

# Increase Use of CNG as Public Transport & Reduce Emissions: A Comparative Study of the Benefits of CNG & Automobiles Fuel: Present Scenario on Bangladesh.

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## Abstract:

Compressed Natural Gas (CNG) is a natural gas i.e. methane, in compressed form. Natural gas at ambient temperature and pressure has very low energy density compared to other fuels. To use natural gas as a transportation fuel, it must be compressed to increase its volumetric energy density.

In recent years due to spiraling hike of fuel price, Bangladesh government had no other options but to increase in fuel price. This has led to increase in conversion of petrol/octane automobiles into CNG system, which runs on natural gas abundantly available in this country. How more and more CNG conversion workshops have developed and CNG has gained popularity and acceptability at a rapid pace. The purpose of this study is to access the popularity of CNG as an alternative automobile fuel.

In many respects, the distribution of modal choices in Dhaka is unique among cities of comparable size in the Asia region. Almost 60% of the 8.5 million weekday person trips are walk trips and about 19.2% use rickshaw. For the remaining 20% trips on motorized models. The high dependence on walking and rickshaw, both slow and typically best suited for short trips on secondary roads and a low dependence on buses, in a city of 14.5 million people with an urban area about 2000 sq. km. is a symptom of inefficient and ineffective transport operations as well as uncontrollable land use (DOE 2011).

The number of CNG vehicles plying on road till to date is 204243 (RPGCL, May-2012). Taking an average of 15 liter/day per vehicle, the cost of CNG use per annum amounts to tk. 170.00 crore. The same number of vehicles would spend tk. 1000.00 crore on equal amount of petrol. It was revealed that the CNG users are saving tk. 830.00 crore by using CNG instead of petrol (EAW 2006).

**Keywords:** CNG, conversion, environment, fuel, gas, transportation

## 1. Introduction

Bangladesh is one of the most populous countries of the world having current population of over 164 million people. About 28% of its population lives in urban areas, its urbanization level is low even by standards of most other Asian countries (Asian urbanization level is over 30%). On the other hand its total urban population is well over 45 million, which is higher than the national population of some 95 countries of the world. Since the total area of Bangladesh is 1, 47,570 sq. km., the overall density of population is almost 1200 (2011) persons per sq. km. and in urban areas it is even higher. Thus in Dhaka, the largest metropolitan area in Bangladesh, the density is 23,000 persons per sq. km. While in medium and small towns, the density ranges between 3000 and 15000 persons per sq. km. (Ali 1997).

The growth of urbanization in recent years is quite high in this context, the projection made by the World Bank in 1985 (Table 1), is worth considering. If the trends projected stand correct, the total urban population in Bangladesh in the year 2015 will be 67.9 million. Thus make about 36.8% of its total populations (Ali 1997).

**Table-1: Urban Population projection in Bangladesh in comparison to other region of the world, 1950-2015:**

Region	1950	1960	1970	1980	1990	2000	2010	2015
Developed region	55	60	68	71	74	77	82	85
Asia	19	21	24	26	31	37	44	55
Bangladesh	-	-	-	15.1	20	26.4	33.3	36.8*

**Source:** World Bank, 1985 and the State of Environment 1990, UNEP & UNICEF, (Modified), (\*2015 data).

The rapid pace of urbanization and the rather haphazard or uncontrolled pattern of urban growth and expansion in Bangladesh are manifest in the various sectors of the urban environment, such as transportation, housing, water and sanitation, garbage disposal, drainage and flooding, health and visual education, community services, air and the visual or aesthetic environment.

In Bangladesh, the total numbers of trucks, buses, cars, auto rickshaws are 1596000 and Dhaka alone has 643003 automobiles (BRTA, June 2011). Although the figure is negligible in comparison to many developed countries of the world but the population level is much higher than those countries, depicting on alarming picture of our urban air quality. This is due to the faulty condition of the vehicles inappropriate industrial emissions and some other activities.

In Dhaka city concentration of Suspended Particulate Matter (SPM) is much higher than the permissible limit (Table-2). The concentration of Nitrogen Oxides and Sulphur dioxide is also increasing rapidly.

