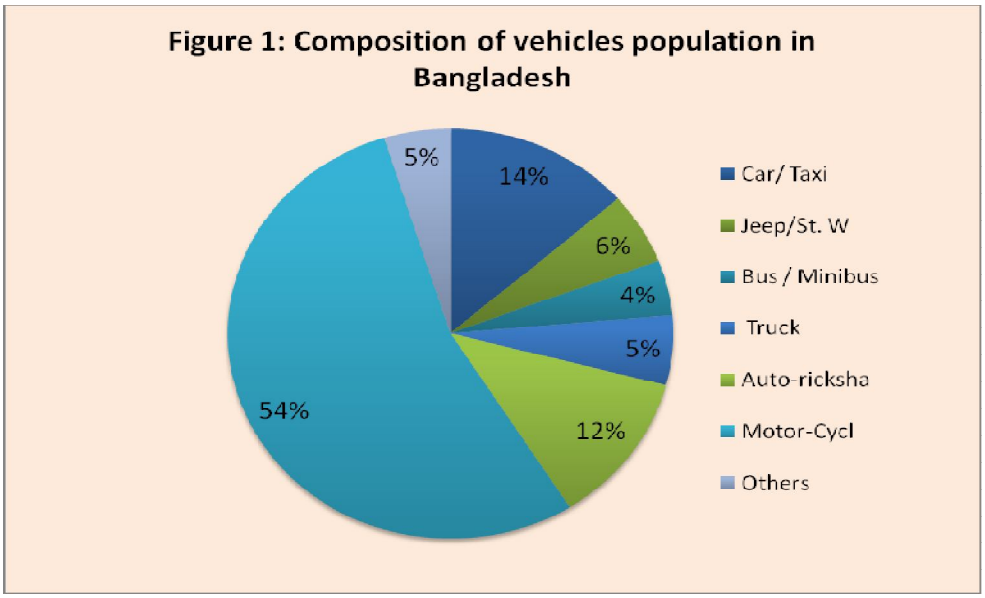
Vehicle Type	Test	CO (% by volume)		Lambda (λ)	Smoke
1	2	3	4	5	6
4-wheeled petrol and CNG vehicles.	Idle Speed	1.0	1200	-	-
	No load, 2500-3000 RPM	0.5	300	1.0 ± 0.03	-
Petrol driven 4-Stroke 2 and 3-wheelers	Idle Speed	4.5	1200	-	-
CNG driven 3-wheelers	Idle Speed	3.0	-	-	-
Naturally aspirated diesel vehicles	Free acceleration	-	-	-	65 HSU or 2.5 m^{-1}
Turbo-charged diesel vehicles	Free acceleration	-	-	-	72 HSU or 3.0 m^{-1}

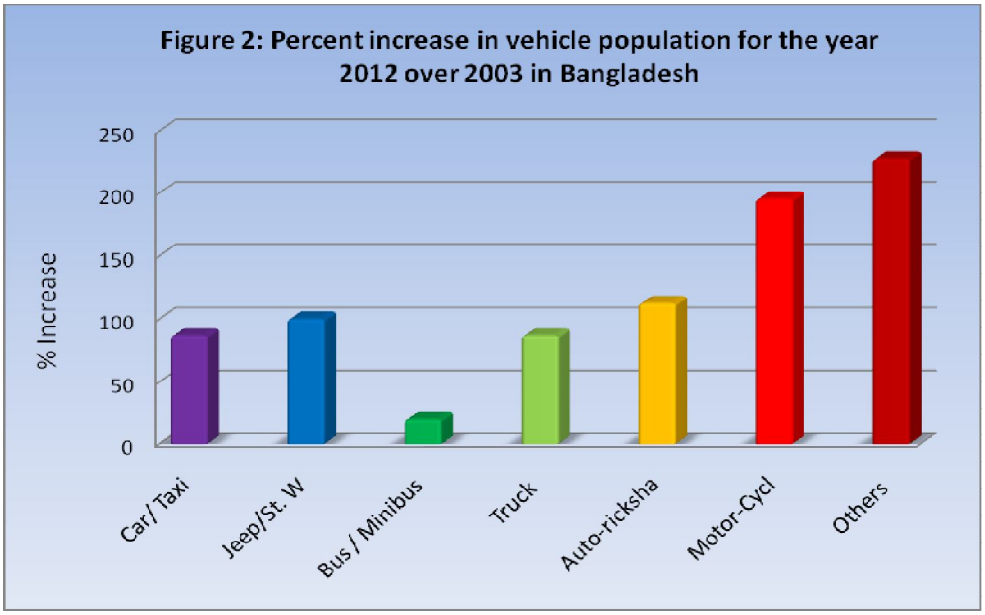
Note: Idle speed rpm to be specified by the vehicle manufacturer.

The Ministry of Environment and Forests with the assistance of the World Bank has undertaken the Clean Air and Sustainable Environment (CASE) project and one the sub-components of this project focuses on strengthening the regulatory framework for vehicular emission control. This emission control program is to be conducted through the introduction of stricter standards, compliance monitoring and strengthened enforcement. For that reason, Enforcement Team of CASE Project has taken an initiative to conduct vehicle emission testing in major cities of Bangladesh viz., Dhaka, Chittagong Cox's Bazar, Rajshahi, Khulna, Jessore, and Kustia.

2. Composition of Vehicles Population and its Growth

The total population of registered motorized vehicles in the country stands at 1.75 millions. The composition of the vehicle population among different categories is shown on Figure-1. The percent increase in the population of different vehicle categories during the period 2003-2012 in Bangladesh is shown on Figure-2. A high growth rate in the number of motorcycles is seen.





3. Vehicular Emissions Inspection Program under CASE Project

3.1 General objective:

The overall objective of roadside emission testing program is to determine vehicle compliance with the in-use vehicle emission standards, and to raise public awareness of the issues concerning vehicular air pollution.

3.2 Specific objectives:

- Obtain basic data on in-use vehicle emissions in some selected cities and make these data publicly available;
- To assess the emission characteristics of in-use vehicle fleet in different cities;
- Identify the major factors that have contributed to high vehicle emissions in these cities.
- To create awareness of the need of regular Inspection & Maintenance of vehicles among the owners;
- To raise public awareness against the mobile air pollution.
- Provide national policymakers and city officials with results and policy implications.

3.3 Methodology and Techniques

In the road side emission testing program, idle CO and HC emissions are measured by exhaust gas analyzer for petrol and CNG vehicles. Carbon dioxide (CO_2) and air-fuel ratio (AFR) were also measured to check the dilution of the exhaust gas by the presence of air in the exhaust system or during sampling.

On the other hand, the parameter measured from diesel engine vehicles was the smoke emission (smoke opacity) under free/snap acceleration test and finally converted to HSU if need.

In this program, we used Horiba Gas Analyzer for petrol and CNG vehicles and Wager smoke meter and Hartridge smoke meter for Diesel vehicles. Light opacity /extinction is the measurement principle of smoke opacity meter and non-dispersive infrared (NDIR) is the measurement principle of exhaust gas analyzer. The emission inspection test is completed in the following phases: a) Test equipment set-up b) Vehicles in warmed-up condition c) Execution of the test and d) Reporting of result.

The routes on which roadside emission inspection is to be carried out should include arterial as well as residential roads and different traffic conditions. However in this study, in Dhaka city we chose arterial and residential roads but for the other cities we selected only main roads where we could get all types of vehicles for testing.

4.0 Results and Emission Data Analysis

4.1 Vehicles Inspected

The project team tested emissions of 1140 vehicles in different cities during the period from March 2011 to July, 2012. The category wise and city wise number of petrol/CNG vehicles tested are given in Table-3 and the diesel vehicles in Table-3

Table-3: Tested - Petrol/CNG Vehicles

Vehicle Type	No of Vehicles tested division-wise (% Pass)				Total Vehicles
	Dhaka	Rajshahi	Khulna	Chittagong	
Passenger Car/ Taxi	113	3	14	23	153
Bus/Mini Bus/Microbus	87	5	3	7	102
Van/Jeep/Pick-up	104	3	3	3	113
Auto-rickshaw	116	1	4	19	140
Motorcycle	124	39	12	21	196
Petrol /CNG	544 (73%)	51(33%)	36(39 %)	73(60%)	704 (67%)

Table-4: Tested - Diesel Vehicles

Vehicle Type	No of Vehicles tested division-wise (% Pass)				Total Vehicles
	Dhaka	Rajshahi	Khulna	Chittagong	
Bus and Mini bus	64	54	20	19	
Truck	52	33	34	23	
Light duty vehicles	100	16	18	3	
Total diesel vehicles	216 (32%)	103 (19%)	72 (32%)	45 (22%)	436(28%)

All the inspections were conducted with the assistance of Traffic Police and DoE personnel. Magistrate/Police officer also fined whenever any vehicle did not meet the standards. Results of this study are expected to give data that may be used for design of a realistic plan for emission reduction strategy and to revise the current in-use vehicular emission standards.

4.2 Categorization of Vehicles in Dhaka by Fuel Used

In this study, DoE/CASE team has collected data on the fuel type used by the vehicles inspected. Bangladesh Road Transport Authority (BRTA) at present does not maintain vehicle registration records according to fuel used. The data collected is summarized in Table-5 for Dhaka City only as for the other cities the number of vehicles tested are not very high.

Table 5- Categorization of Vehicles in Dhaka by Fuel Type Used

Sl. No.	Vehicle Type	Total number tested	Fuel wise vehicle numbers tested			% vehicles as per fuel used		
			CNG	Petrol	Diesel	CNG	Petrol	Diesel
2	Auto rickshaws	116	112	4	-	97	3	0
3	Cars/Taxis	113	108	5	-	96	4	0
4	Jeeps/micro-uses/St. Wagons	58	47	2	9	81	3	16
5	Delivery Van/mini-truck	188	83	2	103	44	1	55
6	Minibus/Buses	92	56	-	36	61	-	39

As the vehicles were inspected randomly, the fuel wise distribution of the vehicle population in Dhaka may be assumed in the same proportions. As expected all the motorcycles operate on petrol.

