# Determinants of autogas demand among Taxi Drivers in rural Ghana

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**ABSTRACT**

In Ghana, road transport is the major form of transporting goods and passengers from one part of the country to the other making up 95% of the form of transport we have (Baffour-Awuah 2015). Liquefied Petroleum Gas which is mainly produced for household consumption and industrial activities is now being used by vehicles as fuel called autogas assumed to be main cause of shortages of LPG in the country. The study employed both quantitative and qualitative methods in gathering the information through the use of questionnaire and interviews. Since it is a non-parametric study, tables and percentages were used for the analysis. From the studies, 71% of the drivers use LPG and the main reason accounting for their choice was the affordability of the fuel. The brand of car engines used by these commercial drivers were the converted ones with about 98% of those cars consuming only one type of fuel (LPG). The conversion to use LPG started about seven years ago. There is the need to develop appropriate safety, health and market regulations to manage the use of autogas in Ghana.

Key words: Transportation fuel, LPG, Ghana, autogas

## 1. BACKGROUND TO THE STUDY

Transportation is necessary for every socio-economic development of any nation including Ghana. Road transport is very high in the world and in 2010, it was estimated that there were more than one billion road vehicles in the world (Sperling and Gordon 2009). Again, in Ghana for instance, though we have other forms of transport such as the water, air and rail, road transport still remains the main mode of transportation, accounting for about 94% of freight and 97% of passenger traffic movements. Mensah, Annan, & Andoh-Baidoo (2014).

According to Asamoah (2009), energy is demanded for socio-economic activities. This is made possible by the use of vehicles powered by energy such as gasoline (petrol) and gas oil (diesel) but currently autogas which is gaining much popularity. According to *Kakar and Sunil (2013),* autogas

is the third most recently consumed automotive fuel in the world with its major markets located in Turkey, South Korea, Poland, Italy and Australia where about half of their passenger cars consume LPG. Globally, there is a growing trend of vehicles being manufactured to operate on LPG. Liquefied Petroleum Gas (LPG) used in vehicle engines and stationary applications such as generator is commonly called autogas. In addition to LPG, natural gas is also used as autogas. Though both LPG and natural gas can be used for the same purpose there exists some differences between them. LPG containing propane is heavier than air at a relative density of 1.5219 to 1 but natural gas made up of methane is lighter than air with a relative density of 0.5537 to 1. In terms of energy content LPG (propane) has high calorific value of 93.2MJ/$m^3$ than natural gas (methane) with 38.7MJ/$m^3$. In Ghana the main autogas consume is LPG.

The WLPGA Annual Report (2010) indicated that the number of vehicles manufactured to use autogas in the world is increasing. According to Biscoff, Akple, Turkson & Klomega (2012), in Ghana what actually pertains is that the vehicles imported are manufactured to operate on petrol but are converted to run on LPG. Likewise in Turkey almost all vehicles using autogas were converted to use autogas (Karamangil, 2007). Moreover, there is no policy promoting the use of autogas in Ghana. However, due to its benefit, drivers are consuming more of LPG which is subsidised for household consumption so as to evade the tax because of high taxes imposed on gasoline. Drivers prefer LPG due to its cheap price, its protection to the vehicle engines and its protection to the environment. For instance, according to Tettehfio, Apreko, Bolu and Amoakohene (2014) drivers in Ghana are using LPG due to its lower price compared to other alternative fuels as well as its protection on the vehicle engines. Whereas the U.S. Department of Energy Report (2015), explains that autogas is widely used as a “green” fuel in US, Europe and Asia because its use protects the environment in reducing carbon dioxide emissions by approximately 15% as compared to any other fuel. The adoption of autogas by the drivers is believed to be the constant cause of LPG shortages experienced across the country. This study is aimed at providing government with the reason for a policy in Ghana to also cover autogas as other countries such as India, Australia, Italy and United States of America have to prevent the issue of shortages created by taxi drivers.

In most parts of the world the use of autogas as fuel in automotives to replace petrol and diesel has been a major issue. For instance in Asia, Europe and USA the consumption of autogas is backed by government policy in promoting the use of clean energy to reduce carbon emissions. Some of those policies include fuel tax exemptions as in Australia and Thailand, grants or tax credits for conversions as in USA from the WLPGA Annual Report (2015). Others also consume LPG as fuel due to the protection it gives to vehicle engines, its availability and the cost of using it. Globally, the above benefits may be the reasons why drivers consume autogas.

However, in Ghana there is no clear cut policy promoting the consumption of autogas and there appears to be less literature on why vehicle drivers are moving away from the consumption of the conventional fuels to the consumption of LPG. This is evidenced from the fact that there is little study into autogas consumption in Africa and particularly in Ghana. (Bayraktar & Durgun, 2015; Gumus, 2011; Beeretal, 2002, Ackah, 2014). Whereas in some parts of the world similar works on autogas has been done such as; a sustainable alternative- Autogas (Europe), slow diffusion of LPG vehicles (China), and Scenario of the emerging shift from gasoline to LPG fuelled cars (Ghana). It appears there is not enough literature into it and the reasons why there is an increasing conversion of vehicles especially taxis to its consumption in the world and for that matter Ghana.

In Ghana the policy that existed instead, was aimed at encouraging households in Ghana to consume LPG through government subsidies. This has attracted Taxi drivers to consume more of LPG which is subsidised for household consumption so as to evade the petroleum tax because of high taxes imposed on gasoline. The adoption of autogas by the drivers is believed to be the constant cause of LPG shortages experienced across the country. Therefore, with dearth of studies on this topic in Ghana, the purpose of this study is to find out which factors drive the consumption of autogas by taxi drivers in Ghana, a case study of Yilo Krobo Municipality.

