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Usage of Autogas within the Road Transport Industry in Two Contrasting Settlements in Ghana

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Abstract
Road transport carries beyond 95% of passenger and freight traffic in Ghana. Though autogas, also referred to as Liquefied Petroleum Gas (LPG) was traditionally encouraged to be used in residences and households, many road transport owners and drivers have shifted to the use of the fuel. The main objective of the study was therefore to ascertain the consumption characteristics of autogas in the urban and rural administrative districts in the Central Region of Ghana. The study adopted both quantitative and qualitative methods in gathering data, using questionnaire and interview schedule. Multistage sampling technique was used in choosing the region, Metropolitans, Municipalities and Districts (MMDs). Ten rural and urban districts were considered while five hundred and fifty-six drivers partook in the study. Open- and closed-ended questions were posed. The Statistical Package for the Social Sciences (SPSS) software (Version 21) was employed as the in the analysis. Descriptive tools such as frequencies, percentages, and tables were utilized in the analysis. It was found among others that between 19 percent (within the districts) and 39 percent (in the metropolis/municipalities) of the drivers use autogas to power their vehicles comprising taxis, private cars and minibuses. The ratios of autogas, gasoline and gasoil usage in the rural and urban districts were 19:29:58 and 39:20:45 respectively. This consumption can be said to be substantial enough to influence autogas shortages. The paper recommends that there must be an integrated and holistic approach, designed in a strategic fashion in dealing with the supply chain of the fuel to avoid frequent shortages.
Keywords: liquefied petroleum gas; rural; transportation; urban.

1.0 Introduction

The importance of transport in the development of communities, societies and states through urban growth, social stratification and forms of symbolic communication as well as rural advancement by acting as an enabler of trade between persons has been recognized and acknowledged throughout history (Garrison, 2001). Various goods are transported by means of pipe lines, canals, waterways, airways, railways and roads in this regard. Human beings are also transported via these means with the exception of pipe lines.

Road transport is the most common means of transport globally. Five hundred and ninety million automobiles were on roads worldwide in 2002. Many advantages accrue from the use of road transport. First, there is flexibility of moving vehicles from lane to lane and road to road as the need may be. This flexibility ensures easy adjustment in relation to travel time, speed, location and direction as well as facilitating direct delivery and conveying services (Intergovernmental Panel on Climate Change, 2007).

Secondly, the flexibility of transport is associated with relatively small capacity transportation. However land use area, and energy requirement are high thus breeding negative consequences to the environment through pollution.

In Ghana road transport carries beyond 95% of passenger and freight traffic, reaching majority of communities through feeder, urban and trunk roads. Vehicles are thus plied in urban and rural communities, both inter and intranetworking to produce the net development agenda of the nation. The road transport sector therefore consumes large quantities of energy; the commonly used ones being gasoline (petrol) and gasoil (diesel); both derived from petroleum.

Vehicles used for human and luggage transport in urban and rural communities in the country are mainly taxis and urban buses referred to as “trotro”. With increased investments in the transport sector in the past two decades the demand of energy in the country has increased tremendously (Mahama, 2012).

The parallel demand of energy in the domestic sector has also contributed to high energy requirement in the country causing energy shortages. Though LPG was traditionally encouraged to be used in residential and domestic households in the country, many road transport owners and drivers have shifted to the use of the gas.

Autogas has many advantages. Its users have tax breaks and less tax than petrol or diesel. It is environmentally friendly than petrol or diesel and has many technical merits that supports its use. However with more of its use in the road transport there has been the belief that shortages of LPG in the country is as a result of the inclusion of road transport users in its patronage. Both politicians and sections of the public are of the view that, motorists have contributed to a large extent, the recent intermittent shortages of LPG in the country. However there appear to be no records on the ratio of vehicles using autogas as well as the exact quantity consumed. It is therefore evidenced that studies relating to autogas and autogas fuelled vehicles for that matter are scanty in Africa in general and Ghana in particular. (Bayraktar & Durgun, 2015; Gumus, 2011; Beeretal, 2002)

Considering the fact that the Central Region is one of the regions usually hit by these shortages there is the need to ascertain the usage of fuel in the region. The Central Region is one of the ten administrative regions in Ghana (Maks Publications & Media Services, 2006). It is located in southern Ghana and bounded by Ashanti Region in the north–west, Eastern Region in north–east, Greater –Accra Region in the east, Western Region in the west and the Gulf of Guinea in the south. The region has 20 administrative districts (comprising metropolis, municipals and districts; MMDs) with Cape Coast, the former national capital, as its administrative capital (Refer Figure 1).