More than 96 % cars and three wheelers and 81% jeeps/microbus presently use CNG due to its lower price than petrol. CNG fuelled commercial vehicles like delivery vans and small size goods carriers/mini- trucks, accounted for 44% and the CNG fueled minibuses and buses numbered 61%, the balance being diesel operated.

4.3. Emissions from Petrol/CNG Vehicles

4.3.1. Passenger Cars and other 4-Wheeled Light Duty Vehicles

4.3.1.1 Idle CO Emissions:

The frequency distribution of CO emissions from petrol/CNG cars and other 4-wheelers is presented in Figure 3 and cumulative distribution in Fig. 4. About 73.1% of the petrol and CNG cars, taxis and other light duty vehicles gave idle CO emissions ≤ 1.0 % and 66% vehicles ≤0.5% . Post 2004 vehicles as a group were observed to give generally lower CO than the older vehicles. However, the correlation between the idle CO emissions and vehicle registration year presented in Fig. 5 is seen to be very poor ($R^2 = 0.001$)

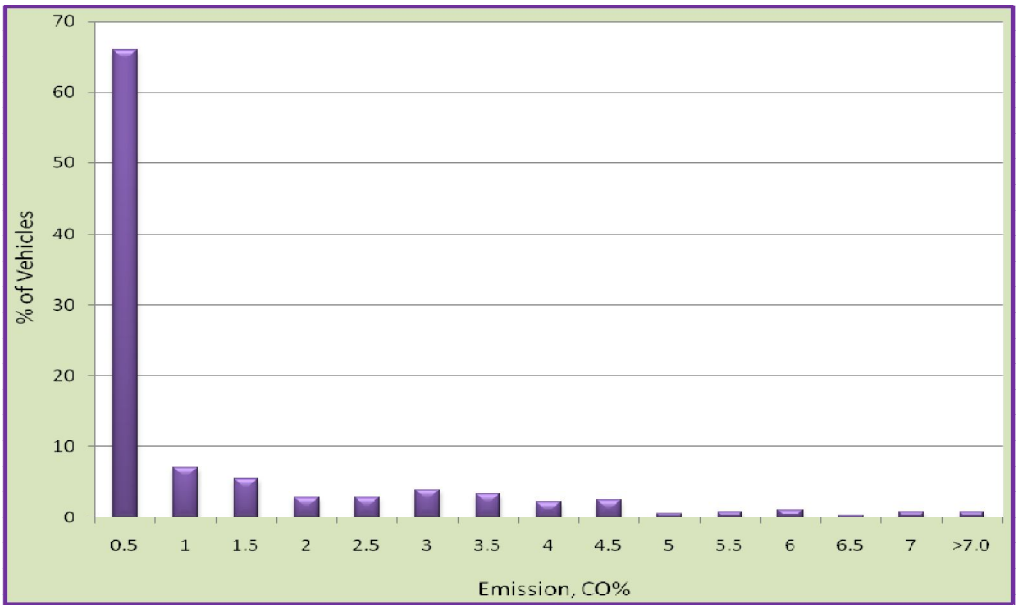


Figure 3: Frequency Distribution of CO% for 4-Wheeler Petrol/CNG Vehicles

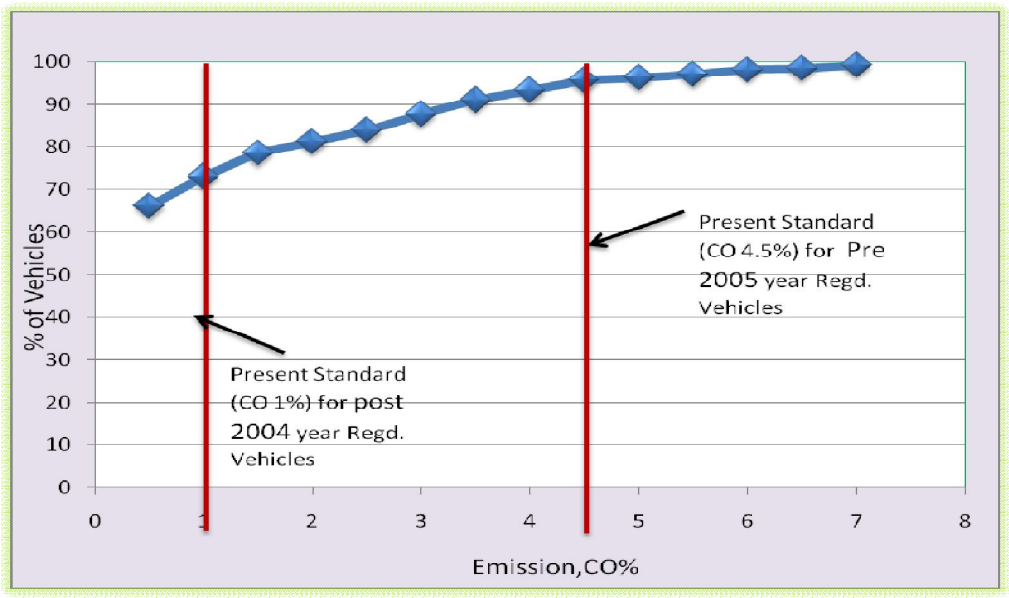


Figure 4: Cumulative Distribution of CO(%) for 4-Wheeler Petrol/CNG Vehicles

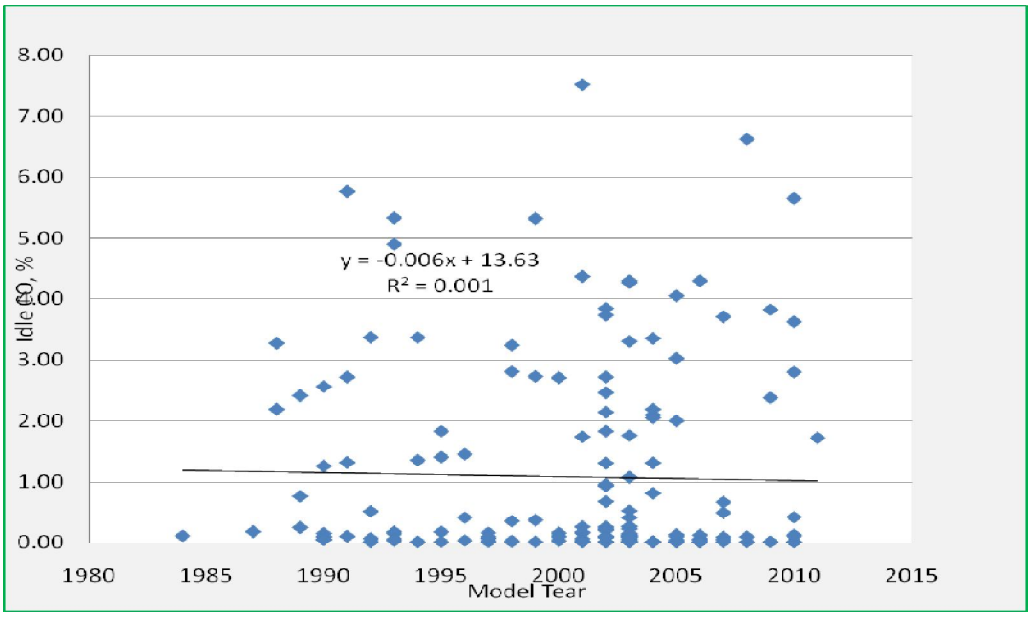


Figure 5: Idle CO % vs model year of manufacturer for petrol cars and light duty vehicles

4.3.1.2 Idle HC Emissions:

The frequency and cumulative distribution of idle HC emissions from the cars and other light duty vehicles are presented in Figures 6 and 7, respectively. About 75% cars/taxis and light duty vehicles had idle HC emissions ≤ 600 PPM, more than 82% vehicles ≤ 800 PPM and more than 89% vehicles ≤ 1200 PPM (Figure- 7). Again, a very poor correlation between the vehicle registration year and idle HC emissions was observed with correlation coefficient R^2 being 0.01.