**Table-2: Concentration of different gases and Suspended Particulate Matters (SPM) in the air:**

Location/ Month	No <sub>x</sub> (gm/m <sup>3</sup> )	So <sub>2</sub> (gm/m <sup>3</sup> )	SPM(µgm/m <sup>3</sup> )
<b>Farmgate Police box</b>			
January 97 (avg.)	27.43	64.39	1490.33
February (avg.)	55.02	71.67	953.32
March (avg.)	30.00	125.12	1773.74
<b>Tejgaon (Bangladesh Beverage)</b>			
January (avg.)	42.87	131.28	321.73
February (avg.)	47.08	103.72	354.633
March (avg.)	47.03	73.10	438.957
<b>Standard value:</b>			
(i) Residential & Rural	80.00	80.00	200.00
(ii) Commercial & mixed use	100.00	100.00	400.00
(iii) Industrial & mixed use	100.00	120.00	500.00

**Source: DOE, 1997**

The urban hierarchy of Bangladesh is strongly dominated by Metropolitan Dhaka, which is the country's largest and most industrialized city and also its administrative, commercial and cultural capital. The population of 16 million presently and is projected to be about 18.5 million by 2015, making it the seventh largest mega city in the world.

Current average annual growth rate of population is 1.34% and Dhaka contributes about 13% of the national GDP. Although Dhaka city's area is less than one percent of the country's total land area, it supports about 7.2 percent of the total population of the country (DOE 2005).

The transport environment in Dhaka is characterized by different types of modes, both Motorized Transports (MT) & Non-Motorized Transport (NMT), using the same road space, traffic congestion, delays, inadequate traffic management, conflict of jurisdictions, and poor coordination among organizations. Dhaka is perhaps the only city of its size without a well-organized properly scheduled bus system or any other mass transport system. Women and urban poor are particularly disadvantaged in accessing the existing facilities due to extreme overcrowding. The city's traffic problems have reached a crisis and automobile related air pollution has become a major health problem such that these shortcomings seriously compromise the ability of the transport sector in DMA to sustain economic growth and reasonable quality of life.

In many respects, the distribution of modal choices in Dhaka is unique among cities of comparable size in the Asia region. Almost 60% of the 8.5 million weekday person trips are walk trips and about 19.2% use rickshaw (tricycle). For the remaining 20% trips on motorized modes, 1.4% use auto-rickshaw (three wheeler), 9.2% travel by bus, 3.1% by private car, and the other 6.7% by various other modes. The high dependence on walking and rickshaw, both slow and typically best suited for short trips on secondary roads, and a low dependence on buses, in a city of 10 million people with on a urban area of about 2000 sq. km. is a symptom of inefficient and ineffective transport operations as well as uncontrolled land use (DOE 2005).

**Table-3 Different Sectors of public transportation of Dhaka City.**

Public Sector	Private Sector	Informal Sector
Bus service is managed and operated by Bangladesh Road Transport Corporation. Other Institutions having fleet of buses include: Public sector office and semi-government institutions.	Medium and small sized mini buses and coasters operated and coasters operated mainly by small sized operations or individual owner-managed companies.	Mainly cycle rickshaws operated by individual owners up to a fleet of 100 or more rickshaws. Most rickshaws are rented out to drives for eight-hours shift.

In 1998, Rickshaws were the 38% of the total vehicles of the whole city. In 1999, there are 79619 Licensed Rickshaws in Dhaka. Till March 2000, this number has increased up to 88000. At present Dhaka have about 350,000 rickshaws, most of which are unauthorized.

**Table- 4: The number of public transports, especially the buses registered in Bangladesh (per Year)**

Year	Motor Car	Jeep/St. Wagon/ Microbus	Taxi	Bus	Mini-Bus	Truck	Auto-rickshaw	Motor-Cycle	Others	Total
2007	11941	5650	15	1368	382	2521	10530	85131	3734	121272
2008	16927	6537	9	1342	307	2609	19071	93541	4076	144419
2009	21461	9027	12	1184	320	6561	14902	85142	6634	145243
2010	20690	8040	0	1233	311	10056	19018	88499	13331	161178
June 2011	8283	3623	9	704	180	5621	8404	55439	8840	91103

Source: BRTA 2012

## 2. Background

Since inception of motorized transport system, gasoline has been only source of fuel. In 1982 a World Bank sponsored project was initiated to find the feasibility of CNG as an alternative automotive fuel in Bangladesh.