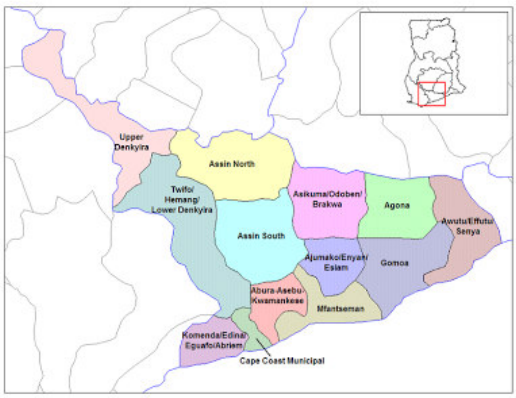

Figure 1: Map of Central Region, showing some of the administrative districts in the study area (Source: Ghanadistricts.com)

The region has a population of about 2, 376,020 according to the 2010 population census. It currently has 20 administrative districts, made up of metropolis, municipalities and districts. The metropolis and municipalities are urban in character; the districts being rural.

With population density 220/km^2 the region has a land mass of 9826 km^2. It is rich in academic institutions particularly secondary and tertiary institutions, tourist attractions such as castles, forts, lagoons; and beaches stretched along the coast line. The economy of the region is dominated by fishing, mining and services (both private and public). Tourist attractions include UNESCO World Heritage Site such as the Cape Coast and Elmina Castles as well as the Kakum National Park. The region is therefore one of the major contributors to the socio–economic development of Ghana. Road transport for this reason is very prominent making it a dependable and dependent source and means of transportation in the region. Intermittent and erratic supply of energy to the road transport sector can disrupt social and economic activities in the region in particular and Ghana in general. The use of autogas with its numerous advantages particularly to the environment and relatively lower cost might therefore be the reasons behind its patronage by vehicle owners and drivers.

The objectives of this study were therefore to find out the proportion of vehicles that use autogas in the urban and rural administrative communities in the region. It also ascertain the relative quantity and amount of autogas used and spent respectively by vehicles in the region. The study further aimed at making a comparative analysis between rural and urban autogas consumption characteristics. Reasons for the shift of energy by vehicle owners and drivers were also sought

It is hoped that findings from this study will enrich the database of energy usage in the region in particular and the country in general. The results will also contribute to policy design and implementation in both region and country. Recommendations, it is also hoped, will go a long way to help stakeholders such as politicians, academicians, the media and the general public to form a scientific opinion on the usage of autogas in the country thus shaping policy formulations in the energy and other related sectors of the Ghanaian economy.

1.1 Study area

The study considered six districts, three municipalities and one metropolis. The rural districts include Ewutu-Senya, Twifo-Atti/Mokwa, Assin-South, Assin-North, Gomoa-East and Twifo/Hemang/Lower-Denkyira. The urban districts are Mfantsiman-East, Efutu Municipality, Agona-West Municipality and the Cape Coast Metropolis. Information in the study area section was obtained from Ghanadistrcts.com (Refer figure 1).

The Ewutu-Senya District forms part of the districts carved in 2012. The district capital is Awutu-Breku. It shares boundaries with Ewutu-Senya-East Districts to the East and North, Efutu Municipality to the West and to the South with the Atlantic Ocean (Gulf of Guinea). Farming and civil services are the main economic activities.

Twifo-Praso is the administrative capital of Twifo-Atti/Mokwa District. Its capital is Twifo-Praso. The district in bounded to the North by Lower-Denkyira and to the South by Twifo/Hemang/Lower-Denkyira Distrcts. It covers an area of 1199 km^2. Inhabitants are mainly engaged in farming, with civil service and commerce in towns such as Twifo-Praso. The District had a population of 107,787 people in 2010. The current population growth rate in the district is 2.2 percent.