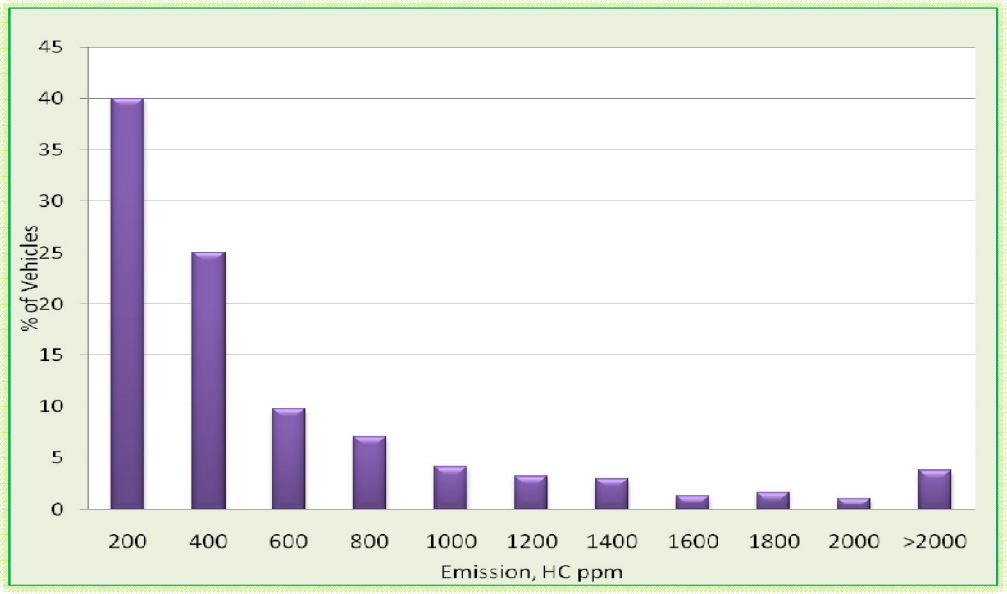


Figure 6: Frequency Distribution of HC (ppm) for 4-Wheeler Petrol/CNG Vehicles

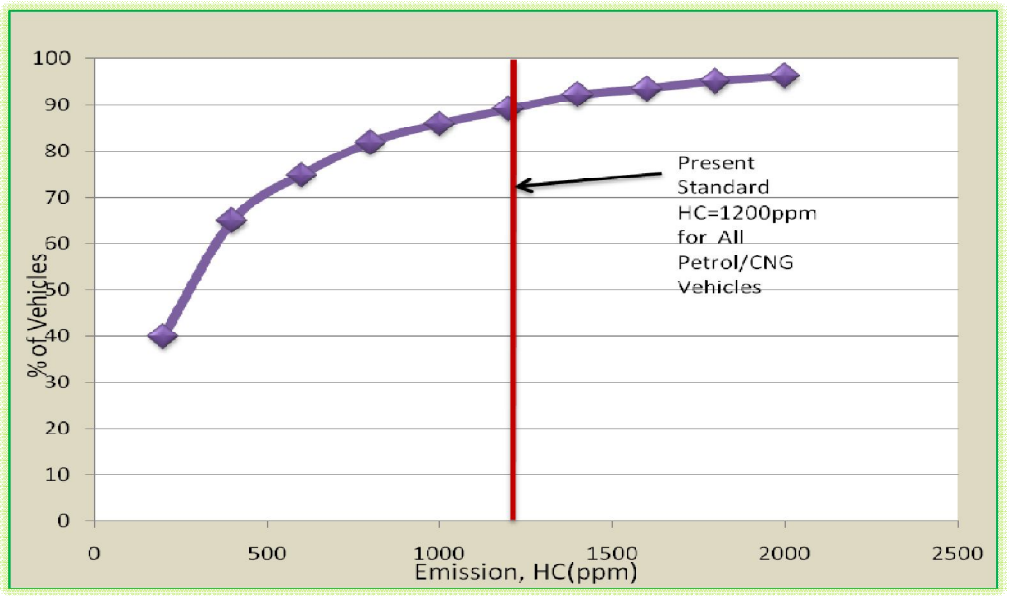


Figure 7: Cumulative Distribution of Emission HC (ppm) for 4-Wheeler Petrol/CNG Vehicles

4.3.1.3 Idle CO and HC Emissions

In-use vehicle emissions standard for 4-wheeler Petrol/CNG vehicles is divided in two categories: before and after September 2004 year of registration. Results for both the CO and HC emissions are presented on Figure- 8. It shows that about 87% 4-wheeled petrol/CNG vehicles can meet the Pre 2005 year registered vehicles emission standard and 65% showed compliance with the post 2005 year registered vehicles emission standards. If the limits are lowered to 0.5% CO and 1200 ppm HC about 57% vehicles meet this emission level.

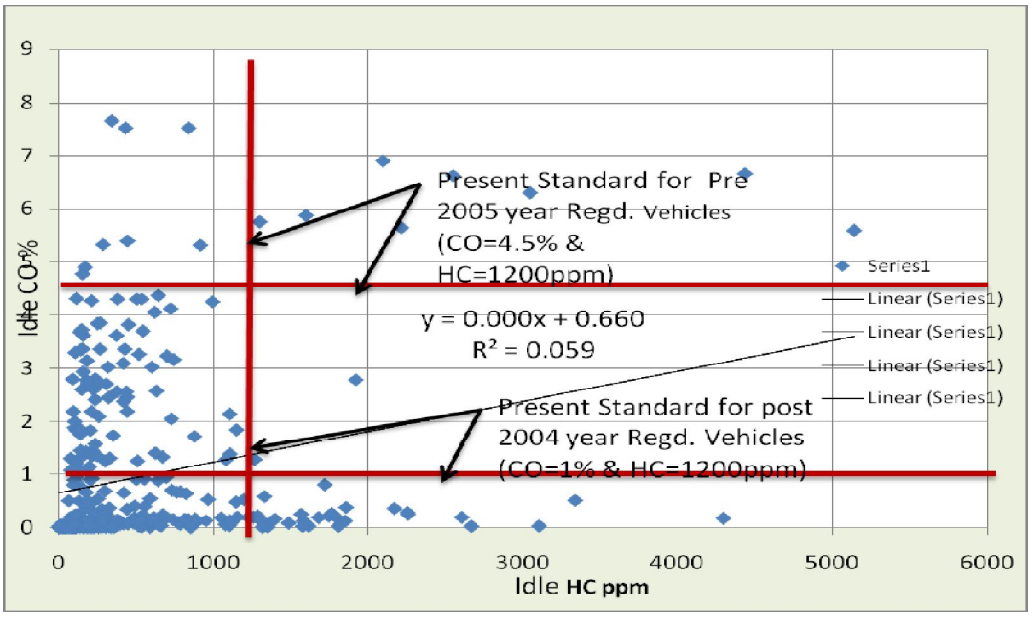


Figure 8: Correlation of CO% Vs HC ppm for 4-Wheeler Petrol/CNG Vehicles

The average of CO% after 2004 year of registration is 0.97% and for HC is 399 ppm. On the other hand, the average of CO% for cars registered before 2004 is 0.99% (vol) and for HC is 574ppm. In addition, only 5.7% more post 2004 vehicles (70.7%) meet the standards compared to 65% of all the vehicles.

4.3.2. Motorcycles

4.3.2.1 Idle CO Emissions

Out of 196 motorcycles tested only 11 were powered by 2-stroke engines since after the year 2004 import of the 2-stroke motor cycles was banned. The results on idle CO emissions from motorcycles are presented in Figs. 9 and 10. Motor cycles are high emitters of CO as only about 36% gave CO below 4.5% and only 27% were below 3.0% (Figure -10). Similar to cars, the correlation between the CO emissions and vehicle registration year obtained through linear regression of the data was very poor with correlation coefficient, R2 = 0.002 (Figure-11). At the survey time it was found that even some new motor cycles failed to meet the standards.

