Preference of Domestic Car Users for CNG over Conventional Fuels- An Empirical Study

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Abstract

In the recent years because of fluctuating prices of petrol in the international market, domestic car users particularly business families, middle class families are buying diesel cars. As a result the level of suspended particulate matter and pollution in general is on the rise again. The honorable Supreme Court on July 1998 gave a ruling, which made it compulsory for all public transport vehicles to use CNG as the source of fuel which had given very good results and has lead to drastic reduction of pollution in the capital region of Delhi. This paper is a modest attempt to examine whether domestic car users are ready to switch over to this green fuel.

Introduction

In the near future as our country moves from a developing economy to a developed economy, the number of automobile is going to increase manifold. Despite of the maximum technologically possible reduction in emission from the conventional fuelled Internal Combustion engines, air pollution from vehicles will remain a perennial threat to the public health. As far as Conventional Internal Combustion (IC) engines running on conventional fuels are concerned, there is a limit to emission efficiency. Even if technological advancement reaches its maximum, vehicular emission will always take place and the only option left, in such a scenario, is the alternate fuelled vehicle. With alternate fuelled vehicles, the dream of producing Zero-Emission vehicles shall become a reality. Alternate fuelled vehicles will hold the key to the future of the automobile industry in times to come (Centre for Science and Environment, 2001).

Conventional Fuels and Alternate Fuels

Fuels are the source not only for providing energy to the moving vehicle but also become a source of chemicals whose combustion emits many toxic gases and particulates. These emissions have heavily affected human health and physical environment. To make matters more complicated, fuel is also a resource whose supply is dependent on nature. India has woken up to harsh realities after much damage has been done and is trying to cope with bringing changes simultaneously in technology and fuel quality.

Automotive fuels can be classified into conventional fuels and alternate fuels. While conventional fuels are predominantly fossil fuels like Petrol and Diesel; alternate fuels can be of both fossil fuel origin like Compressed Natural Gas (CNG) and Liquified Petroleum Gas (LPG) and non-fossil fuel origin like Methanol, Hydrogen fuels, Electricity, Solar energy, Bio-diesel. The cost of operating the vehicle on conventional and non-conventional fuel has been compared in Table 1.

Health and environment implication of automobile emissions

Today everyone is concerned with environmental issues as they influence all our human activities. People are increasingly concerned about the impact that air pollution has on the health and on the urban and rural environment. This concern is also backed by increasing

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scientific evidence, which proves that the exhaust of an automobile contains pollutants like carbon monoxide(CO), oxides of nitrogen (NOx), particulate matter and volatile organic compounds(VOCS).Some hydrocarbons from diesel are carcinogenic. Oxides of Nitrogen affect the respiratory tract, leads to bronchial hyper activity, impaired lung defences. Sulphur dioxide leads to asthma, respiratory irritation. Lead can cause impaired mental growth in children. It can also affect the blood chemistry, damage kidneys, nervous system, reproductive system leading to infertility.

The World Health Organization (WHO) has concluded that, on a worldwide basis , suspended particulate matter is the most serious air pollutant which has resulted in a total excess mortality per year of about 4,60,000 additional deaths, of which 1,35,000 are because of chronic obstructive pulmonary disease or chronic asthma and about 90,000 due to cardio vascular disease.

ARAI Study

ARAI , Pune conducted a series of experiment to assess the emissions from Petrol, CNG, LPG and Methanol fuelled vehicles. It is found from the study that (1) Compared to petrol, CO reduction on LPG was 32% and 60% in case of CNG (2) Compared to petrol, CO increases by 7% in case of Methanol (3) Reduction in the reactive Hydro Carbons using CNG for vehicle was 65%, while it was 58.5% in case of LPG and 84% in case of Methanol .This showed that CNG propelled vehicles have significant benefits over Petrol and Diesel propelled vehicles.

In the above backdrop; present study is a modest attempt to investigate whether domestic car users in India are ready to switch over to this green fuel in order to minimize the negative impact of petrol and diesel on human health in particular and environment in general.

Research Methodology

The study was conducted in Delhi. For the purpose of study 50 car owners were randomly selected, which constituted sample for the study. Sample was selected from the areas of Delhi only as CNG is freely available in this area. The study was carried over a span of six months and primary data was collected through a structured questionnaire. Prior to the study, a pilot survey was carried out by taking a sample size of ten car owners.