CNG has its roots to Rupantarita Prakritik Gas Company Limited (RPGCL), as it was first in Bangladesh to embark on a pilot project to introduce CNG as an alternative fuel.

The project gradually but steadily gained momentum as more and more vehicles were converted into CNG system but these vehicles were mostly from Govt. pool of transport. Although gasoline was readily available, the project established the fact that CNG is a safe, cheap and above all it is environment friendly.

In recent years due to spiraling hike of fuel price, Bangladesh Govt. had no other alternative but to increase in fuel price. This had led to increase in conversion of Petrol/ Octane automobiles into CNG system, which runs on natural gas abundantly available in this country. Now more and more CNG conversion workshops have developed and CNG has gained popularity and acceptability at a rapid pace.

Bangladesh Govt. has identified CNG sector as a thrust sector and has given a lot of incentive to the private entrepreneurs to invest in this sector. Thus CNG sector has gained moment exponentially due to such effort on the part of the Govt. and also due to high rise of fuel prices in recent months.

## 3. Objectives:

- To assess the popularity of CNG as an alternative automotive fuel.
- Problems facing CNG users.
- Benefits of CNG users.
- To assess the reasons for petrol users not using CNG.
- To have information regarding facing CNG station owners.

## 4. Methodology of the study:

-As a part of the study a report on A Comparative Study of the Benefits of CNG & Automotive Fuel, which has led us to prepare two sets of questionnaire for Petrol & CNG users respectively. Also, a brief interview with gas station owners was

undertaken to have their ideas and suggestion. We have gone through various literatures to get information regarding the issue mostly supplied by RPGCL.

-It is a quantitative type of methodology.

**-Selection of Participants:**

Drivers of private automobiles using Petrol and CNG. It is to be mentioned here that we have avoided CNG taxicab and 3 wheelers, because it would not reflect the true nature of the survey. Also, diesel vehicles have been excluded from this report because diesel automobiles engine are not been converted in this country as yet.

**-Questionnaire:**

Two sets of questionnaires one each for CNG and Petrol driven vehicles.

**-Interview:**

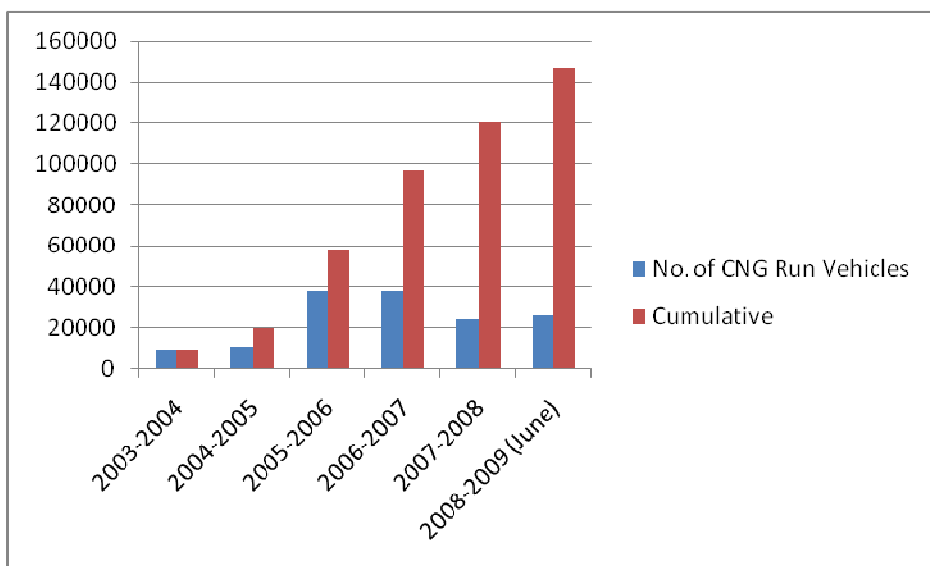
After questionnaire section interview was taken of the drivers, which helped to do the discussion more specifically.

