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## Analysis of Future Aspects of Alternative Fuel Driven Vehicles in Bangladesh

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**Abstract** Bangladesh transport sector is still heavily dependent on imported oil in an effort to support its growing economy. The volatile oil prices and the unstable political situation of the Middle East, put the government of Bangladesh in a politically compromising position and force the country to a big amount of financial loss every year in the fuel and energy sector. Becoming energy independent has been a long-term goal for Bangladesh, a logical governmental goal is to decrease use of fossil fuel and increase use of domestically produced alternative energy sources. Adopting compressed natural gas (CNG) and Liquefied Petroleum Gas (LPG) in old vehicles and encouraging alternative fuel driven vehicles and electric vehicles in Bangladesh would improve national, political and environmental standing. Imposing new rules and VAT and Taxes on both CNG conversion product and recondition car, CNG and LNG sectors are going towards downstream. The government of Bangladesh should take necessary steps in well advance to make clean and environment friendly transportation systems and to become energy independent country. Thus, the market of alternative fuel driven vehicle has got a chance to explore to meet the future challenge. This paper shows how to meet the future challenge of the vehicular fuels in Bangladesh.

**Keywords** Alternative Fuel, Compressed Natural gas (CNG), Liquefied Petroleum Gas (LPG), Vehicle Fuel in Bangladesh

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### Introduction

Energy consumption is one of the most important indicators showing the development stages of countries and living standards of communities. The usages of private and public transportation, urbanization, industrializing and technological development result directly in increasing of the fuel consumption [1]. The usages of energy and crisis of fuel is one the great concerns all over the world. Different empirical studies show that the incompetence energy independence of Bangladesh to meet its own demand for energy is one of the main factors hampering its smooth development processes. Although Bangladesh, belonging to the group of developing nations, had some promising macroeconomic performances, notably maintaining an annual growth rate of about 6.34% on average since 2011, it still has not been efficacious in matching its demand for energy. Thus, energy crisis mitigation is set to be one of the top-most prioritized agendas of the current government [2]. Commodity-wise statistics record of central Bank of Bangladesh figured out that the expenses of Bangladesh in crude petroleum in 2015-16 (July-May) and 2016-17 (July-May) are USD 341.8 million and USD 444.4 million respectively. So, this increasing trend of expenses on import crude oil is an issue to concern and find out alternative fuel resources is a better solution.



The production of natural gas began in 1960, since its discovery in 1957 [3]. At that time, the annual consumption of natural gas in the country was only 1 Bcf, but this figure has risen so that natural gas is now the major fuel for power generation in the country. Before 1970, Bangladesh relied predominantly on oil for its energy needs. Beginning of the mid-1970s, the country increasingly adapted to the use of natural gas. The increasingly high demand for natural gas during the 1980s is clearly from fuel switching. After that in 1982 as a pilot project of World Bank, CNG was first introduced as a vehicular fuel in Bangladesh. Rupantarita Prakritik Gas Company Limited (RPGCL) was established in 1987, which is responsible for promoting CNG in transport sector by establishing a transportation infrastructure based on CNG in Bangladesh and spreading out its commercial operation. The Company is also responsible for extraction of LPG, Petrol and Diesel by fractionating of Natural Gas Liquid (NGL) and marketing of the same. In 1999, four private companies start their journey in CNG sector. Venture with RPGCL to set up 51 stations wherever pipe line gas is available in early 2000 [4]. The reason of spreading CNG as an alternative fuel in Bangladesh was due to the low cost of its price. Moreover, lower demand for foreign petroleum, exude fewer pollutants than traditional petroleum based vehicles and decrease pollution emitted into the air are the key reasons of high consumption of CNG.

### **Literature Review**

The suitability of CNG as vehicular fuel, environmental and economic benefits as well as the commercialization of CNG as well as the growth pattern of CNG filling stations, CNG conversion workshops in Bangladesh was described by Iqbal *et al.* [5] and Hossain *et al.* [6]. Government has given permission to the private sector entrepreneur to install CNG refueling station and to establish of CNG conversion workshop and Government has also provided land to some private entrepreneurs for establishment of CNG conversion workshop and CNG refueling station [7]. The suitability of CNG as vehicular fuel, environmental, and economic benefits as well as the commercialization of CNG as well as the growth pattern of CNG filling stations, CNG conversion workshops in Bangladesh was represented on these papers [8-18]. Currently there is little work has been done on LPG converted vehicle. In terms of running costs CNG is the best fuel for running costs. For initial purchase cost and running cost, LPG is a sensible fuel. [19]. An article of Shah *et al.* [20] provides review on bio-gas conversion into bio-CNG for automobile fuel in Bangladesh. Globally, LPG or autogas has becoming the primary gaseous fuel for vehicles. While CNG has captured a significant share of the fuel market in gas-rich countries with tax and pricing structures that incentivized its use in transportation, its appeal has been limited to buses, taxis and other urban fleets attracted by its environmental benefits (primarily reduced emissions) [21]. So, study on alternative fuel becomes important for Bangladesh to overcome the existing crisis and the future problems about vehicular fuel.