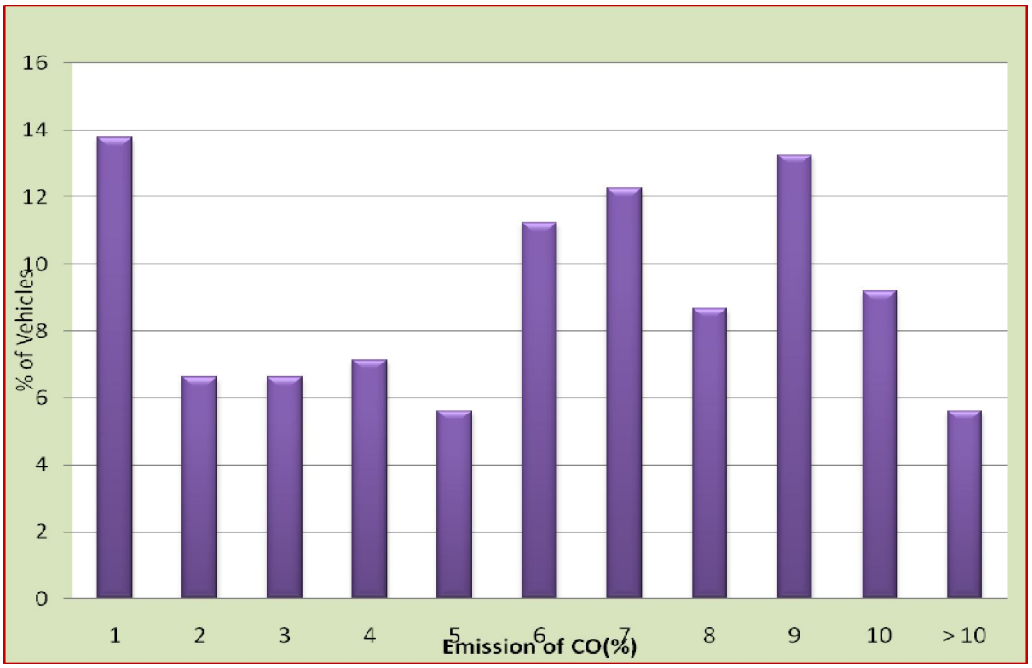


Figure 9: Frequency Distribution of CO (%) for Motorcycles

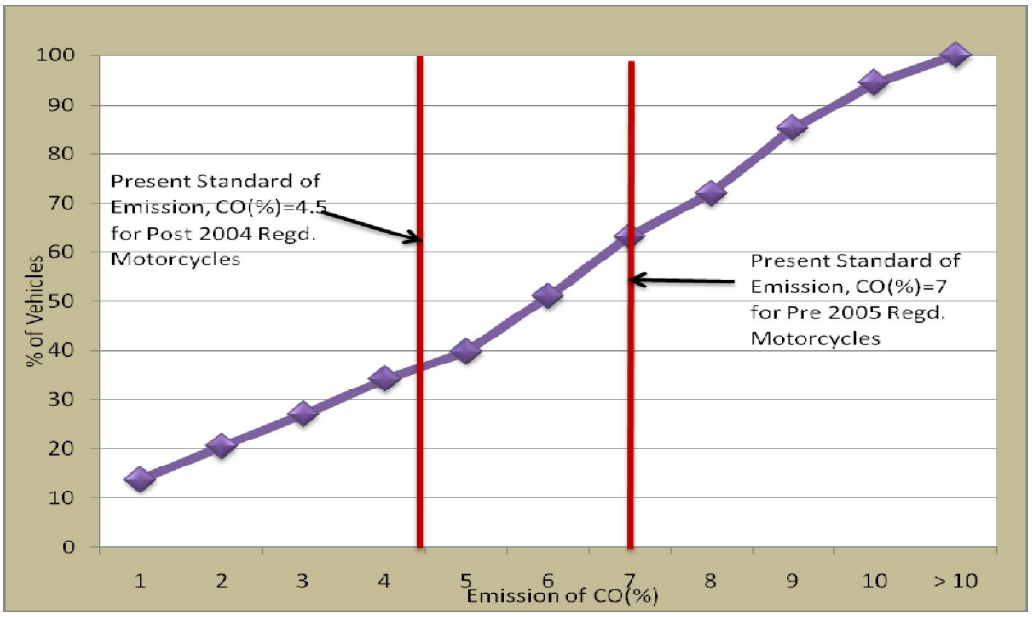


Figure 10: Cumulative Frequency Distribution of Emission, CO (%) for Motorcycles

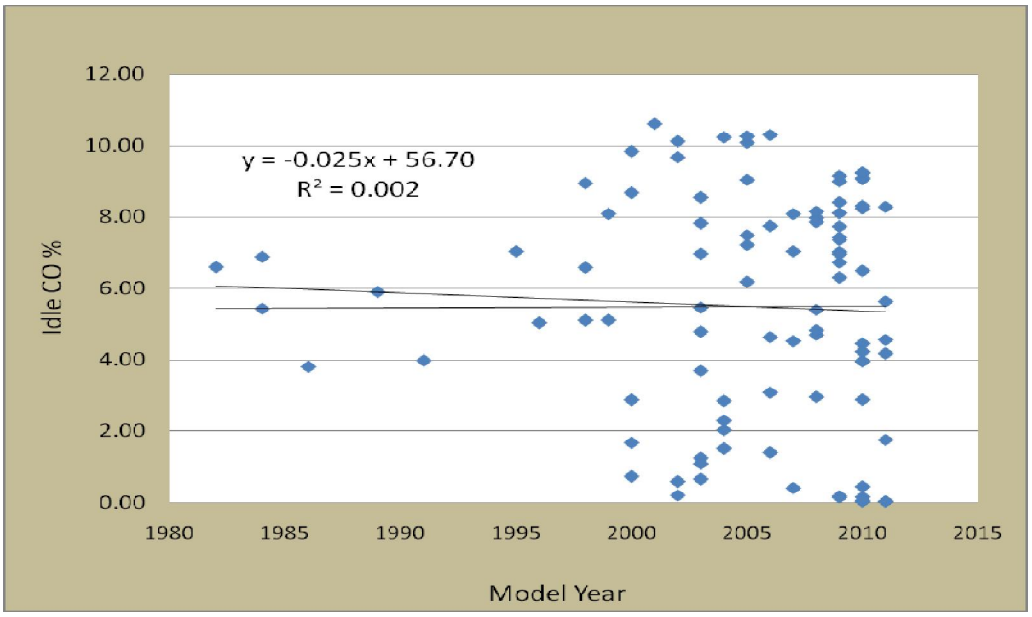


Figure 11: Idle CO % vs model year of manufacturer for petrol cars and light duty vehicles

4.3.2.2 Idle HC Emissions

The motorcycles gave higher idle HC compared to cars. Only about 27% of motorcycles had HC less than 1200 PPM and 57% less than 3000 PPM (Figure-13). 1200 ppm HC limit is the emission standards for motorcycles registered after September 1, 2004.

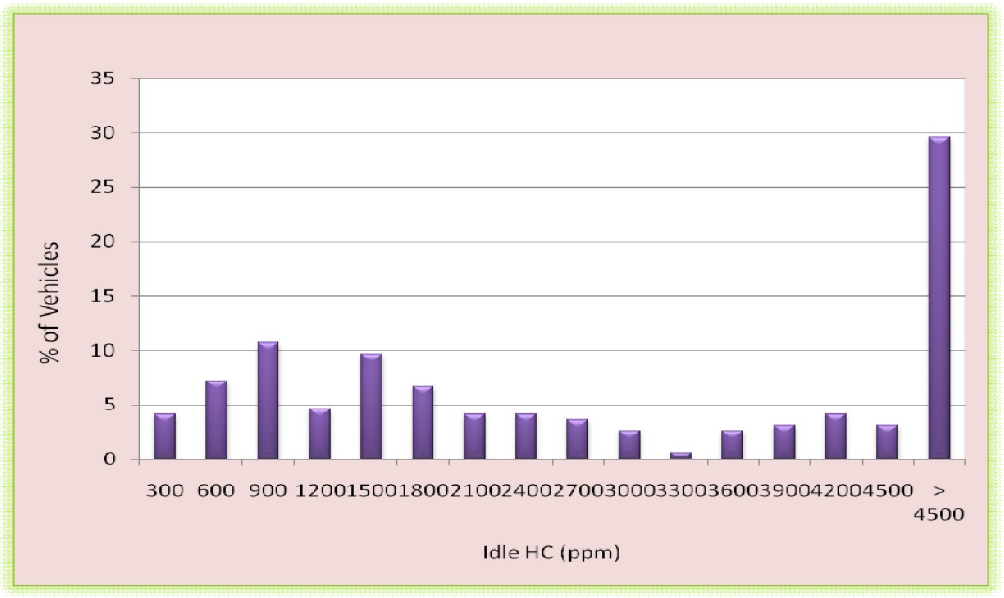


Figure 12: Frequency Distribution of HC (ppm) for Motorcycles

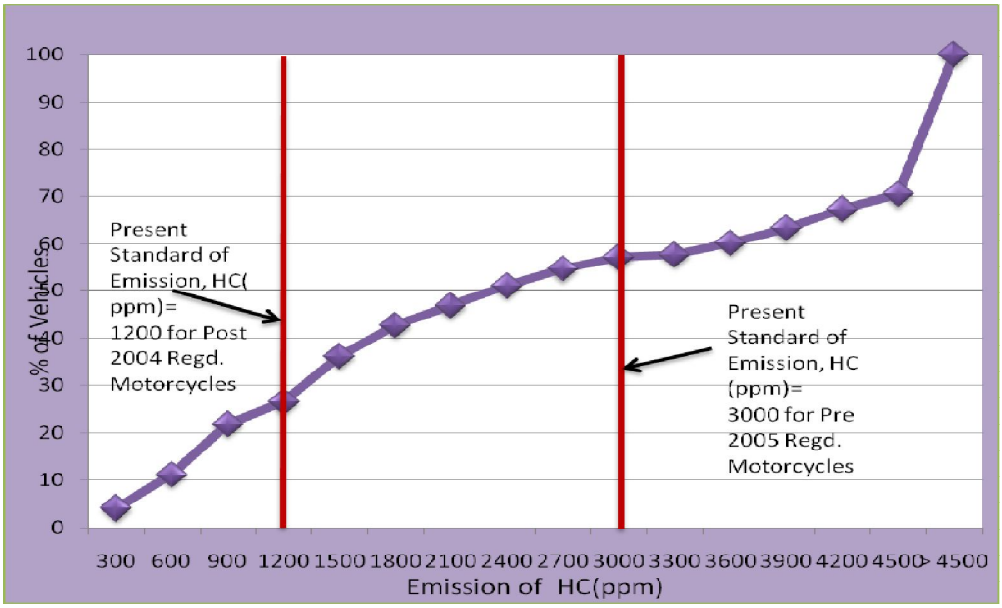


Figure 13: Cumulative Frequency Distribution of Emission, HC (ppm) for Motorcycles

4.3.2.3 Idle CO and HC Emissions

In-use 4-stroke motorcycle emissions standard is divided in two categories: before and after September 2004 year of registration. Results for both the CO and HC emissions are presented on Figure- 14. It is seen that only about 37% motorcycle meet the Pre 2005 year registered vehicles emission standard and only 19% showed compliance with the post 2005 year registered vehicles emission standards.

The average of CO% after 2004 year of registration is 5.5% and for HC is 2973 ppm. On the other hand, the average of CO% for Motorcycles registered before 2004 is 5.31% (vol) and for HC is 7590ppm.

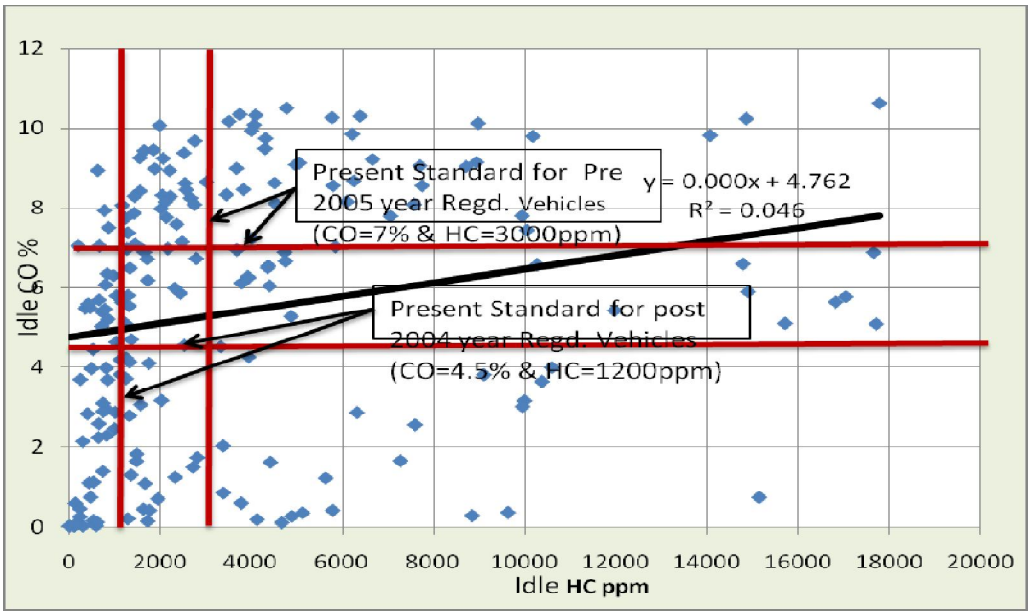


Figure 14: CO% versus HC ppm for Motorcycles

4.3.3 Auto-rickshaws

4.3.3.1 Idle CO Emissions

For CNG auto-rickshaw only idle CO limits are stipulated. However, for the petrol 3-wheelers which are very few in numbers in Dhaka both the CO and HC limits apply. The idle CO results for auto-rickshaws are presented in Figs. 15 and 16.