Nsuaem-Kyekyewere is the administrative capital of Assin-South District. It is one of the 46 new districts carved in June 2012. It is bounded to the West by Twifo-Heman-Lower- Denkyria District, Abura/Asebu/Kwamankese District to the South, to the East by Odoben-Brakwa District and Ajumako/Enyan/Esiam District and to the North by the Assin-North Minicipal. Farming is the main economic activity.

Assin-North District is also one of the administrative districts in the Central Region of Ghana. Fosu is the municipal capital with a population of 20, 541 according to the 2010 population census. The district has a population of 161,341 (Ghana Statistical Service, 2010). The main economic activities are farming, commerce and civil service.

Afransi is the capital of Gomoa-East District. It is a new district carved on the 29th of February 2008 among the 27 created. It shares boundaries with Awutu-Senya-East District to the East, Asikuma-Odoben-Brakwa District to the West, Agona-West Municipality to the North and to the South and mother district, Gomoa-West. The main economic activity is farming.

Twifo-Heman-Lower-Denkyira is also one of the new districts in the region, with Heman as the administrative capital created on 28th June 2012. The district shares boundary with Abura-Asebu-Kwamankese district to the East, Twifo-Atti-Mokwa to the South, Mpohor- Wassa-East district to the West and Upper-Denkyira-East Municipality to the North. The Kakum National Park is located in the administrative district. Farming, tourism and civil service are the main economic activities.

The Mfantsiman-East Municipality is bounded by Abura-Asebu-Kwamankese to the West and North West, Ekumfi District to the East and the Gulf of Guinea to the South. It has a land mass of 533 $km^2$with Saltpond as the district capital. The main economic activities are farming, fishing and small scale businesses. Saltpond is the first town to experience off –shore oil drilling in Ghana. However no middle or downstream oil activity takes place in the capital. As at 2012 the population of Saltpond stood at 24,132. The main economic activities are civil service, fishing and farming.

With Winneba as the administrative capital, the Efutu Municipality is bordered to the North by Agona Municipality, North-East by West-Akim Municipality, to the East by Gomoa District and to the South by the Gulf of Guinea. The land mass is 417.3$km^{2.}$ The population of Winneba is 58,750 as at 2012. The main economic activities are farming and civil service. It has various educational institutions including a public university.

Agona-West Municipality has Agona-Swedru as the capital. The district has a population of 115,358. It is bounded to the East and West by Efutu Municipality and Asikuma-Odoben-Brakwa District respectively. The municipality shares a border to the North-East with Akim-West Municipal, to the North-West with Birim-South District and to the South, with Gomoa District. Agona-Swedru has a settlement population of *68,216 people as at 2012*. It lies to the North of Winneba and is about 40 km off the main Accra-Takoradi Highway. The location of the township makes it a commercial centre of the region and a nodal point from which roads radiate to the rich cocoa growing countryside of the Region. It has a total land area of 667 square kilometres. Economic activities are mainly farming, commercial and civil service activities.

The Cape Coast Metropolis is the largest administrative district in the region. It has a land mass of 122 square kilometres with Cape Coast as the administrative capital. It has boundaries with Komenda-Edina-Eguafo-Abrem Municipal to the West, Abura-Asebu- Kwamankese District to the East, Twifo-Hemang-Lower-Denkyira to the North and the Atlantic Ocean to the South. The population of the Municipality stood at 169,894 (Ghana Statistical Service, 2012). The main economic activities include tourism, fishing, commerce, and civil service. An industrial area was completed in 1976. The town produces soap, sugar cane and other horticultural products, poultry products, cocoa products, beverages, salt, and chemicals.

2.0 Literature review

This section reviews literature relating to the use of autogas in road transport as sustainable fuel globally in general and Ghana in particular. It also deals with the benefits of autogas and LPG use in Ghana with reference to empirical studies.