## 2.0 THE PREVALENCE RATE OF AUTOGAS CONSUMPTION BY COMMERCIAL VEHICLES

An annual Report from the World Liquefied Petroleum Gas Association (WLPGA) (2010), indicated that there is an increasing number of vehicles converting to the use of LPG worldwide with about 12.7 million vehicles using natural gas. Again, according to WLPGA (2010), in 2008 there were about 21% increase in autogas use over the past 5years making 14.6million vehicles using autogas in the world. And as at 2009, United State of America recorded about 114,270 vehicles using natural gas with 147,030 using LPG. These reports show an increase in the consumption of LPG in the developed countries of the world.

Again, according to the Gas Vehicle Report (2009) the number of natural gas vehicles has increased over the past years in many parts of the world such as America and Asia due to the high price of oil. At the beginning of 2009, there were 9.5 million natural gas vehicles worldwide, which corresponds to a share of 1% of the total vehicles population.

This was supported with the fact that report from the AEGPL (Association Européenne des Gaz de Pétrole Liquéfiés)(2013), indicated an increase in the number of LPG vehicles from 200,000 to 455,000 in Germany and in Italy between the years 2007 to 2011. During the same period LPG cars increased from 1 million to 1,787,000.

Furthermore, literature shows that in December, 2011, the government of Australia introduced a strategic policy for the use of an alternative automotive fuels (AGDRET 2011). And this policy has established an approach as a strategy to encourage the use of autogas and other fuels in the country. Investigations also show that the government support for natural gas as an autogas in Pakistan is to address the current account problems of the country. The large number of 7000–8000 vehicles that are converting monthly to the use of natural gas is an indication. This has been made possible by reducing tax for vehicles which have converted from traditional fuels to Compressed Natural Gas (CNG). And in addition to this, about 3000 natural gas vehicles are produced monthly in the country (Bundesagentur f ¨ ur Außenwirtschaft, 2008). Another developing country such as Bangladesh is also promoting the conversion of vehicles to CNG.

Studies also shows that in Thailand, autogas consumption has also increased as government policy on lower tax has encouraged the use of autogas of about 67% in 2013 making it the net largest importer of LPG. Again, in 2000, almost all the taxis in Shanghai, China, were using autogas with about 80% of commercial buses. And according to CAIY (China Automotive Industry Yearbook) (2001) Shanghai intends to convert all 40,000 taxis to the consumption of autogas by 2001 to 2002 with autogas consumption reaching 260,000 tons per year. Later in 2003, all the taxis in Hong Kong were also using autogas. Then in 2008, more than 60% commercial buses had been converted to autogas. The studies carried out by Polat (2010) shows that in Turkey, there has been an increased consumption of autogas as compared to petrol in 2009 with over 8,500 fuelling stations presently making her have the highest number of autogas stations in the world. The above study was supported by Platts Oilgram News (2011), with its investigations showing an increasing number of vehicles using autogas causing the number of autogas fuelling stations in Thailand to increase from 140 recorded in December 2010 to 1,030 by mid-2011. However, according to Gas Vehicles Report (2009), an increase in the number of fuelling stations rather indicates an increase in the use of natural gas as autogas. The comparison made between countries revealed that Pakistan had the largest number of CNG fuelling stations (about 2600), followed by Argentina (1800), Brazil (1700), and then China (1300), with Germany (800) and Italy (700) having the lowest number of the fuelling stations. Though, in European countries, Germany ranks first with regard to the number of vehicles per fuelling stations (80 vehicles per station), India has 2500 vehicles per fuelling station, and in Iran, 1300 vehicles per fuelling station. Those countries where natural gas is widely used as vehicle fuel that is Argentina, Brazil and Pakistan has a ratio of 1000 vehicles per fuelling station. The countries with the largest numbers of autogas vehicles at the end of 2008 were Pakistan (2 million), Argentina (1.7 million) and Brazil (1.6 million). These countries together have more than half of the worldwide existing stock of natural gas vehicles. In Iran and India, the stock of natural gas vehicles amounted to more than 800,000, followed by Italy (5, 80,000).

According to Tettehfio, et al (2014), the number of vehicles manufactured to operate on LPG is very few but what exists most in Ghana is the conversion of the cars to LPG use. It was estimated that about 75% of taxis in the Tema municipality are using LPG instead of the consumption of petrol and diesel. Edjekumhene, Atta-Owusu and Ampong (2007) explains that although, in Ghana

taxis are converting to the use of autogas there is no record currently on the number of vehicle competing with households over LPG causing the regular shortages of the LPG.

Edjekumhene, et al, (2007) again stated that the increase in the consumption of autogas by taxi drivers is now giving rise to a lot of emerging gas fuelling stations in Ghana. It has been estimated that there is about 40% increment of LPG fuelling station from the year 2000 and 2006.

## 2.3 THE FACTORS THAT INFLUENCE THE CONSUMPTION OF AUTOGAS

Some of the factors that influence autogas consumption in countries are

1. the effects of autogas on income of taxi drivers,
2. its effect on vehicle engines,
3. its effect on the environment and
4. the benefit of autogas to countries with natural gas endowment

a) Its effect on the income of taxi drivers before and after their conversion to the use of auto-gas

In the WLPGA (2015) report, it is economical to use an autogas vehicle. This is because the gas itself is not expensive compared to the alternative fuels petrol and diesel. Cost in consuming the autogas is also reduced since engine oil and spark plugs will not require regular replacements. By this Income of taxi drivers will increase because of lower prices of LPG. The average price of autogas globally is about 55% lower than petrol and about 66% lower than diesel.

Furthermore, studies by Avtogas (2008), indicates that nowadays, price regulation across the globe has kept CNG prices well below gasoline prices (that is less than 50% of those for gasoline) and by this commercial car owners will be able to cut down cost in buying fuel and increase their income levels.