The CNG powered auto-rickshaws are very low emitters of CO. Almost 95.2% tested in this program had CO less than 0.5 % and 96.5% equal to or lower than 1.0%. When compared to the present standards which are 3% vol for CO then it showed all of 100% vehicles met the limit (Figure-16). A few vehicles operating on petrol were found to be very high emitters of CO.

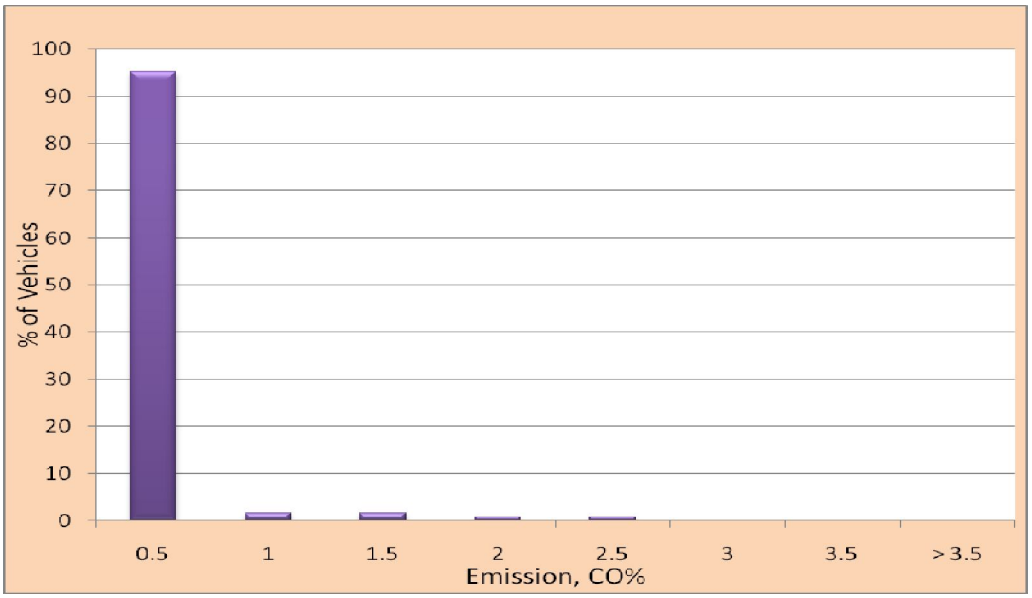


Figure 15: Frequency Distribution of CO% from 3-Wheeler Auto-rickshaw

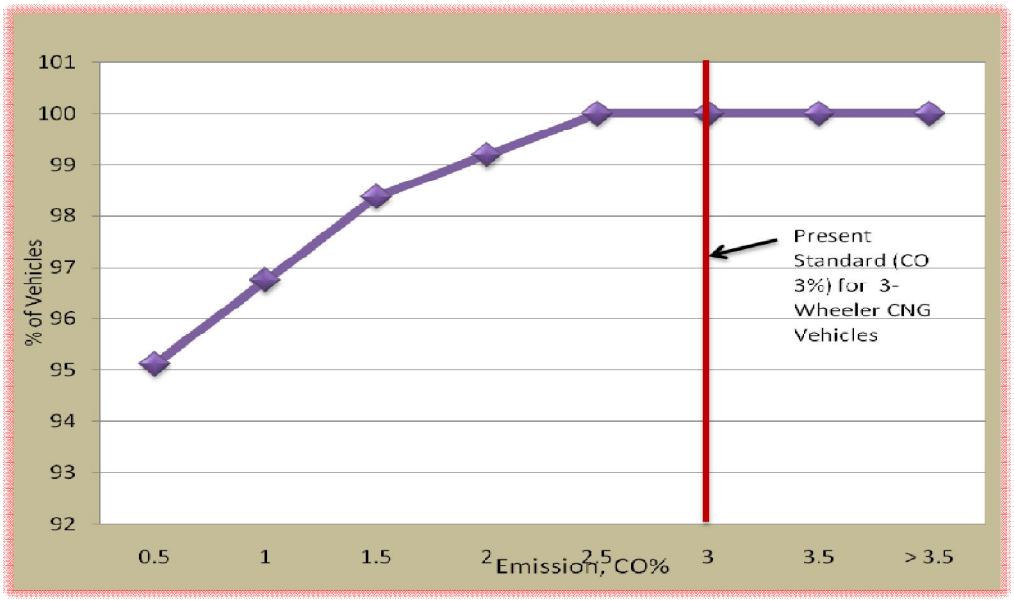


Figure 16: Cumulative Frequency Distribution of CO% from CNG 3-Wheeler Auto-Rickshaw

4.3.3.1 Idle HC Emissions

The idle HC emissions from the CNG auto-rickshaws are presented in Figs.16 and 17. CNG operated three wheelers are expected gave low HC emissions, 56 % falling below 600 PPM and 71% below 1200 PPM (Figure-17). Only about 15% CNG auto rickshaw are above 2000ppm HC. As mentioned before, at present there is no standard for HC for the CNG operated three wheelers.

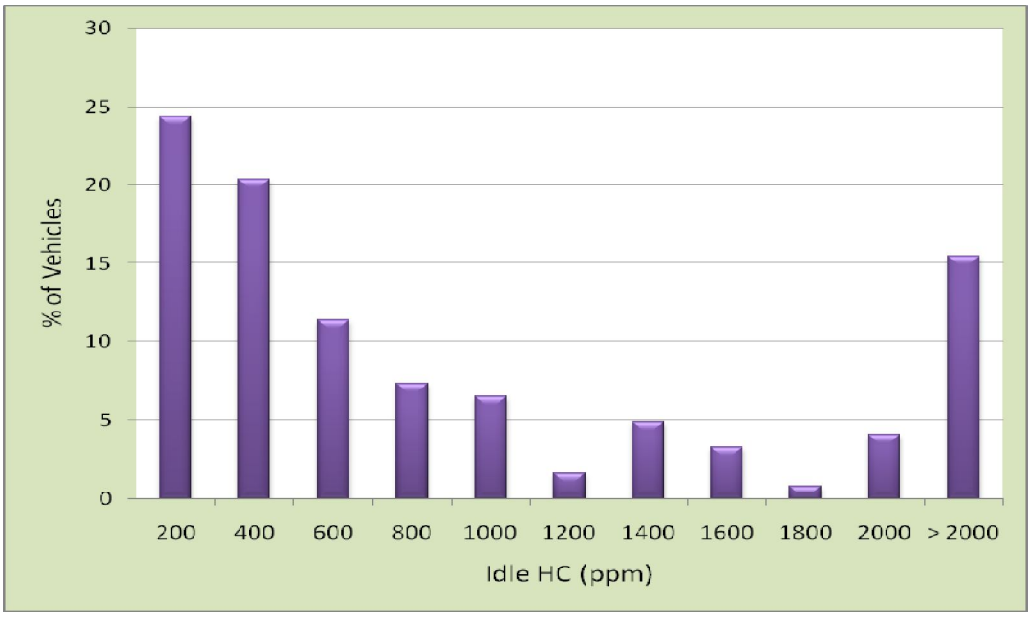


Figure 17: Frequency Distribution of Emission, HC (ppm) from CNG 3-Wheeler Auto-rickshaw

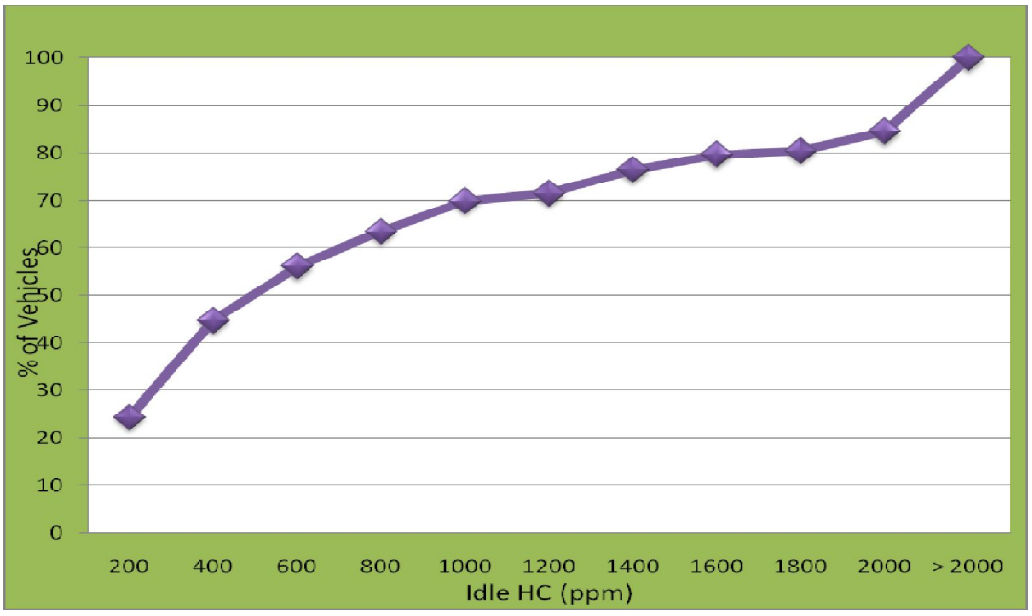


Figure 18: Cumulative Frequency Distribution of HC (ppm) from CNG 3-W Auto-rickshaw

4.3.4 Comparison of Emissions from Different Vehicle Types

The average CO and HC emissions from the different category vehicles are presented in Figs. 18 and 19. Among all the Petrol/CNG vehicles, the average percentage of CO and HC of Taxis (all CNG operated) is the lowest and motorcycle (all petrol operated) is the highest (Figure-18 and 19).