Taking into consideration the benefits of using CNG and commercialization of CNG in Delhi, the study was carried with the following objectives:-

- To find out the factors, which motivate the domestic car users to switch over to CNG; and
- To study the decision making criteria of consumers while switching over to CNG.

The study was carried out by formulating eight null and alternative hypothesis, which were tested by applying Chi- Square test of independence of variables.

Findings

The results obtained from the survey have been summarized in Table 2 .It was found that most of the domestic car owners did not prefer CNG to petrol. Only 18 (36%) respondents wanted to shift to CNG and of these one- third were above the age of 50 years. All the respondents (100%) people had shown concern for safety and considered it risky. Among the respondents who had shown interest to switch over to CNG had an annual income of more than Rs.1,50,000. As shown in Table 2 it was surprising to observe that switching over to CNG was independent of the family size ($c^2 = 4.102 < 7.82$) and people who wanted to switch over were single and as the family size increased the tendency to switch over had shown a decreasing trend. The decision had nothing to do with the level of education ($c^2 = 4.828 < 9.49$). Maximum interest to switch over was shown by the under graduates (33%) followed by professionally qualified people (28%). The decision to change over to CNG was dependent on the occupation ($c^2 = 13.217 > 9.49$). Mainly service class and businessmen preferred CNG. It may be noted that service class and businessmen taken together do not exhaust the population as professionals and students have been dealt separately in this study. Professionals like doctors and engineers were not using CNG in their cars; students too didn't show keen interest in using CNG as an alternative fuel.

Decision was also gender biased as maximum

respondents who agreed to switch over were males (14/18) and maximum respondents who declined to switch over to CNG were females (17/32). People whose place of work was more than 30 kilometers preferred to switch over to CNG as they consider it to be economical for them. On the other hand, people whose workplace was less than 10 kilometers didn't show any interest in switching over to CNG. Expenditure on fuel was not affecting the decision of change over to CNG as it could be seen from Table A-15 that maximum people who said no to CNG had monthly expenditure between Rs1000 to Rs.3000.According to them maintenance of CNG vehicles compensated for the money saved on fuel. Other factors which were affecting the choice of CNG have been listed in Table 3. From the table, it can be seen that majority of the people considered the cost of fuel as important factor and diesel being cheaper and risk free was the first choice of people under study. Supply of the fuel was also an important factor because CNG is not available outside Delhi in the states of Uttar Pradesh, Haryana , Punjab and Rajasthan. Thus, domestic car users don't prefer using CNG. Since CNG driven cars require maintenance and fitness certificate after few years, therefore, people want to avoid these hassles.

On the other hand, people are happy with the decision of the government to impose CNG as a fuel for commercial vehicles as this has drastically reduced pollution in the capital region of Delhi but surprisingly they don't want the same decision for themselves. This can be seen from Table 4.Only 18% of the respondents agreed that the decision of the government was correct and that if it is implemented on them, it shall be acceptable. Rest of the respondents had given a mixed response. Thus, change over to CNG was not readily acceptable.

General preference and awareness level of the consumers regarding various aspects of fuel and car has been summarized in the Table 5. It was observed that people are aware of the new fuels being introduced in the market, but prefer cheaper form available, all of them abide by the law and possess pollution under control certificate. Majority of the respondents (56%) prefer to go to the same filling station and majority of the respondents (68%) are not aware of the people who have shifted to CNG. Thus it can be seen that CNG is not very popular among domestic car owners at present.

Discussion

Change over to CNG cannot be attributed to its low cost and environmental friendliness but like any other consumer product buyer behavior plays an important part in purchase of a CNG Kit and there by CNG fuel. Since CNG kits cost somewhere around Rs.28,000 to Rs.35,000 and occupies a major portion of luggage space in the car, people are not readily accepting it as an alternative fuel for their car. Decision to change over to CNG is a function of many independent variables like Age, Family Income, Occupation, Gender, and Distance from the workplace. Younger people do not prefer this fuel because it affects pickup and makes the air conditioner less effective. It takes lesser time to fill petrol or diesel as compared to CNG and filling of the cylinder depends on the pressure available at the filling station. It was noticed that people having smaller cars like Maruti 800 or other smaller cars and having income greater than 1,50,000 preferred shifting to CNG but people with bigger cars did not prefer shifting to CNG. Females considered CNG as a menace as it required lot of maintenance, which they wanted to avoid. According to them CNG driven cars suffer from starting problems. People are well aware of the benefits of using CNG but are more concerned about the safety and maintenance of the vehicles. The manufacturers of CNG kits need to give adequate attention to educate the domestic car users about the least risk involved through various tests and retest procedures. They should make the kits readily available at service stations and by giving proper demonstration of CNG fitted vehicles; a customer can be convinced to switch over to this green fuel. In order to promote CNG among domestic car users the manufacturing organizations must take care of the initial investment, which is too high. Introducing financing schemes at retail outlets where CNG kits are available can take care of this.