**5. General Information**

In order to prevent pollution conversion of petrol driven vehicle to compressed natural gas (CNG) driven is being carried out and promotion of this mode of fuel is being encouraged. Efforts are continuing to convert more vehicles to CNG mode, and installation of more re-fuelling stations are being planned to ensure supply of CNG to the converted vehicles. The following tables show the progress status of the initiative in place to introduce CNG across the country. Besides, the number of CNG conversion workshop operating in the country is 180 (BRTA, May 2012).

**Table-5: Growth of CNG in Bangladesh**

Financial Year	No. of CNG Run Vehicles	Cumulative
2003-2004	9308	9308
2004-2005	10525	19833
2005-2006	38353	58186
2006-2007	38454	96640
2007-2008	24042	120682
2008-2009 June-2009	26141	146823

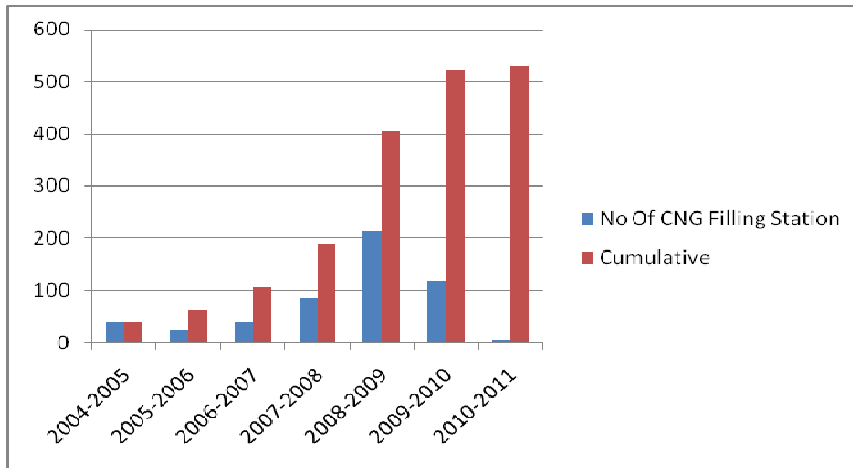


**Figure 1: Growth of CNG in Bangladesh**

**Table-6: Growth of CNG Filling Station in Bangladesh**

Financial Year	No Of CNG Filling Station	Cumulative
2004-2005	41	41
2005-2006	23	64
2006-2007	42	106
2007-2008	85	191
2008-2009	213	404
2009-2010	119	523
2010-2011	05	528

Source: RPGCL 2012

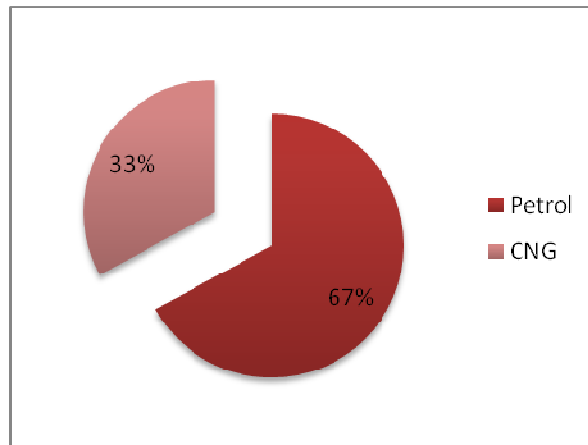


**Figure 2: Growth of CNG Filling Station in Bangladesh**

**6. Findings of the study:**

Questionnaires were distributed at random to 50 CNG users and 50 Gasoline users. Information is displayed in different charts as given below:

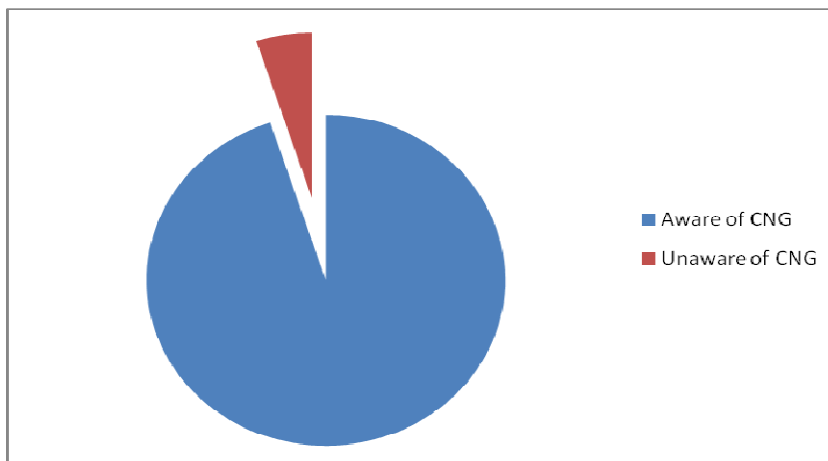
**6.1 Distribution of respondents using differed type of fuel.**



**Figure 3: Distribution of respondents using different type of fuel, Source: Field Survey**

As mentioned earlier CNG driven taxicabs were excluded from the sample. The chart shows that 33% of the vehicles still using gasoline and 67% are using CNG.

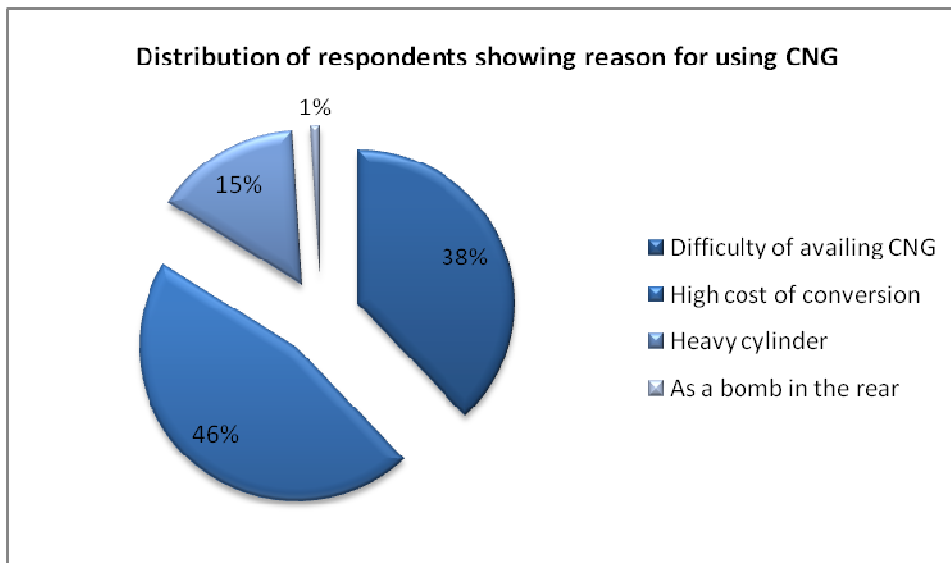
### 6.2 Distribution of respondents on awareness of CNG



**Figure 4: Distribution of respondents on awareness of CNG**

As per above pie chart almost every driver is aware of CNG as an alternative fuel.

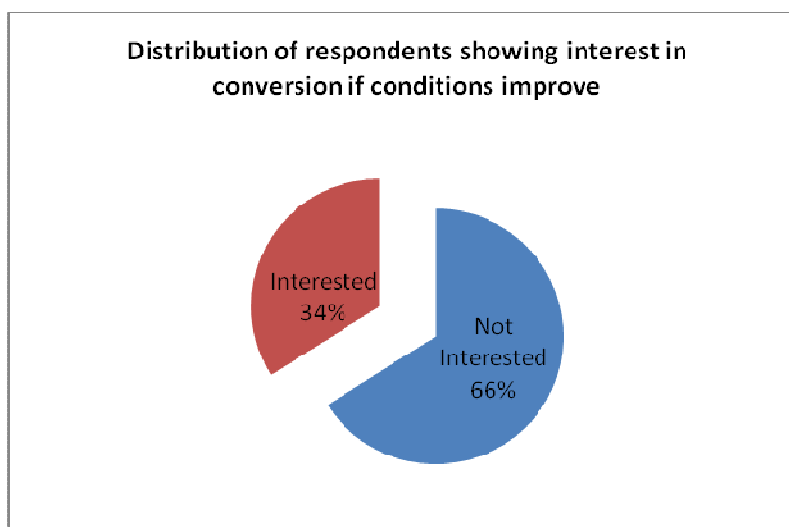
### 6.3 Distribution of respondents showing reason for using CNG