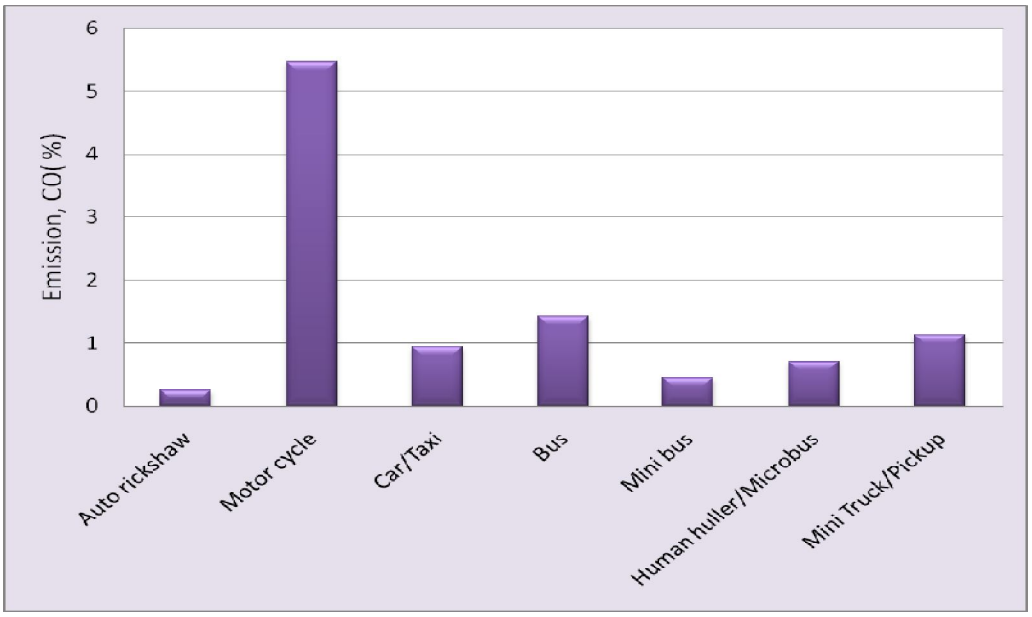


Figure 19: Average CO Emission from different Types of Petrol/CNG Vehicles

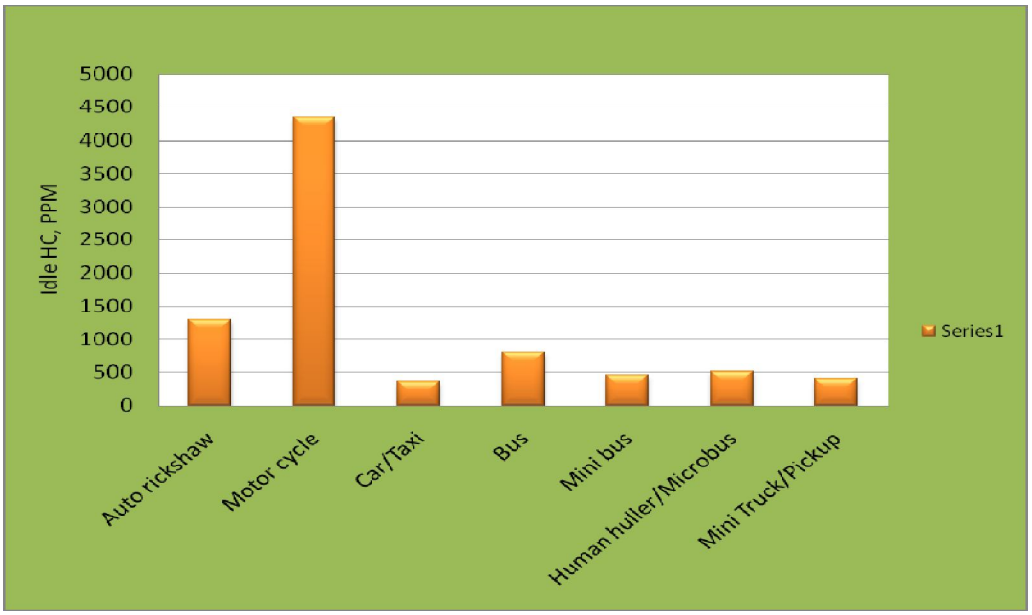


Figure 20: Average HC Emission of different Types of Petrol/CNG Vehicles

4.4 Diesel Smoke Emissions:

Free acceleration smoke from the different diesel vehicle types are presented in Figs. 20 and 21. It is observed that only 26% diesel vehicles gave free acceleration smoke lower than 65 HSU, 29 % lower than 75 HSU and only 31 % were below 80 USU.. The average smoke emission levels of different types of diesel vehicles are compared in Figure-22. The comparison shows the that human haullers are the highest smoke emitters.

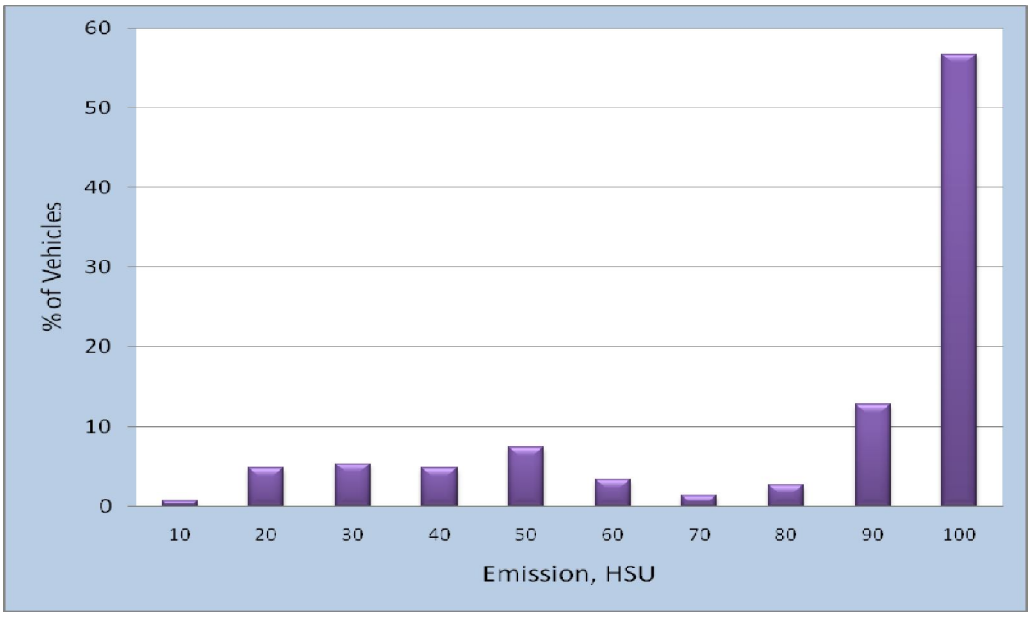


Figure 21: Frequency Distribution of Smoke Opacity of Diesel Vehicles, HSU

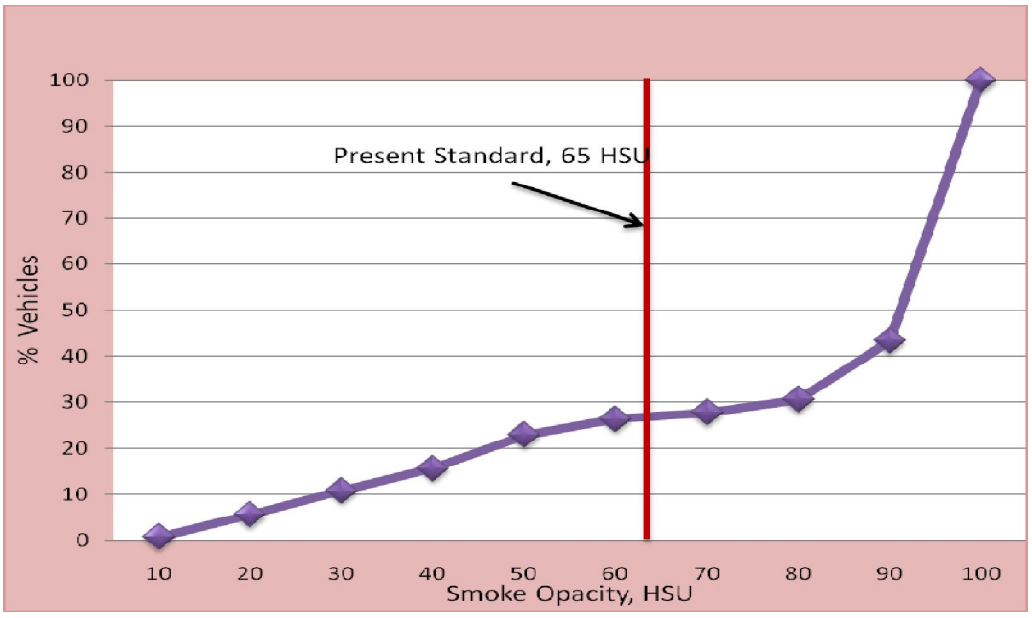


Figure 22: Cumulative Frequency Distribution of Smoke Opacity of Diesel Vehicles, HSU