Since, the study has revealed that people have high concern for environment and have welcomed governments decision to convert commercial vehicles to CNG, this fact itself is an indication that if negative factors like cost of the kit, suitability of AC's, risk associated with CNG and some technological factors related to engine are taken care of, it is not impossible to make people realize the importance and utility of switching over to CNG from already existing conventional fuels like petrol and diesel.

Appendix

1. To test whether switching over to CNG was dependent on the age group following hypothesis were formulated.

   H_0: Shifting to CNG from conventional fuel is independent of Age Group

   H_1 : Shifting to CNG from conventional fuel is dependent on Age Group

Table A-1

Observed Frequencies:

Age in yrs	<30	31-40	41-50	>50	Total
Yes	4	3	5	6	18
No	14	10	6	2	32
Total	**18**	**13**	**11**	**8**	**50**

Table A-2

From the observed frequencies following calculations were performed

i	j	O_{ij}	E_{ij}	$(E_{ij}-O_{ij})^2/ E_{ij}$
1	1	4	6.48	0.949
1	2	3	4.68	0.603
1	3	5	3.96	0.273
1	4	6	2.88	3.380
2	1	14	11.52	0.534
2	2	10	8.32	0.339
2	3	6	7.04	0.154
2	4	2	5.12	1.901
			Total =	**8.133**

Since observed value of $c^2 = 8.133 >$ the table value of $c^2 = 7.82$ therefore Null Hypothesis is Rejected and thus it can be concluded that shifting to CNG from Conventional fuel is ***dependent on Age Group.***

2. To test whether switching over to CNG was dependent on the ***Family Income*** following hypothesis were formulated.

   H_0 : *Shifting to CNG from conventional fuel is independent of* ***Family Income.***

   H_1 : *Shifting to CNG from conventional fuel is dependent on* ***Family Income.***

Table A-3

Observed Frequencies

Income	<50000 60000	50001-150000	60001-	>150000	Total
Yes	**1**	**6**	**4**	**7**	18
No	**6**	**3**	**16**	**7**	32
Total	7	9	20	14	50

Table A-4

From the observed frequencies following calculations were performed

i	j	O_{ij}	E_{ij}	$(E_{ij}-O_{ij})^2/ E_{ij}$
1	**1**	**1**	**2.52**	**0.917**
1	**2**	**6**	**3.24**	**2.351**
1	**3**	**4**	**7.20**	**1.422**
1	**4**	**7**	**5.04**	**0.762**
2	**1**	**6**	**4.48**	**0.516**
2	**2**	**3**	**5.76**	**1.322**
2	**3**	**16**	**12.80**	**0.800**
2	**4**	**7**	**8.96**	**0.429**
			Total =	**8.519**

Since observed value of $c^2 = 8.519$ > the table value of $c^2 = 7.82$, Null Hypothesis is Rejected Therefore shifting to CNG/LPG from conventional fuel is ***dependent on Family Income.***

3. To test whether switching over to CNG was dependent on the Family Size following hypothesis were formulated.

   H_0: *Shifting to CNG from conventional fuel is independent of* ***Family Size***

   H_1: *Shifting to CNG from conventional fuel is dependent on* ***Family Size***

Table A-5

Observed Frequencies

Size of family	Single	2-4	5-7	>7	Total
Yes	7	6	4	1	18
No	7	14	4	7	32
Total	14	20	8	8	50

Table A-6

From the observed frequencies following calculations were performed

i	j	O_{ij}	E_{ij}	$(E_{ij}-O_{ij})^2/ E_{ij}$
1	**1**	**7**	**5.04**	**0.762**
1	**2**	**6**	**7.20**	**0.200**
1	**3**	**4**	**2.88**	**0.436**
1	**4**	**1**	**2.88**	**1.227**
2	**1**	**7**	**8.96**	**0.429**
2	**2**	**14**	**12.80**	**0.113**
2	**3**	**4**	**5.12**	**0.245**
2	**4**	**7**	**5.12**	**0.690**
			Total =	**4.102**

Since observed value of $c^2 = 4.102$ < the table value of $c^2 = 7.82$

Hence the Null Hypothesis is Accepted.