2.1 Autogas as sustainable energy

Urban and rural movement of people, animals and goods from one location to another has become regular activities and the norm in various settlements. Though there are various methods and means by which this could be done, road transport by virtue of its flexibility in terms of timings of travel, speed of travel, change in direction and location and the resulting capability of changing lanes and roads and ability to offer immediate door to door services has become the most popular and widely used means of transportation around the globe. Though many road vehicles are available, the automobile being able to propel itself has been the most recognized road transport vehicle in use today. Road vehicles include trains and trolleys (U.S. Department of Transportation 2010; World Energy Council, 2007; Jeon, & Amekudzi, 2005; Schafer, 1998).

Roads are used by both urban and rural dwellers also connecting towns, villages and cities. About 600

million automobiles were in use around the globe by 2002. It is estimated that there were over 1, 015 billion automobiles in use globally as of 2010 excluding off-road vehicles with 148 vehicles per 1000 per capita vehicle ownership playing significant role in the socio economic development and growth in individual countries (United Nations Economic Commission for Europe, 2012). Road vehicles used to be powered through various means. However the internal combustion has superseded the mechanisms through which this could be achieved.

The internal combustion engine is usually powered using fossil fuels, transforming its chemical energy into kinetic energy through thermal energy conversion. Gasoline and gasoil as products of petroleum have been used since the industrial revolution in powering internal combustion engines. However these fuels have been known to cause air pollution in cities, towns, villages and beyond. Their impacts on the global climate, generating global warming and consequential climate change have questioned how its use could be sustained in the global context. The concept of sustainable transport therefore comes to the fore. Among other parameters, sustainable transport is meant to address social, environmental and economic impact vis-a-vis the availability, efficacy and cost of energy supply now and the future. It also includes the types of vehicles used and the type of energy source applied.

Ideally alternative renewable energy sources would ensure desirable sustainable transport. However many of these sources are not economically viable as at now. For example the hydrogen cell technology has not been fully developed to ensure its economic use. Fortunately other fuel source for road vehicles, such as autogas, though fossil fuel is relatively friendly to the environment.

In the short term sustainable transport activities aim at encouraging consistent improvement of engine performance in order to increasing fuel efficiency resulting in better vehicle emission controls. In addition to this, long term measures are ensured by shifting from traditional energy source of petroleum-based fuels to alternative or renewable sources of energy (U.S. Department of Transportation, 2010; Schafer, 1998)

The impact of transport systems through the use of petroleum fuels could be enormous. For example, globally, between 20 and 25% of energy consumption is through transportation. Similar amount of carbon dioxide is also emitted contributing to greenhouse challenges, local air pollution and smoggy environments (Intergovernmental Panel on Climate Change 2007; World Energy Council; 2007). Thus weighing the social and economic advantages associated with road transport against economic and social sustainability, there is the need to have a second look at the use of traditional petroleum-based source of energy in powering road transport systems. Air pollution, passenger commuting time, period of absence from home, fuel price increase vulnerability, traffic congestion resulting in longer travel periods of humans, goods and services are but some of the social costs of road transport (World Health Organisation, 2014; Social Exclusion Unit, 2001).

Sustainable transport using autogas, among others, will therefore, according to the European Union Council of Ministers of Transport, provide the fundamental availability and development requirements of individuals, organizations, communities and societies to be met without detrimental effects on health of humans and ecosystems. It will also promote intergenerational equity among future generations. It will further reduce emissions and waste below the capability of the planet in absorbing them. The use of autogas in the transport sector could therefore have a role in ensuring sustainability from cradle-to-grave in the design and management of road transport systems (European Union, 2003; US Environmental Protection Agency, 1976) in Ghana in particular and globally in general.

2.2 Road transport in Ghana

Major gaps exist in road transport energy consumption between solely urban settlements, urban and rural settlements and individual rural settlements globally. For example, private transport systems in the U.S use an average of 24 times energy than the Chinese systems and 4 times more than European systems. Seventy two percent of Europeans lied in urban settlements, generating 85% of G D P in urban cities (Kenworthy, 2003) and using road transport as the main means of transportation.

In Ghana, road transport is the dominant means of conveying passengers and freight across and within settlement areas. Over 95% of all freight and passengers are taken care by road transport. About two-thirds of road transport is within metropolis, cities, towns and villages and linking these settlement areas. About 13,500 kilometres of road networks are trunk roads (Newman & Kenworthy, 1989).