**Figure 4: Distribution of respondents showing reason for using CNG**

Above pie chart shows various reasons for not using CNG by Gasoline users. Most common reason (38%) given was difficulty in availing CNG. They complained that one has to stand for hours to fill in the gas 46% cited that conversion cost was very high for a middle class ear owner. 15% complained of cylinder being too heavy and too large to hold for a very small amount of gas. One of them stated that he feels cylinder as a bomb in the rear.

#### 6.4 Distribution of respondents showing interest in conversion if conditions improve



**Figure 5: Distribution of respondents showing interest in conversion if conditions improve**

An interesting finding was that 34% of petrol users still opted to use gasoline even if the conditions for CNG improve. This may be due to driver's biasness toward petrol or rich and higher middle class are not interested in the cost of fuel or the environment.

#### 7. Advantages of CNG

- Less costly
- Safer
- Environment friendly

- Lower emission/ Lower pollution
- Sulphur and lead free
- Health cost saving
- Saves foreign currency
- Reduces dependency on imported fuel
- Improves engine output and engine life
- In case of CNG runs out petrol may be used

**7.1 Use CNG as an alternative fuel makes sense for various reasons:**

**7.1.1 Safety:**

CNG has a specific gravity of 0.587. This means it is lighter than air. So if it leaks, it just rises up and dissipates into the atmosphere. On the contrary the other fuels will puddle on the ground and may cause accident. It has a self-ignition temperature of 700°C as against 455°C for petrol.

CNG cylinder is designed and built of special materials to withstand high pressure. So, it is far safer than petrol tanks.

**7.1.2 Cheap:**

CNG costs 80% less than petrol. It needs no refining and creates no harmful by products.

**Comparative cost of CNG and Petrol:**

1 liter of Petrol		= 0.8m <sup>3</sup> of CNG
Price of 1 liter Petrol	= Tk. 95.00	
Price of 0.8m <sup>3</sup> of CNG		= Tk. 30
Savings per liter petrol		= Tk. 65.00

The above statement clearly demonstrates the benefits of using CNG as fuel. It was revealed that majority of the vehicles use 10-20 liter of fuel per day. Taking an average of 15 liter/day the cost of CNG use per annum amounts to TL 170.00 crore from 46,501 numbers of CNG vehicles plying on road till to date. The same number of vehicles would spend Tk. 1000.00 crore on equal amount of petrol. Thus the government is saving Tk. 1000.00 crore in valuable foreign currency by introducing CNG as an alternative fuel for Petrol & CNG Consumers are saving Tk. 830.00 crore by using CNG instead of Petrol.

**7.1.3 Environment friendly:**

Environment pollution is one of the major national problems facing most of the cities of Bangladesh, more so in Dhaka. Environment of the few of the areas of Dhaka city shows far more than accepted level air pollution resulting in increased number of eye diseases and respiratory tract infections. These are mostly due to low qualities of fuel used in the transport system, which contains Carbon Monoxide, Hydro Carbons, Nitrogen Oxides and Sulphur Dioxide. Till recently leaded fuel was imported unhindered and which was the main reason for abnormal level of lead in the atmosphere of our country. Lead is one of the noxious agents, which is very harmful to health especially of the children. Use of CNG will reduce these agents from air, if used in mass scale.