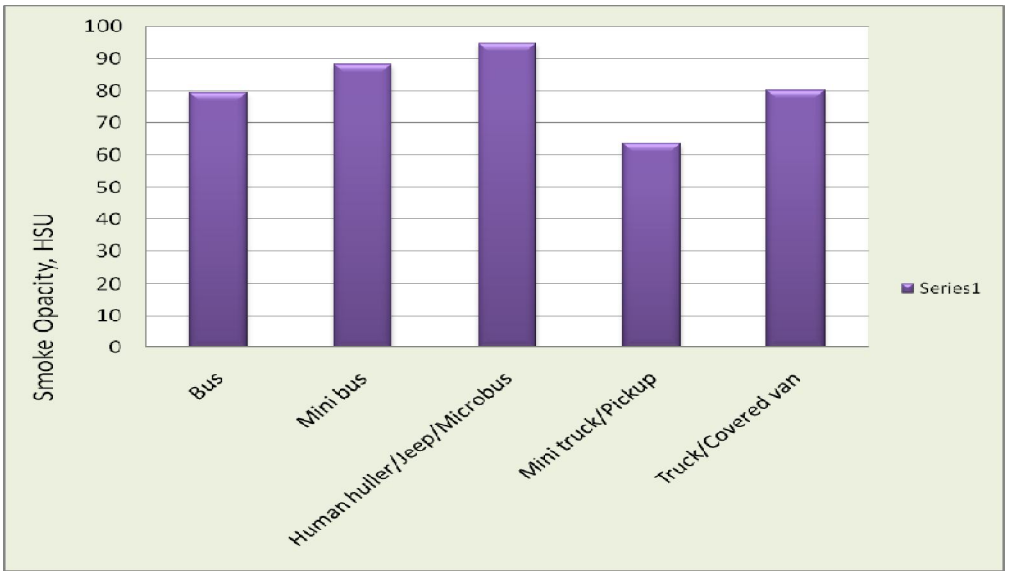


Figure 23: Average HSU of Different Types of Diesel Vehicles

4.5 Emission Levels in Different Cities

The CASE Project team measured emissions data in several major cities of Bangladesh. However, except Dhaka and Chittagong the numbers of vehicles tested in other cities were small. A comparison is therefore, made of vehicular emissions observed in Dhaka and Chittagong only in Figures 23 and 24.

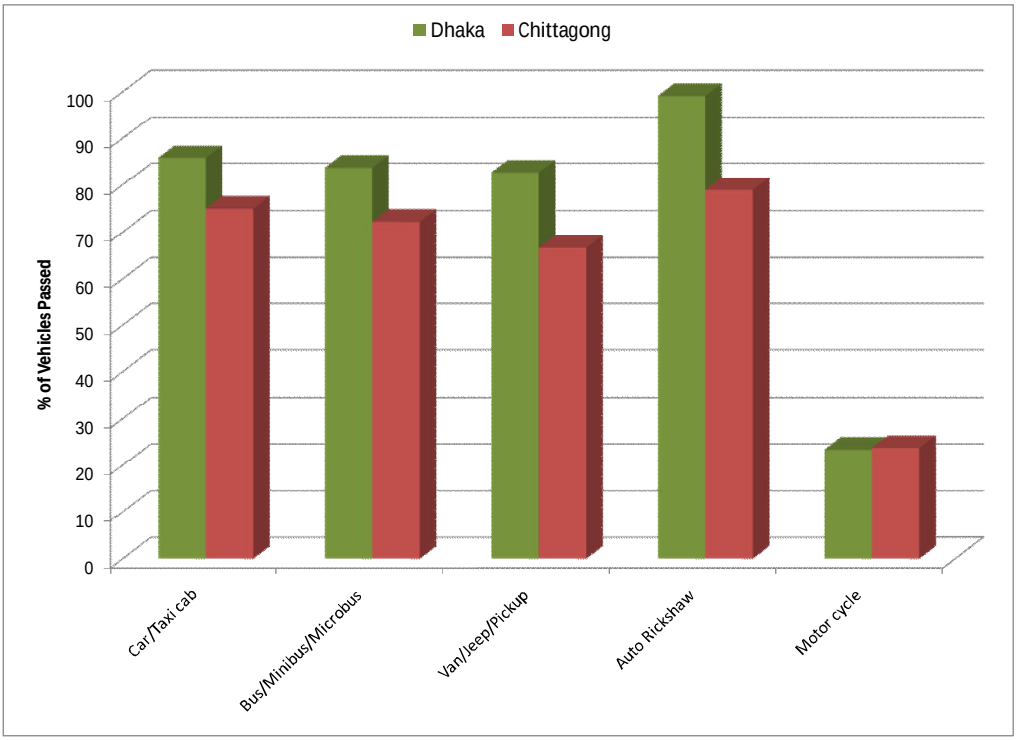


Fig-24: Comparison of idle CO emissions from perol/CNG vehicles for Dhaka and Chittagong (Petrol/CNG)

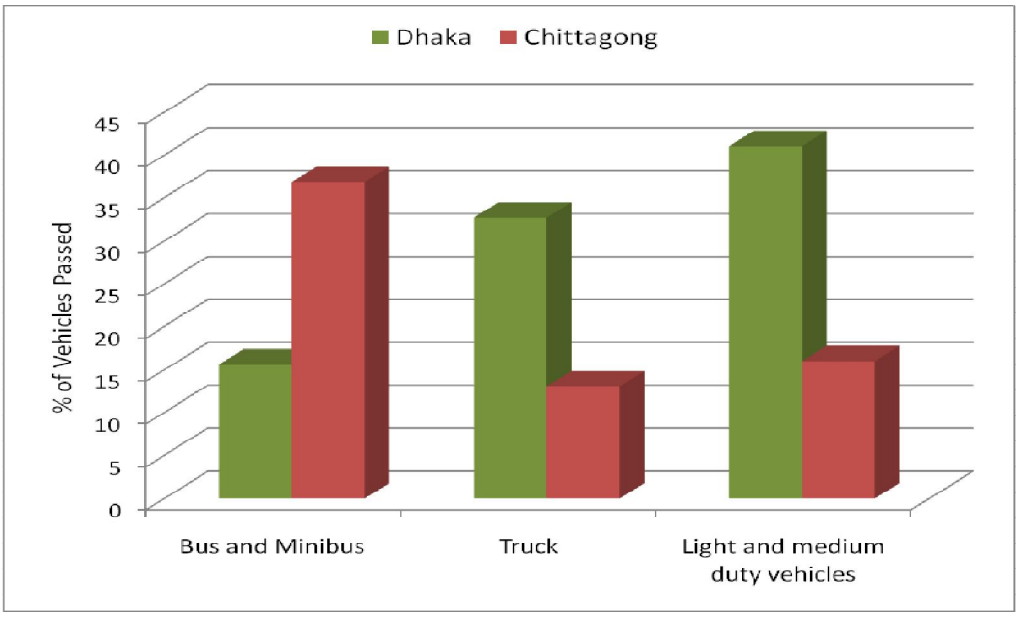


Fig-25: Comparison of diesel smoke emissions for Dhaka and Chittagong

5. Key findings and Challenges that Hinders the Road Side Program

Though the road side program is simple in concept, the detailed design and implementation of this program is far from simple. Sometimes, emission control equipment might malfunction, data collection procedures are generally not systematic or adequate resources are not available for its implementation. In addition, individuals have not the knowledge and training they need to perform the roles they are assigned. It is necessary to ensure that the calibration of test equipment is done on time and test equipment is maintained properly that provides accurate emission measurements. Inspectors should check any leakage inside the exhaust pipe. Accidental dilution of the exhaust stream will result in low readings. However, the roadside inspection should be considered only as a supplement to periodic mandatory emission inspection and maintenance.

It is usually seen that the driver has no registration card of vehicle. As in-use vehicle emission standards depend on registration year, therefore all drivers must keep all certificates on the vehicle.

6. Policy Implications

The primary function of roadside testing should be the identification of gross polluting vehicles. Billowing black smoke from aging diesel trucks and buses is a common sight in Khulna, Jessore, Kustia. Though their numbers may be relatively small, but due to their high emission rates and high mileage combine to produce a disproportionate share of total emissions. In addition, although in June 2010, the communications ministry officials and

transport department decided to remove 20-year-old buses and minibuses and 25-year-old trucks from the city. However, the it could not be implemented.

Besides, over- fuelling is commonly resorted to by the truck operators in their desire to increase engine power and carry more freight. Vehicle being over loaded always emit more emissions. Hence, it should be strictly inspected and controlled.

Fig -26: Over loaded vehicle plying at Jessore road

Government already banned 2-Stroke -3 Wheelers from Dhaka city. However these vehicles are plying in the other cities and emitting high smoke and especially unburned hydrocarbon that are injurious to health and environment. Accordingly, this is judicious to ban all 2-stroke 3 wheelers plying in major cities.

Policymakers should also consider the option of using private contractors to conduct inspection program with police accompaniment. In addition, DoE/BRTA must devote appropriate resources to public awareness campaigns to promote compliance. Campaigns can also to publicize the public benefits of properly maintained vehicles (in terms of reducing air pollution and better health) or the personal benefit. Public must know that a well-tuned vehicle typically burns less fuel and saves money. Proper adjustment of an engine can improve fuel efficiency by 5 to 15 percent. It is essential to identify the lacunae in the present enforcement mechanism of vehicle emission regulations so as to enhance efficacy of the emission control program. In this regard, Department of Environment along with BRTA and Bangladesh Traffic Police should design Inspection and Enforcement program that ensure all in-service vehicle performance are in good and reduce vehicle emissions and it should be done in a cost-effective way.

Government should support exploration of “one-stop” government facilities for emission and safety inspections as well as vehicle registration. All vehicles should go through Central Emission Inspection Centre annually for getting its fitness certificate. This approach deserves support given its promise to improve air quality, safety, and vehicle registration. The quality assurance entity should set minimum qualifications and well trained for test center staff, and auditing and supervising the program to guarantee its objectivity and transparency.