Inter- and intra-urban settlements are mostly reached by mini buses (trotro) and taxies run by privately owned individuals. The contribution of privately-owned buses, big buses and publicly owned buses is relatively minimal and mostly ply inter-urban road networks. By 2012 the road network was 64,323 kilometers still constituting the most dominant means of road transportation in Ghana (White Paper on Transport, 2004). Road transport therefore helps solve social problems relating to health, demographic trends, regular attendance to school, fostering economic and social cohesion with respect to families and children as well as solving the needs of persons experiencing reduction in mobility (White Paper on Transport, 2004). Investing in the transportation sector is therefore required to deal with societal challenges as well as economic, technical and environmental issues of the nation.

Various governments have invested greatly in the road transport sector of the economy, particularly in the southern regions, including the Central Region, where gold, cocoa, timber and now crude oil and natural gas abound. For example, in 2012, U.S $500 million was invested by the Ghana government for road transportation (White Paper on Transport, 2004). Expanding the road network and transportation may result in higher energy consumption in relation to gasoline, gasoil and autogas which may cause shortages. The questions that arise are "why are auto vehicle users shifting from the use of traditional and conventional fuel such as gasoline and gasoil; and to the use of autogas? How much do they patronise that may warrant intermittent shortages of the fuel?"

2.3 Benefits of autogas

Liquefied Petroleum Gas (LPG) also referred to as autogas is a flammable mixture of hydrocarbon gases. It is obtained by refining petroleum or natural gas, both being fossil fuel sources. It constitutes about 3% of global energy consumption. When used as a fuel in internal combustion engines, it is commonly referred to an autogas. It consists of mainly propane, butane, propylene, and butylene in various mixtures (Social Exclusion Unit, 2001). Though LPG can cause suffocation by displacing oxygen and cause explosion when conditions are conducive, it has many beneficial properties such as technical, economic and environmental benefits. LPG burns relatively clean with low sulphur emission and virtually no soot. It has lower smoke emissions and low fuel consumption as compared to gasoline and gasoil. Particulates present in gasoil are absent in LPG when used as autofuel. It has high octane rating (102 -108 Research Octane Number (RON) depending on engine and mixture specifications ((World Health Organisation, 2014; Social Exclusion Unit, 2001).

LPG has a specific calorific value of 46.1 MJ /kg while gasoil and gasoline have 42.5MJ/kg and 43.5MJ/kg respectively. Energy density per volume is 26 MJ / L and relative density is about 0.5 - 0.58, compared with 0.71 - 0.77 for gasoline. The boiling point of LPG is below room temperature enabling it to evaporate under atmospheric temperatures and pressures. The vapour pressure of LPG varies according to the composition of gases in the mixture and the prevailing temperature. For example, for pure butane, vapour pressure at 20^{o}C is 220 kilopascals while pure propane will liquefy at 2,200 kilopascals at 55^{o}C (World Health Organisation, 2014; US Environmental Protection Agency, 2002; Social Exclusion Unit, 2001). Twenty percent and 60% less nitrogen-oxide and carbon-dioxide respectively are emitted when compared with gasoline-fuel vehicles. When running, there are no evaporative emissions. Gas escape into the atmosphere, when refuelling, is 50% less reactive in relation to gasoline vapours. Its contribution to acid rain and smog-forming ozone is also minimal (Social Exclusion Unit, 2001).

Technically autogas has numerous advantages over conventional automotive fuels. The conversion kit of engines originally designed for conventional fuels to use autogas is relatively inexpensive. The kits ensure easy and quick vaporization of liquid LPG into gaseous form at the right air-fuel mix. A closed-loop feedback mechanism in the kit also continuously monitors and regulates the required oxygen content of the exhaust and the air-fuel ratio respectively thus ensuring an optimum efficiency of the engine (U.S. Department of Energy, 2003).

In contrast with liquid fuel-run engines, LPG vehicle combustion chambers are devoid of cold-starting challengers as a result of gaseous nature of the air/fuel mixture. It has regular emission levels and less for that matter when running hot or cold unlike gasoline engines which generates high emission levels when running cold. Because of its gaseous nature LPG does not strip engine oil from cylinder walls. It does not also dilute engine oil when running cold. LPG run engines have low carbon build-up when compared with gasoil and gasoline-run engines as a result of proper combustion efficiencies in combustion chambers due to efficient air/fuel mix. Comparatively, therefore, LPG engines have longer service life and low maintenance cost.