**Table-7: Level of elements of noxious agents in different fuel used in Bangladesh:**

Elements	Gasoline (cu mm)	Diesel (cu mm)	CNG (cu mm)
Carbon Monoxide (CO)	6.34	1.06	0.22
Hydrocarbons (HC)	0.85	0.21	0.06
Nitrogen Oxides (NO <sub>x</sub> )	0.78	1.08	0.5
Particulate matters (PM)	0.0 11	0.215	0.003
Carbon diodides (CO <sub>2</sub> )	220	210	163
Sulphur dioxide(SO <sub>2</sub> )	0.08	0.21	.0..15

Source: DOE 2005

**7.1.4 Good for Engine:**

CNG has an octane rating 130 compared to only 92 with petrol, therefore lower maintenance cost. CNG vehicles can go up to 10,000 km between oil changes and spark plugs can last up 30,000 km.



### **7.1.5 Clean:**

CNG is the cleanest burning fuel available today. CNG vehicles reduce emissions of carbon monoxide by 85% and also it reduces 99% respiratory illness and carcinogenic particulate (cancer causing agents).

### **7.1.6 Safe:**

Thirty years of worldwide experience and millions of problem free miles driven by CNG vehicles show that CNG is an extremely safe fuel for vehicles,

### **7.1.7 Use of Internal Resources:**

CNG is readily available as a product of Bangladesh internal resources its increase use could help reduce the national trade deficit and significantly cut our dependency on foreign oil import.

## **7.2 Disadvantages of CNG:**

### **7.2.1 A very few numbers of CNG stations operating at present**

Although 25 CNG stations are presently in service, these stations are inadequate. But there are 35 stations currently in the pipeline and eventually by December 2003 the numbers will rise to 60, which will be hopefully enough.

### **7.2.2 Low gas pressure in the pipeline**

Almost all the CNG stations are facing this problem, which leads to temporary suspension of gas dispensing occasionally.

### **7.2.3 Frequent disturbances of electric supply**

Frequent disruptions of electricity are a national problem, which in the form of load shedding, is a menace to gas station owners and CNG users alike.

## **7.3 Gas dispensing time is comparatively longer than that of gasoline.**

### **7.3.1 Advantages of Gasoline:**

Petrol has been the common fuel along with and octane before introducing of CNG as an alternative fuel. It is readily available and there are no shortages of petrol stations. So there is no long queue and it is not dependent on gas inlet and outlet pressure. Heavy cylinder is not a mandatory part of the equipment.

### **7.3.2 Disadvantages of Gasoline:**

Gasoline can be adulterated at will by dishonest traders. In Bangladesh dishonesty with regards to gasoline is rampant. Very recently government has banned import of leaded gasoline but it has already polluted air and soil of this country a great deal. Gasoline has much higher cost and its price is dependent on international oil market. A lot of foreign exchange is spent for import of this fuel.

## **8. Conclusion:**

The result of the report suggests that majority of the vehicle drivers are still using gasoline but recently CNG has gained considerable popularity among the vehicle owners.

Government of Bangladesh has declared CNG as 'Thrust Sector' to reduce air pollution of Dhaka. It has taken various steps to popularize CNG by encouraging private entrepreneurs to invest in this business by withdrawing import duties and taxes on CNG equipments. Another import decision was to ban 2 stroke 3 wheelers and import 4-stroke 3 wheelers, which are solely CNG driven. Taxicabs imported from abroad are all equipped with CNG system. Also, there are number of CNG buses plying on the roads of Dhaka and more are being imported.

## **9. Recommendations:**

- To popularize CNG among the private car owners the cost of conversion into CNG system should be reduced, as it is one of the factors that inhibited the gasoline users to convert into CNG system.
- Government should ensure continuous supply of electricity and gas to reduce the woes of the consumers and gas station owners alike.

Another point, which was raised by the gas station owners, was the price of CNG, which according to them, was too low for return of such a huge investment. They suggested that 33% increase of the CNG selling would be sufficient to attract more investors; also it would not be a burden to the consumers too. This proposal is worth considering.

- Government, as an incentive, has allocated government-owned land to the investors of CNG. It has also instructed national and private banks to disburse loan to the investors of CNG on a soft term.

- It is recommended that government should ensure import of quality CNG equipments, which should be of international standard to prevent any outward incident, which will inhibit the consumer.
- Implementation of government prescribed rules and regulation regarding the installation of CNG stations and conversion workshops should be stringently followed to ensure adequate supply.

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