Therefore shifting to CNG/LPG from conventional fuel is independent of Family Size.

4. To test whether switching over to CNG was dependent on the ***Level of Education*** following hypothesis were formulated

   H_0: Shifting to CNG from conventional fuel is independent of ***Level of Education***

   H_1: Shifting to CNG from conventional fuel is dependent on ***Level of Education***

Table A-7

Observed Frequencies:

Education	Matriculation Graduate	Under	Graduate Graduate	Post Qualification	Professional	Total
Yes	**2**	**6**	**3**	**2**	**5**	18
No	**3**	**4**	**9**	**9**	**7**	32
Total	5	10	12	11	12	50

Table A-8

From the observed frequencies following calculations were performed

i	j	O_{ij}	E_{ij}	$(E_{ij}-O_{ij})^2/ E_{ij}$
1	**1**	**2**	**1.80**	**0.403**
1	**2**	**6**	**3.60**	**1.600**
1	**3**	**3**	**4.32**	**0.022**
1	**4**	**2**	**3.96**	**0.970**
1	**5**	**5**	**4.32**	**0.107**
2	**1**	**3**	**3.20**	**0.227**
2	**2**	**4**	**6.40**	**0.900**
2	**3**	**9**	**7.68**	**0.013**
2	**4**	**9**	**7.04**	**0.546**
2	**5**	**7**	**7.68**	**0.060**
			Total =	**4.828**

Since observed value of $c^2 = 4.828$ < the table value of $c^2 = 9.49$.Hence the Null Hypothesis is accepted.

Therefore shifting to CNG from conventional fuel is ***independent of Level of Education.***

5. To test whether switching over to CNG was dependent on the **Occupation** following hypothesis were formulated.

   H_0 : *Shifting to CNG from conventional fuel is independent of* ***Occupation***

   H_1 : *Shifting to CNG from conventional fuel is dependent on* ***Occupation***

TableA-9

Observed Frequencies:

	Service	Business	Housewife	Professional	Student	Total
Yes	7	7	1	2	1	18
No	5	3	6	8	10	32
Total	12	10	7	10	11	50

Table A-10

From the Observed Frequencies following calculations were performed.

i	j	O_{ij}	E_{ij}	$(E_{ij}-O_{ij})^2/ E_{ij}$
1	1	7	4.32	1.663
1	2	7	3.60	3.211
1	3	1	2.52	0.917
1	4	2	3.60	0.711
1	5	1	3.96	2.213
2	1	5	7.68	0.935
2	2	3	6.40	1.806
2	3	6	4.48	0.516
2	4	8	6.40	0.400
2	5	10	7.04	1.245
			Total =	13.217

Since observed value of $c^2 = 13.217$ > the table value of $c^2 = 9.49$.Hence the Null Hypothesis is Rejected. Therefore shifting to CNG from conventional fuel is ***dependent on Occupation.***

6. To test whether switching over to CNG was dependent on the **Gender** following hypothesis were formulated

H_0:Shifting to CNG from conventional fuel is independent of ***Gender***

H_1: Shifting to CNG from conventional fuel is dependent on ***Gender***

Table A-11

Observed Frequencies

Gender	Male	Female	Total
Yes	14	4	18
No	15	17	32
Total	29	21	50

Table A-12

From the Observed Frequencies following calculations were performed.

i	j	O_{ij}	E_{ij}	$(E_{ij}-O_{ij})^2/ E_{ij}$
1	**1**	**14**	**10.44**	**1.214**
1	**2**	**4**	**7.56**	**1.676**
2	**1**	**15**	**18.56**	**0.683**
2	**2**	**17**	**13.44**	**0.943**
			Total =	**4.516**

Since observed value of $c^2 = 4.516$ > the table value of $c^2 = 3.84$

Hence the Null Hypothesis is Rejected.

Therefore shifting to CNG from conventional fuel is **dependent on Gender.**

7. To test whether switching over to CNG was dependent on the **Distance from work place** following hypothesis were formulated.