Power delivery, acceleration and cruising speed characteristics of LPG is comparable to gasoline albeit driving range is lower. This limitation is however compensated for by undestructive knocking characteristics of the former.

With octane rating being 105 and higher engine power output and fuel efficiency, LPG engines have higher and better tuning capabilities as a better option to gasoline and gasoil. Thus reduction in cost when using LPG could typically range from 5% to 30% when compared to gasoline. Above all the construction cost of LPG-dispensing outfit is similar to that of gasoline-dispensing systems. Conversion cost can be recovered through fuel savings within a short period of time, that is, between four and eight months (Brignall, 2014). From the forgoing it can be concluded that the overall net benefits of using LPG by standards outweighs the use of conventional vehicle fuels such as gasoline and gasoil.

2.4 LPG use in Ghana

Since the U.S Bureau of Mine investigated gasoline to find it contains propane, Liquefied Petroleum Gas has been used in the U.S and other parts of the world (Consumer Energy Centre, 2015). Behind gasoil and gasoline, LPG is the third most widely used transportation fuel in the United States. Countries such as Japan, Canada, Australia, the Netherland and Italy also use LPG in vehicles to a large extent.

In Ghana it appears many people are patronizing LPG, particularly in the administrative district capitals.

Since 1990 the LPG market has been growing at an average rate of 14%, thus LPG being the fastest growing fuel consumption in Ghana (Edjekumhene, Atta-Owusu & Ampong, 2007). The launching of the LPG promotion program by the Ghana government in 1990 has contributed to this demand rate. According to (Edjekumhere et al, 2007) though households were the initial target only 72% of the total consumption was by the household sector; 20% by the industrial sector; and the commercial/services sector patronizing the remaining 8% of annual consumption. The study further indicates that as at 2007, only 10% of Ghanaian urban households were using LPG for cooking. The rural counterparts used 0.6%. The report however added that 65% of Ghanaians not using LPG preferred doing so. Unfortunately the government deregulation policy according to the report on fossil fuel prices has resulted in price increases of the product.

By 2007, 20% of average total LPG sales were for automobile use (Adjekumhene et al, 2007) in urban areas. A study by Asamoah et al (2012) indicated that 80% users of LPG in Ghana are for domestic purposes, 13.3% for commercial; and 6.7% for both domestic and commercial activities. The study revealed that between 47.9% and 68.8% of LPG users experience shortages; thus during the year shortages are rampant for commercial users (68.8%) than for domestic users (47.9%).

According to Biscoff, Akple, Turkson & Klomega (2012), 95.6% of vehicles in the Ho municipality in the Volta region of Ghana are for commercial purposes; 4.4% being private cars. This is in contrast with 88% of motor vehicles in Turkey being for commercial purposes (Karamangil 2007). The results from Biscoff et al (2012) therefore confirm the findings of Karamangil (2007) that in the absence of emission standards for vehicles, LPG systems for motor vehicles are in vogue. The study further showed that the amount spent on LPG as autogas is twice when gasoline is used. Suggesting the reason why many commercial vehicles convert to autogas systems.

A study by Broni-Bediako & Dankwa (2013) on the "Assessment of liquefied petroleum gas (LPG) utilization in Ghana – A study at Tarkwa, in the Western Region of Ghana'' revealed that 75% of LPG use was for domestic purposes, 17.5% for commercial purposes and 7.5% for industrial use. The study identified five causes of LPG shortages in Ghana. These include, technical, natural disasters, financial, location of LPG source from supplies to retailers and growing demand for the commodity. About 55% respondents in the study attributed autogas shortage in the Tarkwa Municipality to growing industrial and commercial demand of the product. Industrial consumers include heavy duty machines initially designed to use gasoil and gasoline. Commercial users include hotels, restaurants and chop bar operators.