### **Economical Point of View**

#### **Natural Gas Reserves and Future GDP relation**

The Committee for Gas Demand Projections and Determination of Recoverable Reserve and Gas Resource Potential in Bangladesh, appointed by the Ministry of Energy and Mineral Resources, undertook the difficult task of reviewing all the existing studies of gas reserves in Bangladesh at June 2002. They found include an energy demand projection for the country, estimating the need for natural gas to the year 2050. They showed that in the event of low growth rates (3% GDP), the total gas requirement will be between 40 and 44 Tcf. But when the economic performance continues at around a 4.55% GDP growth rate, gas requirements will be between 64 and 69 Tcf. At a higher growth rate of 6% GDP, gas requirements will be between 101 and 110 Tcf and between 141 and 152 Tcf, given a 7% GDP growth rate. According to their analysis, the undiscovered gas resources of the country range from 8.43 Tcf (95% probability) to 65.70 Tcf (5% probability). The survey on gas demand by Japan International Cooperation Agency (JICA) in 2012 and another survey on gas supply by Petrobangla (state owned national oil company of Bangladesh) has provided gas demand and supply of natural gas up to 2030, which have been shown in Fig. 1.



## Natural Gas Supply and Demand Forecast upto 2030

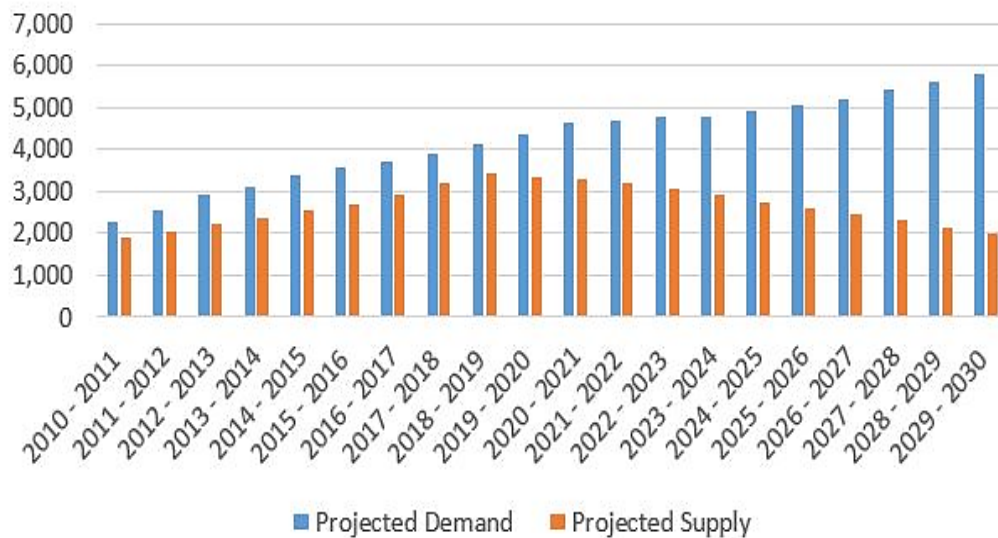


Figure 1: Forecast of natural gas supply and demand up to 2030

### Reduce expense on foreign currency

The government is importing crude and refined fuel from Middle East, Singapore and India, using one quarter of the country's yearly national budget. Natural gas vehicles are saving foreign currency, USD 53.6 million per year in 2006. In 2008, the saving increased to USD 142.85 million. NV's directly contribute to the protection of foreign reserve funds of Bangladesh. World Bank estimates savings of BDT 400 million per station per year which is twice that of the investment cost due to its cost effectiveness.

### Tax regulation

Most analysis recommends that CNG can be use as alternative fuel with the existing situation. Maintaining air quality in metropolises like Dhaka has become the nation's top most priority. Thus, CNG could cater to that need and make significant cross saving in the health sector and reduce public hazard. A new fleet of CNG three-wheelers was introduced in January 2003 after the Government of Bangladesh decided to ban two-stroke baby taxies from 1st December 2002. Now the name CNG has become synonymous with the auto-rickshaws, which are painted green and referred to simply as NGVs.

Growth rate of CNG conversion is more than 11% – from 11,700 in 2002 to 50,500 in 2005. At present, the growth rate is 8%. Already BDT 2 billion (USD 285 million) have been invested in this sector by the Bangladeshi. The Government of Bangladesh has newly enforced tax imported cylinders and conversion kits. Thus, the government has a long-term plan to migrate to CNG to LPG.