Again, in Ghana according to Ampofo (2010), there is no clear cut policy promoting the use of autogas, and so all vehicles operating on LPG are seen to be evading tax on petrol and diesel because LPG is subsidised for households' consumption. This makes the LPG cheaper for drivers to be able to maximize profit.

b) On the vehicles engines.

Many taxi owners confirm that LPG performs better on vehicle engines causing less damage than the conventional fuels SAEHRB, (2005). An additional studies show that LPG alone guarantees

about 50% extra life span for their engines and for the exhaust system to also last a little longer than any other fuel can do (California Energy Commission, 1999; Menrad et al., 1985)

c) On the environment

According to Dubel (2009), in addition to low cost of the autogas, it is also possible to get higher energy efficiency and lower emissions than with diesel motors. This will help protect the environment.

Furthermore, the use of autogas protects the environment with a reduced amount of carbon and nitrogen emissions. According to the U.S. Department of Energy Report (2015), autogas is widely used as a "green" fuel because its use protects the environment in reducing carbon dioxide emissions by approximately 15% as compared to any other fuel. A litre of petrol that produces 2.3 kg of $CO_2$ when burnt, has its equivalent amount of autogas emitting only 2 kg CO2 when burnt.

In Asia, the main reason for the promotion of natural gas as autogas is its reduction of emissions, particularly in big cities. India is the front-runner and in the second half of the year 1980 she has regulated the use of alternative fuels in public transport and in 1988 the Supreme Court enacted the conversion of commercial cars to natural gas in Delhi. Again, in 2003, the Supreme Court identified nine additional cities with a very high amounts of air pollution and directed for their public transports to be converted into CNG (Yeh, 2007).

d) The benefit of autogas to countries with natural gas endowment

Though most countries subsidise natural gas vehicles due to its lower emissions, economic considerations are also made in some countries such as Latin America with their own natural gas reserves. This is because the gas is used in place of the imported oil to reduce expenses on imports in the account balance of a given country. This is because the use of domestic natural gas as vehicle fuel can have positive effects on the current account balance of a given country (Yeh, 2007). Studies also show that all countries with a substantial share of natural gas use had faced current

account crises (e.g. Argentina) or are currently characterised by high current account deficits (e.g. Pakistan, Bangladesh, Armenia), as well as high foreign liabilities. Those countries which own large oil reserves as well as large natural gas reserves support the domestic use of natural gas in order to increase their oil export volumes.

Moreover, both Bolivia and Argentina are net exporters of natural gas. But Bolivia's share of export in energy is high (Indeed, the country has large natural gas resources (2000Gm3), which could be explored in the long run to benefit the country (International Energy Agency, 2003).

The USSR had abundant natural gas and tried to substitute mineral oil with natural gas in domestic consumption so that oil exports could be increased to earn the country foreign exchange. After the dissolution of the Soviet Union, some successor states still used CNG, in particular the Ukraine, Armenia and, to some smaller extent, Russia(see International Association for Natural Gas Vehicles,2005). Due to its positive impact on the current account of the economy

## 2.4 THE DRIVERS' KNOWLEDGE ON THE EFFECT OF AUTOGAS CONSUMPTION ON THE ENVIRONMENT

According to Inkoom and Biney (2010), LPG is clean, harmless and with high heat content making it a preferred source of energy for households and drivers. Also, it is highly combustible than other crude oil products (WLPGA, 2001).

Again, the investigation carried out by Bayraktar (2005), shows that autogas vehicles emit a less amount of carbon dioxide as low as 40% hydrocarbon and 60% carbon monoxide is not so harmful to the environment.

The WLPGA (2005) report also stated that there is a reduced amount of carbon emissions with the use of LPG by vehicles compared to the conventional fuels. Apart from attempts of advanced

countries to reduce carbon emissions the use of LPG is also aimed at providing energy security to those countries who have the natural gas resource (Johnson, 2002). According to Guangzhou Public Transport Committee Vehicle Control Unit (Gong, 2009), in 2004 there were a number of complains about a black smoke from public vehicle but which stopped after all taxis and public transport buses switched to the use of LPG. With the estimation that commercial vehicles have contributed to the world emissions (Forster et al., 2007; Fuglestvedt et al., 2008), all efforts are being made to use an alternative fuel to reduce this emission (Gumus 2011). Among these clean fuels is LPG recommended to be used by commercial vehicles (Gumus, 2011; Bayraktar and Durgun, 2005).

**METHODOLOGY**

## 3.1 RESEARCH DESIGN

There was collection of primary data because of the qualitative analysis that was made. Primary data is the collection of first-hand information to achieve a purpose such as carrying out a research. Information of this nature was best obtained using a field survey where the researcher had a personal contact with the units of analysis. The study was on Ghana with the focus of an adopted a case study of the Yilo Krobo municipality. A prospective cross- sectional design was adopted in selecting the participants for the study. The study used a cross- sectional design because it provided for one time collection of data and it was a good design for estimating the prevalence of a condition among a population.

## 3.2 POPULATION

The targeted population under consideration was all taxi drivers whose activities covered Somanya and its surroundings as well as the attendants of all fuelling stations in Somanya.

## 3.3 SAMPLE SIZE

The study used this method for the sampling that was n=N/1+N ($e^2$) where n=sample size N=total population e=sign error of 5% with a sampled size of 100 taxi drivers and at least 6 fuelling station attendants for the three fuelling stations in Somanya. But due to the limitations mentioned above only 79 commercial drivers and four fuelling station attendants were questioned and interviewed respectively. According to Trochim (2006), purposive sampling has to do with selecting of a section of people with a demonstrated knowledge and expertise in some area.