H_0: Shifting to CNG from conventional fuel is independent of ***Distance from Workplace.***

H_1: Shifting to CNG from conventional fuel is dependent on ***Distance from Workplace.***

Table A-13

Observed Frequencies

Distance(Km)	<10	11-20	21-30	>30	Total
Yes	**3**	**2**	**5**	**8**	18
No	**10**	**12**	**7**	**3**	32
Total	13	14	12	11	50

Table A-14

From the Observed Frequencies following calculations were performed.

i	j	O_{ij}	E_{ij}	$(E_{ij}-O_{ij})^2/ E_{ij}$
1	**1**	**3**	**4.68**	**0.603**
1	**2**	**2**	**5.04**	**1.834**
1	**3**	**5**	**4.32**	**0.107**
1	**4**	**8**	**3.96**	**4.122**
2	**1**	**10**	**8.32**	**0.339**
2	**2**	**12**	**8.96**	**1.031**
2	**3**	**7**	**7.68**	**0.060**
2	**4**	**3**	**7.04**	**2.325**
			Total =	**10.421**

Since observed value of $c^2 = 10.421$ > the table value of $c^2 = 7.82$. Hence the Null Hypothesis is rejected.

Therefore shifting to CNG from conventional fuel is dependent on **Distance from workplace.**

8. To test whether switching over to CNG was dependent on the Expenditure on Fuel following hypothesis were formulated.

H_0 : Shifting to CNG from conventional fuel is independent of ***Expenditure on Fuel***

H_1 : Shifting to CNG from conventional fuel is dependent on ***Expenditure on Fuel***

Table A-15

Observed Frequencies

Expenditure (Rs/month)	<1000	1001-2000	2001-3000	>3000	Total
Yes	**2**	**6**	**7**	**3**	18
No	**4**	**13**	**11**	**4**	32
Total	6	19	18	7	50

Table A-16

From the Observed Frequencies following calculations were performed.

i	j	O_{ij}	E_{ij}	$(E_{ij}-O_{ij})^2/ E_{ij}$
1	**1**	**2**	**2.16**	**0.012**
1	**2**	**6**	**6.84**	**0.103**
1	**3**	**7**	**6.48**	**0.042**
1	**4**	**3**	**2.52**	**0.091**
2	**1**	**4**	**3.84**	**0.007**
2	**2**	**13**	**12.16**	**0.058**
2	**3**	**11**	**11.52**	**0.023**
2	**4**	**4**	**4.48**	**0.051**
			Total =	**0.0387**

Since observed value of $c^2 = 0.0387$ < the table value of $c^2 = 7.82$ the Null Hypothesis is accepted. Therefore shifting to CNG from conventional fuel is independent of Expenditure on fuel.

References

Bhattacharya, K.K(1994), *Emerging Gasoline and Diesel Quality for Clean Air*, mimeo.

Central Pollution Control Board 1995, *Standards for Liquid Effluents, Gaseous Emissions, Automobile Exhaust, Noise and Ambient Air Quality*, Delhi.

Centre for Science and Environment(1996),*Slow Murder The Deadly Story of Vehicular Pollution in India*, Delhi.

Centre for Science and Environment(2001), *Green Rating Project – Environmental Rating of Indian Automobile Sector*, Delhi

Cramer, J. (1998); Environment Management. From fit to stretch, In: ***Business Strategy and the Environment***, Vol. 7, pp 162-172.

Central Pollution Control Board of India (CPCB), 1999. *Workshop on ISO 14001 Certification* for the Chairmen and Member Secretaries of Pollution Control Boards and Committees. Proceedings and compilation of presentations. August 27, 1999.

Das, R.P and Nath Vikas (2003),*Designing Green Supply Chain*, **Effulgence**,Vol 2, No.1,pp 39-54.

Das, R.P and Nath, Vikas (2003), *Green Marketing – An Emerging Issue*, **Prabandh** ,Vol 29, pp 99-103.

Negi, B.S(1993), *Role of GAIL through CNG to Improve Air Quality*, GAIL, Mumbai.

Norman S Wei, "*How to Conduct your own Environment Audits*", Pollution Engineering, September 2001, Vol.33, Issue 8

Pandey, D.K. (2002): *Environmental Consideration*, **Employment News,** Vol. XXVII, no. 29, pp 1-2.

Pundir,B.P,Jain, A.K and Gogia, D.K (1994), *Vehicle Emission and Control Perspective in India:A State of the Art Report*, Indian Institute of Petroleum.