About 30% - 40% particulate pollution has dropped in Dhaka city after greater usages of CNG. In addition, an estimated USD 25 M in health costs were avoided each year by the cleaner environment was reported by Forum of environmental journalists of Bangladesh. Moreover, estimation by World Bank showed that about BDT 1.17 billion per year can be saved in health costs in Dhaka city by reducing pollution. This does not include mortality estimates.

### Drawbacks of CNG used vehicles

Changing all commercial vehicles to single-fuel CNG might not be feasible and sensible decision. The investment required for changing the vehicles to CNG mode and acquiring new vehicles within a short span will lead to ageing of all the vehicles at the same time. A huge cost required to set-up the infrastructure for CNG in a



very short span is bound to reflect in budgetary deficit. Currently there are other problems such as: (a) Traffic need to wait in long queue to refuel due to inadequate number of filling stations. (b) Paucity of trained mechanics for CNG kits have made repairs expensive. In addition, CNG has a higher value of gasoline gallon equivalent (GGE) compared to other gasoline power vehicle. Moreover, the maintenance cost of CNG vehicle is higher comparing with other vehicles.

### Demand of LPG side

The rising demand for LPG and other energy sources is a consequence of depleting gas reserves of the country. As of 2015, the natural gas reserve of Bangladesh is 14.16 trillion cubic feet and is enough to last till 2031, if current rate of extraction is maintained, according to Government statistics. The rapid use of natural gas in power production has been the main source of gas consumption, since it contributed to 56% of domestic energy demand, depleting gas fields and putting pressure on energy sector. Titas gas is already rationing gas connection to higher priority areas as of 2016. The current gas production from the 20 operating gas fields within the country yield about 2,500 mmscdf (million cubic feet per day), and is speculated to reach peak production of 2,700 mmscdf within 2017, and then decline. In fiscal year 2015-16, overall gas demand in the country has been estimated to be 3,200 mmscdf (Information from state owned organization Petrobangla), which means a 30% deficit on total demand. An annual shortage of 500 mmscdf natural gas shows the need for diversifying the energy requirements. The deficiency of Natural Gas (NG) will only increase and it will have an overall impact on electricity generation, fertilizer, transportation and domestic sector.

### Supply of LPG side

Availability and improving the supply system are two major constraints for the supply side. The current demand for LPG in 2015 was 150,000 Tones and currently more than 80% of the LPG demand is met by import and the state-owned BPC supplies the rest 15-20%. The source for government supply are from government oil refineries, since LPG can be produced as a by-product of oil extraction.

Private sector imports are from Singapore, Malaysia, Saudi Arabia, Abu Dubai and Kuwait. The standard import price is the Saudi Aramco (the state-owned oil company of Saudi Arabia) monthly contract price. When buyers order bulk LPG from international market, they have to pay that monthly Aramco contract price and add the freight per ton charge (for shipment to Bangladesh). While the government subsidizes their portion of LPG, the importers sell their products in line with import price.

However, the fluctuation of price is shown as below in Fig. 2.



Figure 2: International LPG contract price trend



### Competitive Matrix for Existing LPG Based Automobile Industry

The basis on which the customer differentiates between different competitors within the industry purchasing decision. Competitive factors and all weights and ratings in this matrix are determined through existing market research. As much as it closes to the point 1.00, represents the better position in the competitive market. However, we have categories the automobile service provider into three categories based on their customer receipt. Category A supports most customer and category C supports less customer and Category B is in medium category.

**Table 1:** Competitive Profile Matrix (CPM) for A, B, C Category automobile

Items	Weight	Category C		Category B		Category A	
		Rating	Extended	Rating	Extended	Rating	Extended
Kits Quality	0.16	1	0.16	4	0.64	2	0.32
Quality of installation	0.14	4	0.56	3	0.42	3	0.42
Sales promotion	0.09	4	0.36	1	0.09	2	0.18
Product reliability and installation	0.14	2	0.28	3	0.42	3	0.42
After sales service	0.11	3	0.33	3	0.33	3	0.33
Price	0.13	4	0.52	2	0.26	4	0.52
Availability of service contracts	0.03	4	0.12	4	0.12	1	0.03
Time in business	0.05	3	0.15	4	0.20	2	0.10
Warranty length and coverage	0.08	2	0.16	4	0.32	3	0.24
Convenience of show room	0.07	2	0.14	4	0.28	2	0.14
Total	1.00		3.15		3.05		2.70

CPM shows that Category A takes the best market position. Surprisingly, it has the same price ratio as compared with Category C but having good sales promotion and customer support it is market leader. Interestingly, Category C has provided long term warranty but could not able to be market leader.

### Solution and Future Challenge

#### Push and Pull strategy for LPG based car

A combined of pull and push strategy can be applied to see the effect conversions to alternative fueled vehicles.