The study adopted purposive convenience sampling techniques in selecting the participants for the study. According to Vanderstoep and Johnson (2009), convenience sampling involves choosing the participants from the nearest and readily available site. Hence the study collected data from drivers who were near and readily available to the area of study. They were also the objects of the study with the requisite knowledge in the field of study in the Yilo Krobo Municipality.

## 3.4 INSTRUMENTS FOR DATA COLLECTION

Different kinds of data were collected to find the actual causality of the problem that was finding a reliable information to achieve this purpose, the study employed an interview and a questionnaire. Structured questionnaire and interview were employed in the sense that individual drivers and fuelling station attendants needed to respond to specific questions as the research demanded of them. Open and closed ended questions were posed in both the questionnaire and interview.

## 3.5 PROCEDURE FOR DATA COLLECTION

This study was done by sending the questionnaire to the various lorry stations and given to those drivers (respondents) available at the stations to respond to them. Respondents were guided to answer the questionnaire. All fuelling station attendants who were willing to grant the interview were interviewed, that was self-selection.

## 3.6 DATA ANALYSIS

The data was analysed based on the findings from the study. Both quantitative and qualitative analysis were made. Quantitative analysis was made using numbers and words used for qualitative analysis. Both quantitative and qualitative analysis was made on information from the questionnaire and interview. The analysis was done by use of Statistical Package for Social Scientist (SPSS) software. With the analysis on the prevalence of the use of autogas, simple frequency and percentage tables with bar graphs were used to find the prevalence rate in the number of drivers consuming LPG than the consumption of petrol and diesel, the various reasons for which they are consuming LPG instead of the conventional fuels and to find out the knowledge of commercial drivers on the effect of emission on the environment. This was to ascertain the factors that actually influence their choice of fuel whether it was profit making, government policy, emissions on the environment or the effect of the fuel on the vehicle.

# 4.0DATA ANALYSIS AND DISCUSSION OF RESULTS

## 4.1 Demographic Characteristics

The demographic characteristics of the respondents considered in the study include; gender, marital status, household size, age as well as educational background of taxi drivers. A total of seventy-nine respondents were involved in the study.

### 4.1.1 Gender

The first demographic variable considered in the study is the gender of respondents. Results obtained from the study indicates that all the respondents were males. This is quite expected because commercial driving in Ghana is mostly undertaken by males with negligible proportion of females engaging in the trade.

### 4.1.2 Marital Status

The next demographic variable of concern is the marital status of respondents. Table 1 summarizes the percentage distribution of respondents' marital status.

**Table 1 Distribution of Marital Status**

| Marital Status | Number of Respondents | Percent (%) |
|---|---|---|
| Single | 23 | 29.1 |
| Married | 55 | 69.6 |
| Divorced | 1 | 1.3 |
| Total | 79 | 100 |

**Source: Author's survey, 2016.**

Results from Table 1 shows that majority of the respondents were married. Specifically, about 70 percent (N=55) of respondents were married whiles 29 percent were single. Also, one respondent was divorced. In summary, the study was dominated by married taxi drivers.

### 4.1.3 Household Size

The study also considered the size of respondents' household. The summary of the percentage distribution of this variable is presented in Table 2.

**Table 2 Percentage Distribution of Household Size**

| Household Size | Number of Respondents | Percent (%) |
|---|---|---|

| | | |
|---|---|---|
| Independent | 12 | 15.2 |
| 1-3 | 35 | 44.3 |
| 4-6 | 32 | 40.5 |
| Total | 79 | 100 |

**Source: Author's survey, 2016.**

Results obtained in Table 2 indicates that about 44 percent (N=35) and 41 percent (N=32) of respondents have a household size between 1 to 3 and 4 to 6 respectively. However, about 15 percent (N=12) of respondents live independently.

### 4.1.4 Age Group

The age group of respondents was also considered in the study. The age distribution of respondents is summarized in Table 3.

**Table 3 Age Distribution of Respondents**

| Age Group | Number of Respondents | Percent (%) |
|---|---|---|
| 18-35 years | 30 | 38 |
| 36-55 years | 32 | 40.5 |
| Above 55 years | 17 | 21.5 |
| Total | 79 | 100 |

**Source: Author's survey, 2016.**

It can be observed fro Table 3 that the majority of respondents constitute the economically active sections of the population. About 41 percent (N=32) and 38 percent (N=30) of respondents were found within the age groups of 36-55 and 18-35 years respectively. Also, about 22 percent of respondents were above 55 years of age.

### 4.1.5 Educational Background

The final demographic variable considered in the study is the educational background of respondents. Respondents were first asked whether they possess any form of formal education. The results obtained indicates that all respondents have had some form of formal educational background. The study further enquired about the level of education attained by the respondents. Table 4 presents the summary of the distribution of the level of educational attainment of respondents.

**Table 4 Distribution of Level of Educational Attainment**

| Level of Education | Number of Respondents | Percent (%) |
|---|---|---|
| MSLC | 34 | 43 |
| JHS | 30 | 38 |
| SHS | 12 | 15.2 |
| Technical | 2 | 2.5 |
| University | 1 | 1.3 |
| Total | 79 | 100 |