7. Conclusions

A program to collect emission data from in-service petrol, diesel and CNG vehicles was carried out in Dhaka and other cities during March 2011 to July 2012. This study was undertaken to know the present status of vehicular emissions level and also to raise public awareness against polluting vehicles.

Idle CO and HC emission were measured from 385 four wheeled petrol/CNG vehicles, 123 CNG auto rickshaws and 196 motorcycles. Free acceleration smoke was measured from 436 diesel vehicles, consisting 157 buses 142 trucks and 137 other light duty vehicles.

The collected emission data were statistically analyzed. The following main conclusions may be drawn from this study:

7.1 Petrol and CNG Vehicles

7.1.1 Idle CO and HC Emissions from 4-Wheeled Vehicles

Among Petrol/CNG four wheeled vehicles, 73% vehicles have CO up to 1% (present standards) and 81% vehicles up to 2% CO. Post-2004 vehicles as a group were observed to give generally lower CO than the older vehicles although the no correlation was found to exist between the CO emissions and vehicle registration year ($R^2 = 0.001$)

About 89% 4-wheeled petrol/CNG vehicles had idle HC emissions $\leq$ 1200 PPM (present standards, more than 86% vehicles $\leq$ 1000 PPM and more than 82% vehicles $\leq$ 800 PPM.

About 65% of CNG/Petrol 4-wheel vehicles are meeting 1% CO and 1200 PPM HC limits while 57% vehicles are below 0.5% CO and 1000 HC PPM regardless of vehicle model year.

7.1.2 Idle CO and HC Emissions from CNG Auto-rickshaws

The CNG powered auto-rickshaws are very low emitters of CO. Almost 95% of tested vehicles had CO less than 0.5 % and 96.7% equal to or lower than 1.0%. All vehicles met the present standards of 3% CO. However, some of these vehicles when tested were operating on petrol and were found to be very high emitters of CO, average being about 6% CO.

CNG operated three wheelers as expected gave low HC emissions, 56% falling below 600 PPM and 71.5% below 1200 PPM (present standards for petrol vehicles).

7.1.3 Idle CO and HC Emissions from Motorcycles

Motor Cycles are very high emitters of CO. Only 63% vehicles gave CO below 7% and only 36% were below 4.5% CO.

Motor cycles with 4-stroke engines as expected had lower HC emissions than the two stroke ones. More than 55% of the 2-stroke motorcycles have HC above 12000PPM.. However, the number of 2-stroke motorcycles is very few. Among the 4-stroke motor cycles, 26.5% have HC equal to or less than 1200 PPM and 57% up to 3000 PPM HC

About 42.5% 4-stroke motorcycles have emissions equal to lower than 7% CO and 3000 PPM HC and 47% below 7% CO and 4000 PPM HC.

Among all the Petrol/CNG vehicles, the motorcycles have been seen to give significantly higher emissions than 4-wheeled vehicles. Therefore, enforcement of compliance with emission standards should be directed specifically for this category of vehicles.

7.2 Diesel smoke Emissions

When all the tested diesel vehicles were considered together, smoke levels of 65 HSU (present standard), 75 HSU and 80 HSU were met by 26, 29 and 31% vehicles, respectively.

Based on this study it is observed that more than 76% of motorcycle and 72% of diesel vehicles do not comply with the in-use vehicle emission standards of Bangladesh. However, the standards are not any more stringent than the standards in others countries. More effective enforcement of the standards through inspection and maintenance (I&M) in conjunction with public awareness programs would minimize the number vehicles failing the emission standards.

In this study, it was also observed that a lot of CNG operated vehicles for instance 97% of auto-rickshaws, 96% of cars/taxis, 81% of jeeps/ micro-buses/station wagons, 44% of delivery vans/mini-trucks and 61% of minibus/buses are plying in Dhaka city. Besides, vehicles that plying in Dhaka are lower emitters than those in Chittagong except diesel buses/minibuses.

8. Recommendations

Typically, emission control program requires massive behavioral change among thousands of drivers; among those who test and repair vehicles; and, among those who manage, oversee, and enforce such programs. However, it is possible with committed leadership, the right institutional design, and the right incentives. Road side emission testing experiences offer the following recommendations regard to pollution control from the vehicle sector:

- Massive awareness program on Vehicular Emissions Standards, maintenance of vehicles and emission impact on health to be undertaken very soon all over the country.

- In-use vehicle emissions standards should be revised and strict enforcement of the emissions standards is essential.

- 20-year-old buses and 25-year-old truck to be dumped forcefully and all diesel vehicles must stop plying in Dhaka city. 2S-3w must ban as soon as possible from all major cities.

- Adequate infrastructure to be built in major cities for the emission testing or checking in connection with BRTA.

- All imported vehicles must have an emission compliance certificate obtained by the vehicle manufacturer or the supplier from an internationally accredited emission testing laboratory/agency and showed for clearance of vehicle imports and also at the time of vehicle registration.

- Adequate infrastructure for maintenance of vehicles to be developed.

- AQ Cell staff should be trained up through this ongoing Road side emission testing program. Practice of QA/QC should be adopted for increasing reliability of tests and minimizing false passes. More realistic system based on dynamometer tests is to be developed in the long run.

- Establish more number of CNG stations in others city where CNG is accessible.

- Campaigns like “No Pollution Week/Pollution Month” should be taken up by the city corporation with DoE to increase awareness for I&M.

Annex-1

Table-6: Category-wise and city-wise number of tested petrol/CNG diesel vehicles

Dhaka		
Vehicle Type	Number of vehicles tested	% of Pass
Petrol /CNG	544	73% (397)
Passenger Car/ Taxi	113	86% (97)
Bus/Mini Bus/Microbus	87	82% (71)
Van /Jeep/Pick-up	104	82% (85)
Auto-rickshaw	116	99% (115)
Motorcycle	124	23% (29)
Diesel vehicles	216	32% (68)
Bus and Mini bus	64	16% (10)
Truck	52	33% (17)
Light and medium duty vehicles	100	41% (41)
Total Diesel vehicles	216	32% (68)
Total vehicles	760	61% (465)
Rajshahi		
Vehicle Type	Number of vehicles tested	% of Pass
Petrol /CNG	51	33% (17)
Passenger Car/ Taxi	3	67% (2)
Bus/Mini Bus/Microbus	5	60% (3)
Van /Jeep/Pick-up	3	100% (3)
Auto-rickshaw	1	0% (0)
Motorcycle	39	23% (9)
Diesel vehicles	103	19% (20)
Bus and Mini bus	54	22% (12)
Truck	33	9% (3)
Light and medium duty vehicles	16	31% (5)
Total Diesel vehicles	103	19% (20)
Total vehicles	154	24% (37)

Khulna		
Vehicle Type	Number of vehicles tested	% of Pass
Petrol /CNG	20	25% (5)
Passenger Car/ Taxi	8	38% (3)
Bus/Mini Bus/Microbus	1	0% (0)
Van /Jeep/Pick-up	1	100% (1)
Auto-rickshaw	2	0% (0)
Motorcycle	8	13% (1)
Diesel vehicles	32	41% (13)
Bus and Mini bus	12	25% (3)
Truck	8	50% (4)
Light and medium duty vehicles	12	50% (6)
Total Diesel vehicles	32	41% (13)
Total vehicles	52	35% (18)
Vehicle Type	Number of vehicles tested	% of Pass
Jessore		
Petrol /CNG	2	50% (1)
Passenger Car/ Taxi	1	0% (0)
Bus/Mini Bus/Microbus	-	-
Van /Jeep/Pick-up	1	100% (1)
Auto-rickshaw	-	-
Motorcycle	-	-
Diesel vehicles	12	17% (2)
Bus and Mini bus	5	20% (1)
Truck	5	20% (1)
Light and medium duty vehicles	2	0% (0)
Total Diesel vehicles	12	17% (2)
Total vehicles	14	21% (3)
Vehicle Type	Number of vehicles tested	% of Pass
Kustia		
Petrol /CNG	14	57% (8)
Passenger Car/ Taxi	5	80% (4)
Bus/Mini Bus/Microbus	2	50% (1)
Van /Jeep/Pick-up	1	0% (0)
Auto-rickshaw	2	100% (2)
Motorcycle	4	25% (1)

Vehicle Type	Number of vehicles tested	% of Pass
Diesel vehicles		
Bus and Mini bus	3	0% (0)
Truck	21	24% (5)
Light and medium duty vehicles	4	75% (3)
Total Diesel vehicles	28	29% (8)
Total vehicles	42	38% (16)
Chittagong		
Petrol /CNG	29	79% (23)
Passenger Car/ Taxi	6	50% (3)
Bus/Mini Bus/Microbus	5	100% (5)
Van /Jeep/Pick-up	3	67% (2)
Auto-rickshaw	11	100% (11)
Motorcycle	4	50% (2)
Diesel vehicles	27	11% (3)
Bus and Mini bus	6	17% (1)
Truck	21	10% (2)
Light and medium duty vehicles	-	-
Total Diesel vehicles	27	11% (3)
Total vehicles	56	46% (26)
Cox Bazar		
Petrol /CNG	44	48% (21)
Passenger Car/ Taxi	6	100% (6)
Bus/Mini Bus/Microbus	2	50% (1)
Van /Jeep/Pick-up	-	-
Auto-rickshaw	8	50% (4)
Motorcycle	17	18% (3)
Diesel vehicles	18	39% (7)
Bus and Mini bus	13	46% (6)
Truck	2	50% (1)
Light and medium duty vehicles	3	0% (0)
Total Diesel vehicles	18	39% (7)
Total vehicles	62	45% (28)
Grand Total vehicles	**1140**	**52% (593)**