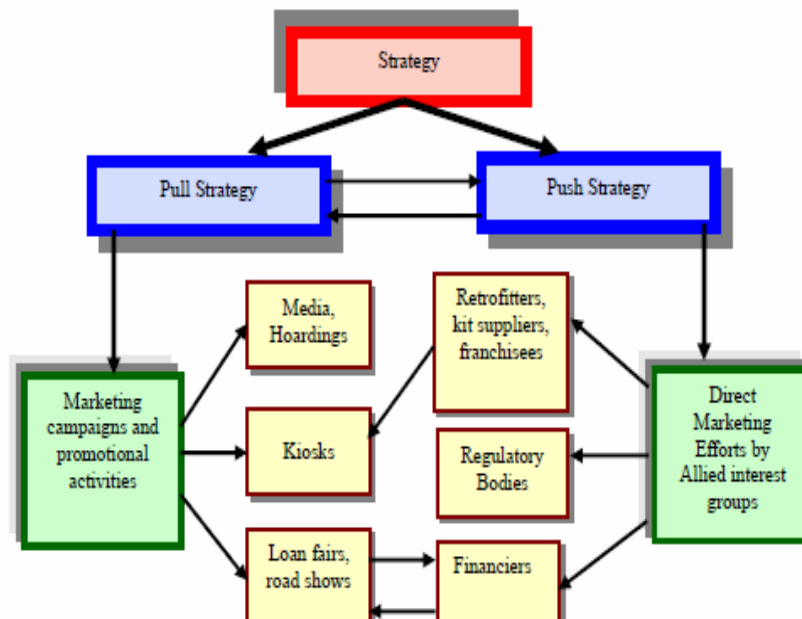


Figure 3: Push and Pull strategy for upholding LPG business



Pull strategy focused on aggressive marketing campaigns and promotional activities. It included intensified road shows concentrating on the economic benefits of alternative fuel along with awareness and education programs focusing upon the misconceptions on safety aspects with respect to alternative fuel as a vehicle fuel. The awareness programs comprised of advertisement in newspapers (media), hoardings at various locations, distribution of leaflets, establishment of alternative fuel kiosks, loan fairs and road shows. The push strategy included direct marketing efforts of other interest groups. All the stakeholders such as kit suppliers, retrofitters, financiers, regulatory bodies, franchisees have been brought on one platform by government. Direct marketing by these groups slowly increased conversions to LPG. Ready availability of kits, prompt retro-fitment services, and initial financial support from the financial institutions prompted many auto rickshaw owners to consider a switch to LPG. The strategy that can be followed by the authority is shown in Fig. 3.

### **Alternative fuel instead of CNG**

Various efforts are on to find alternative fuels viable for Dhaka and some other major cities in Bangladesh. Battery-operated vehicles are the cleanest 'zero emission' vehicles and are plying on narrow routes in Dhaka and some other districts, but have a limited range and carrying capacity. Moreover, the frequent load-shedding prevalent is likely to affect timely recharging. Liquefied petroleum gas (LPG) has been recently given the green signal for use as automotive fuel. The safety considerations are vital and need to be addressed on priority basis. Though the Set up an LPG pump is expensive but the conversion costs of vehicles to LPG may be lower compared to CNG, however the running cost is much higher in this case.

Nowadays, the modern innovation and technologies are being applied in automotive sectors. For example, BMW, Chevrolet, Ford, Honda, Tesla etc. companies are manufacturing electric powered vehicles. Those giant companies are investing huge amount of money for availability of electricity powered vehicles. European countries are subsidizing for electric powered vehicle. They are proving different benefits of the users of electric cars. So, the government of Bangladesh also come forward to meet the challenge of future with a cleaner environment and pollution free country. If the government reduce import tax for the electric vehicle the new car buyer as well as importer will be encouraged to import electric vehicle. In the same time government should encourage the gas stations to setup charging points for the electric vehicles. Once the government set target for clean environment and less polluted country, then moving towards the electric vehicle would not be a huge problem. The government should take the new challenges for electric vehicle for pollution free country.

### **Conclusion**

This study demonstrates that for promotion of alternative fuels for transport sector in the developing countries apart from the command and control approach i.e. a top down approach there are alternative market driven models that can be evolved based on contextual specificities. This requires long-term vision with business model that address concerns of all the major stakeholders evolved in a partnership approach. Such a model not only becomes financially viable but also sustainable in the long run. But it requires appropriate market conditions and deployment of marketing and communication strategies that are facilitated by the governments. The government of Bangladesh should encourage green energy and provide subsidy of electric vehicles rather than the foreign imported crude oil. Using CNG, LPG as a vehicular fuel and electric vehicle will promote innovative technologies, human skills will be developed, and country will be more energy independent.

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