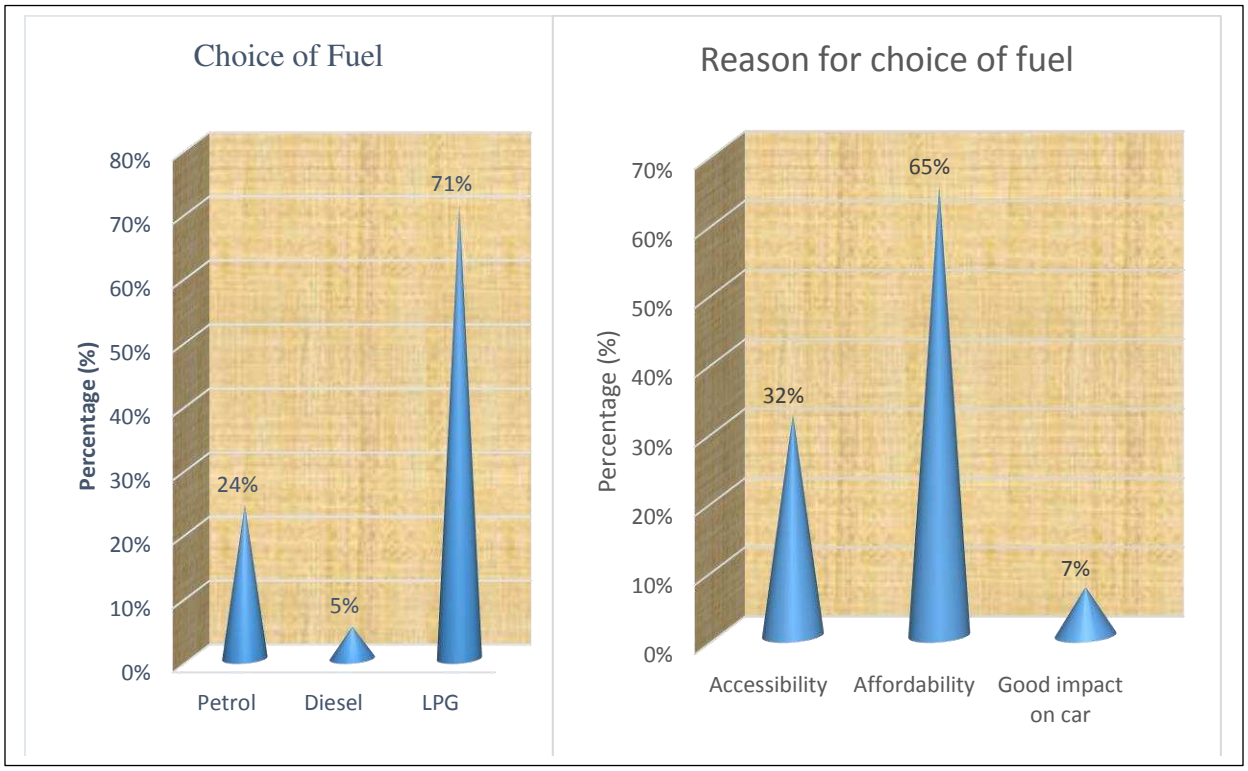
**Source: Author's survey, 2016.**

The results from Table 4 shows that the study is dominated by respondents with Middle School Level Certificate with a frequency of 34 (43%) respondents. This is closely followed by respondents with JHS qualification recording a frequency of 30 (38%) whiles about 15 percent had SHS qualification as minimum academic qualification. Also, about 3 percent and 1 percent of respondents attained the level of technical and university education respectively.

### 4.2 Choice of Fuel

The study sought to investigate the number of drivers who use auto-gas as well as the reasons for their choice of fuel. Figure 1 presents the distribution of the choice of fuel used by the taxi drivers as well as the motivation for their choice.

**Figure 1 Choice of Fuel Use**




**Source: Author's survey, 2016.**

Results obtained from Figure 1 shows that majority of the taxi drivers (71%) use LPG as the main source of fuel for their vehicles. Also, 24% and 5% of taxi drivers use petrol and diesel respectively for their vehicles. However, the taxi drivers were tasked to explain the reason for their choice of

fuel. Affordability of the fuel is the central reason influencing their choice with 65% of respondents alluding to that fact. Other drivers have identified accessibility and good impact on their vehicle as the motivation for their choice of fuel with 32% and 7% of respondents reporting that assertion respectively. These results are consistent with the findings of Tettehfio et al. (2014) who reported that about 75% of taxi drivers in the Tema municipality use LPG. In summary, LPG is the dominant source of fuel used by the taxi drivers' whiles citing affordability as the fundamental motivation behind their choice.

### 4.3 Multiple Fuel Use and Engine Brand

The study among other things investigated the number fuel types used as well as brand of the engine of the vehicles of respondents. Results from the study indicates that about 89% of respondents (N=70) use only one fuel for their car whiles about 11% (N=9) use two types of fuels. Also, about 56% (N=44) of respondents had brand of car engines which were converted whiles 43% (N=35) use brand of engines which is original. This result is consistent with findings of CAIY (2001) who reported that more than 60% of commercial vehicles have converted to the use of autogas. Table 5 presents the summary of the distribution of number of fuel use and engine type used by taxi drivers.

**Table 5 Distribution of Fuel Use and Engine Brand**

| Fuel use and engine brand | Frequency | Percentage |
|---|---|---|
| **Number of fuels used** | | |
| One | 70 | 88.6 |
| Two | 9 | 11.4 |
| | | |
| **Brand of car engine** | | |
| Converted car | 44 | 55.7 |

| | | |
|---|---|---|
| Original car | 35 | 44.3 |
| Total | 79 | 100 |

**Source: Author's survey, 2016.**

To ascertain the brand of engine cars which use multiple fuels, the study constructs a cross-tabulation of the two variables. The results is presented in Table 6.

**Table 6 Cross-tabulation of number of fuel use and brand of car engine**

Count

| | | Brand of your car engine | | **Total** |
|---|---|---|---|---|
| | | converted car | original car | |
| Number of fuel use | One | 43 | 27 | **70** |
| | Two | 1 | 8 | **9** |
| **Total** | | **44** | **35** | **79** |

**Source: Author's survey, 2016.**

It can be observed from Table 6 that about 98% of converted car engines use only one type of fuel whiles 77% of original brand of engines also use one type of fuel. It can therefore be concluded that majority of the taxi drivers who converted their engines use only one type of fuel without maintaining both engines.

In addition, the study attempts to examine the rate of the drivers' decision to switch to the use of LPG. That was to find out if it is a recent occurrence or a long time phenomenon. The results from this enquiry is presented in Figure 2.

**Figure 2 Period of Conversion to Use LPG**


**Source: Author's survey, 2016.**

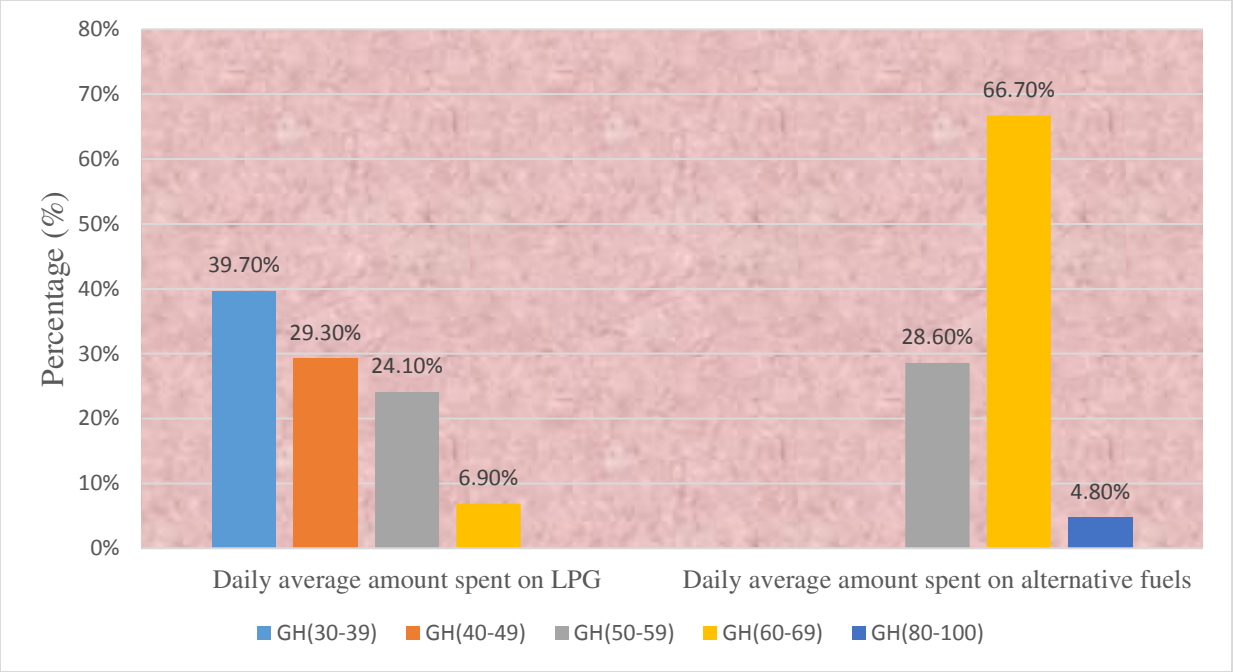
Results from Figure 2 indicates that about 32% (N=18) converted to the use of LPG between 1-2 years ago whiles 25% (N=14) did that between 5-6 years ago. It can be concluded that majority of taxi drivers who converted to the use of LPG for their cars did that less than seven years ago.

### 4.4 Justification for Fuel Choice

#### 4.4.1 Comparison between fuel prices

This study have revealed that majority of taxi drivers are increasing switching from petrol and diesel to the use of LPG. The study therefore attempts to investigate the daily average amount of money spent on LPG and other alternative fuels such as petrol and diesel. The distribution of the results is presented in Figure 3.

**Figure 3 Distribution of daily average expenditure on LPG and alternative fuels**



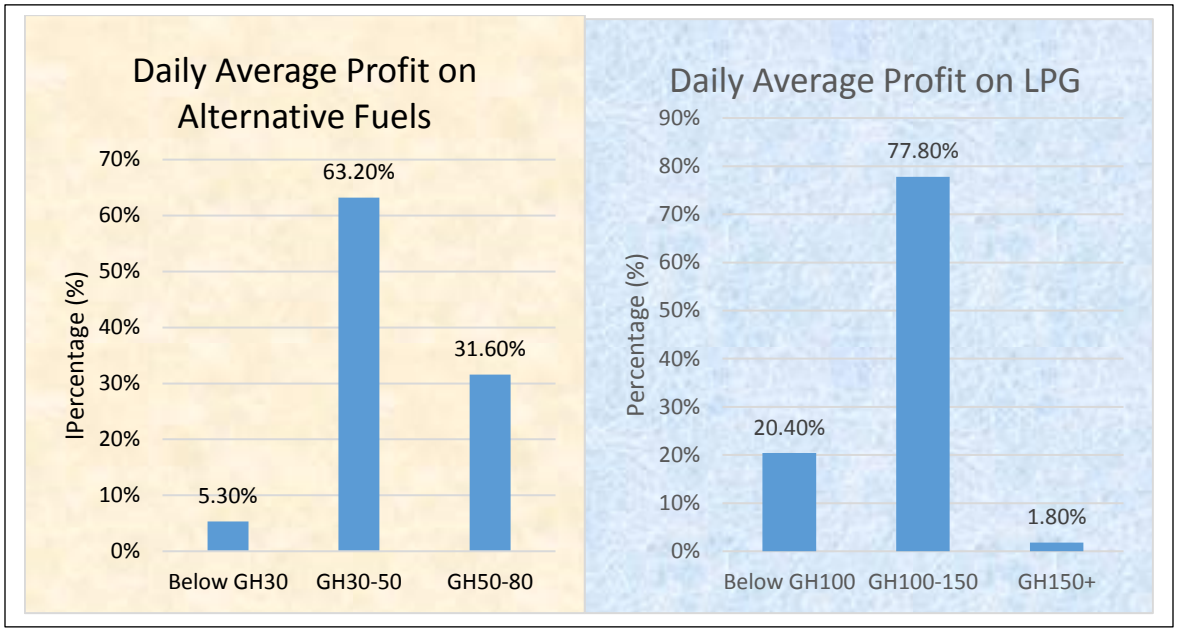

**Source: Author's survey, 2016.**

Results from Figure 3 indicates that majority of taxi drivers who use LPG spend less than GH¢50 a day. However, majority of the taxi drivers who use alternative fuels such as petrol and diesel spend GH¢60-69 on the average daily. It can therefore be concluded that taxi drivers who use LPG as fuel for their cars spend less daily.

### 4.4.2 Profit Made on LPG against Alternative Fuels

Another justification for the choice of LPG over alternative fuels is the average daily profit made by the taxi drivers. Respondents were asked to report the profit they earn on the average daily with the use of LPG as against alternative fuels like diesel and petrol. Table 5 summarizes the distribution of average daily profit on LPG against alternative fuels.

**Figure 5 Average Daily Profit Made on LPG against alternative Fuels**



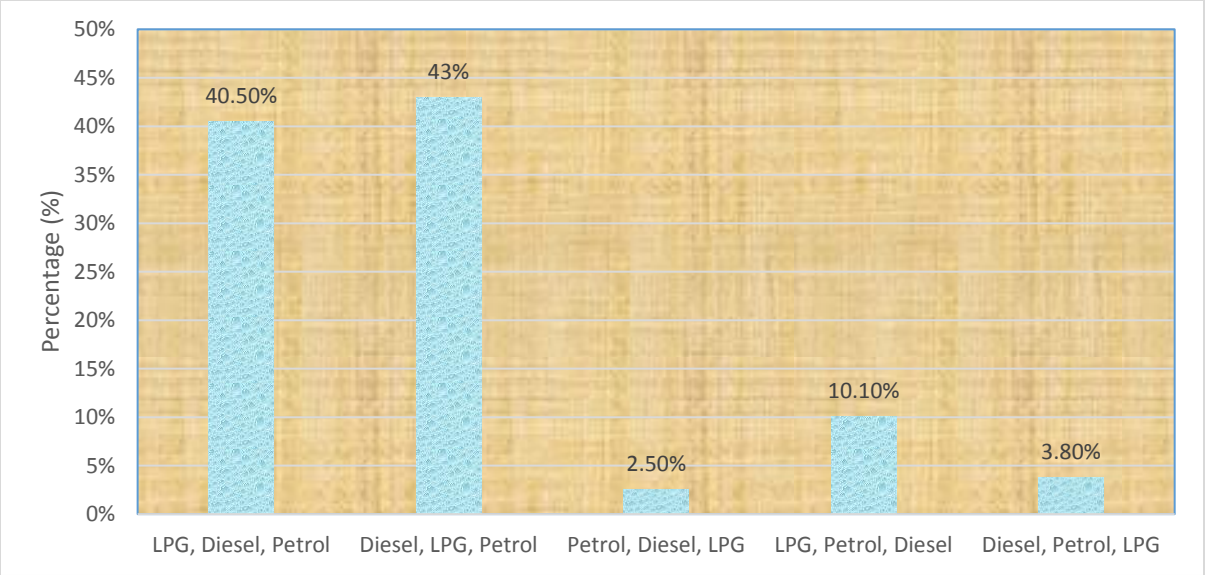

**Source: Author's survey, 2016.**

Results obtained from Figure 5 shows that about 80% of taxi drivers who use LPG make a daily average profit between GH¢100-150 whiles about 63% of respondents who use alternative fuels make daily average profits between GH¢30-50. Clearly, it can be concluded that taxi drivers make substantial profits using LPG than their counterparts using alternative fuels, thus explaining the increasing conversion and use of LPG.

### 4.5 Order of Preference of Fuel Types

Given that some taxi drivers use multiple fuels for their cars as well as others increasingly converting to LPG, respondents were tasked to rank their order of preference for fuel use. The results of their preference is presented in Figure 6.

**Figure 6 Preference Ordering of Fuels**

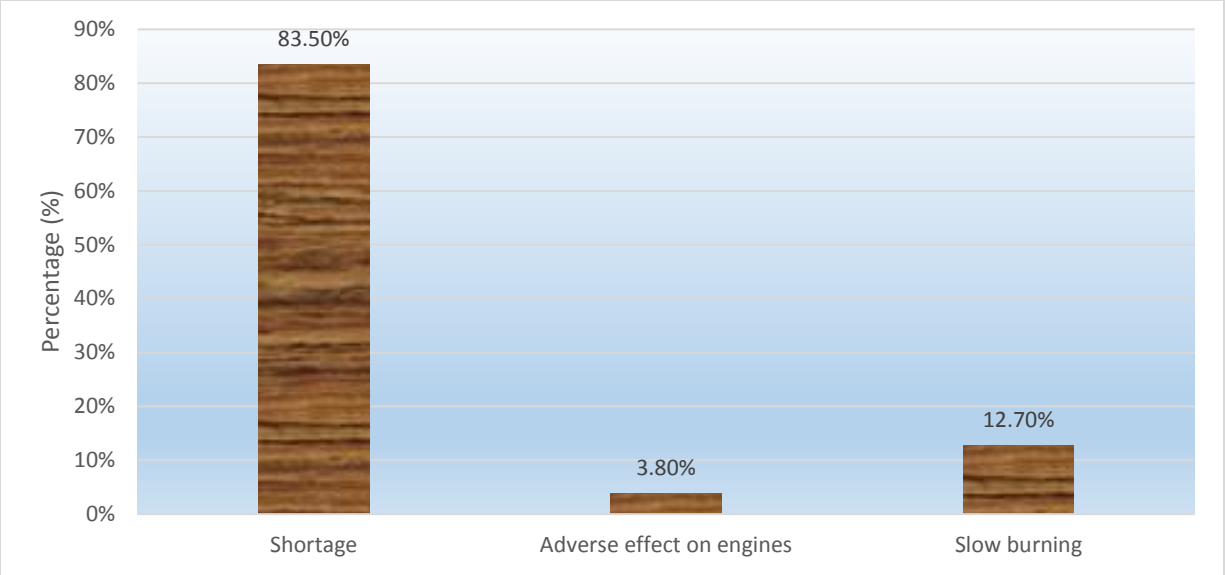



**Source: Author's survey, 2016.**

Results from Figure 6 indicates that 43% of respondents prefer the order of Diesel, LPG, Petrol whiles 40.5% of them prefer the order LPG, Diesel, Petrol. It is quite striking that most respondents have revealed their preference for diesel first before LPG despite the latter's comparatively lower price and higher profit margins.

In an attempt to explain the respondents' preference ordering, the study further enquired about the challenges faced using autogas as the primary fuel for cars. The distribution of this inquiry is presented in Figure 7.

**Figure 7 Challenges Faced Using Autogas**




**Source: Author's survey, 2016.**

It can be observed from Figure 7 that majority of taxi drivers have identified that intermittent shortage of LPG is the fundamental constraint of the use of autogas. LPG fueling stations are very few as compared to petrol and diesel. This basically explains why taxi drivers despite the affordable price and higher profitability of LPG, prefer the order diesel, LPG, petrol. Ampong (2007) explains that LPG shortages occur because of the competing use of the fuel for household consumption. Also, about 13% of respondents have lamented about the slow burning process of LPG whiles 4% reported that the fuel has adverse effects on their engines. This is in contrast with a study by California Energy Commission (1999) and Menrad et al (1985) which shows that LPG alone guarantees about 50% extra life span for car engines and for the exhaust system to also last a little longer than any other fuel can do.

### 4.6 Knowledge of Petrol and Diesel on Environment

To address the final objective, the study assesses respondents' knowledge on the adverse effects of the use of diesel and petrol on the environment. The distribution of this inquiry is summarized in Table 4.7.

| Knowledge of Petrol and Diesel on Environment | Number of Respondents | Percent (%) |
|---|---|---|
| Air pollution | 11 | 13.9 |
| Don't Know | 68 | 86.1 |
| Total | 79 | 100 |

**Source: Author's survey, 2016.**

The results obtained from Table 7 shows that about 14% of respondents (N=11) have identified that the use of diesel and petrol pollutes the air through the emissions from exhaust pipes of cars. However, majority of the respondents (86%) do not have any idea of the adverse effects the use of diesel and petrol has on the environment. Thus, in spite of the reduced carbon emissions from the use of LPG as studied by Gumus (2011), most taxi drivers are not aware of the benefits it has on the environment as compared to alternative fuels. It can be concluded that, respondents are much more concerned about the economic benefits from the use of autogas rather than the environmental benefits.

The section presented the analysis and discussion of the results of the study. Firstly, it analyzed the demographic characteristics of the respondents involved in the study. It further investigated the number of respondents who use LPG as well as the justification for their choice of fuel. Finally, the study assessed the respondents' knowledge of the use of petrol and diesel on the environment. The next chapter of the study provides a concise summary and conclusion of the study as well as the relevant recommendations.

## 5.0 CONCLUSION

The problem of the study was to find out the factors that drives the consumption of autogas by taxi drivers in Ghana. And the objectives were; to ascertain the prevalence rate of commercial drivers that consume autogas, to identify the factors influencing commercial drivers' consumption of autogas instead of the conventional fuels, petrol and diesel and to finally assess the knowledge of drivers on the effect of autogas consumption on the environment. On the demographic characteristics of the various respondents, all the seventy-nine taxi drivers were married men with few dependants. The study also showed that majority of the drivers were between the ages of 36-55 years of age and they all had some level of education with the Middle School Living Certificate holders being the majority.

From the studies, 71% of the drivers use LPG and the main reason accounting for their choice was the affordability of the fuel. The brand of car engines used by these commercial drivers were the converted ones with about 98% of those cars consuming only one type of fuel (LPG). The conversion to use LPG started about seven years ago. Drivers consuming LPG spend less daily on the LPG than the alternative fuels hence they make a substantial amount of profit on LPG than the alternative fuels. This explains the reason why there is an increasing conversion and use of LPG but with the challenge of shortages of LPG and few fueling stations, majority of the driver showed much preference for diesel to LPG. The study indicated that the drivers had no idea about the effect of emission from alternative fuels on the environment but were much concerned about the economic benefit than the environmental benefits from the fuel type they consume.

The analysis shows clearly that the conversion to the consumption of autogas by commercial drivers in Ghana is increasing mainly because of economic benefits and not due to environmental concerns as pertains in others countries like Europe among others

## 5.1 RECOMMENDATION

The study showed that the use of LPG will improve the living standards of commercial drivers from the profits they make hence there is the need for government to make the use of autogas a policy to enable the commercial drivers to use the LPG and to make provisions for constant supply of the fuel to them to avoid the regular shortages. Government should develop health and safety

regulations for the autogas industry. Finally, commercial and industry should take advantage of the high demand for autogas to invest in areas that will make the product available.

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