The shortage of LPG in some parts of the country may therefore be a reality. It appears the role of drivers in using the fuel to power their vehicles could contribute to perennial and sporadic shortages in the market in the Tarkwa Municipality. As far as the Central Region is concerned no such studies appear to exist. It is therefore important that studies are made in other parts of the country such as the Central Region to affirm or otherwise a nationwide shift if it exists in reality, and the reasons behind the shift or otherwise. The quantity of annual use in the region if known could help in policy designs and implementation as well as distribution of the fuel, to contain, if not reduce, the sporadic shortages eating up the autofuel industry in the region in particular and the country in general.

3.0 Study methodology

The study adopted both quantitative and qualitative methods in gathering data, using both questionnaire and interview schedule for literate and non-literate respondents respectively. It was ensured that no single vehicle was sampled twice by recording the vehicle registration number of each sampled vehicle. Ten administrative districts were studied using simple random sampling method to select the administrative districts in Central Region. The Central Region was also selected using same sampling process. Thus multistage sampling technique was used in choosing the MMDs.

In sampling the respondents, the accidental sampling method was employed through traffic survey on the business roads in the administrative district capitals. Six districts and four municipal/metropolitan capitals were thus considered. The districts are Assin-North, Assin-South, Ewutu-Senya, Twifo/Heman/Lower-Denkyra, Gomoa-East and Twifo-Atti-Mokwa; the respective district capitals are Assin-Fosu, Nsuaem-Kyekyewere, Awutu-Breku, Heman, Afransi and Twifo-Praso respectively. The urban administrative districts are Cape Coast, Mfantseman-East, Efutu and Agona-West; the metropolis, and municipality capitals being Cape Coast, Saltpond, Winneba and Agona-Swedru respectively.

Five hundred and fifty-six drivers partook in the study. Open- and closed ended questions were posed. Statistical Package for Social Sciences (SPSS) software programme (Version 21) was employed in the analysis. Descriptive analysis using frequencies, percentages, and tables were utilized in result presentation. Results were discussed based on administrative districts. Results were also compared and contrasted between districts and municipalities/metropolis. Analysis was purely quantitative using frequency-based percentages.

4.0 Results and discussion

This section discusses the results of the study according to administrative districts. It ends by comparing and

contrasting the results based on rural and urban administrative districts in the Central Region of Ghana.

4.1 Assin-North District

In the Assin-North District 100 drivers took part in the study Eighty-nine male and eleven female drivers were involved. Eight percent were less than twenty-five years, 38 percent between 26 and 35, 38 percent between 36 and 45, 10 percent between 46 and 55 years and 4 percent more than 56 years. Two percent of the respondents had no basic education 26 percent had basic education; 46 percent had vocational/secondary/technical education and 26 percent had tertiary education. Fifty nine percent of the drivers drove taxis, 34 percent private cars and 7 percent minibus.

Sixty-one percent of the vehicles drove on gasoline, 25 percent on gasoil and 14 percent on autogas. Thirty-one 31 percent attributed using autogas to affordability; about 54 percent to availability; and 15 percent to low fuel consumption. For those who use autogas about 70 percent bought fuel everyday, 19 percent every week and 11 percent biweekly.

On LPG shortage 79 percent answered in the affirmative, while 8 percent were uncertain. Twelve percent indicated "no" to the question. For those who answered in the affirmative about 56 percent attributed LPG shortage, to less number of fuelling stations, 13 percent to increased demand and 31 percent to fewer storage tanks in the fuelling stations. According to the drivers in the district, shortage of LPG has been experienced since the last five years. Five percent indicated shortage since the last year, 19 percent about 2 years ago, 22 percent since the last 3 years, 51 percent about 4 years ago and 3 percent since the last 5 years.

Majority of the drivers, comprising 64 percent had used LPG since the last 5 years, 29 percent between 6 and 10 years; 6 percent between the last 11 and 15 years and 1 percent since the last 16-20 years. In terms of LPG purchased by drivers, 73 percent bought less than GH¢50 worth of the fuel per day; 8 percent bought about GH¢51-100; 12 percent buying GH¢101-150 and 7 percent buying GH¢151 -200 per day.

About 88 percent of the drivers were of the view that LPG prices are fixed by the government. While 10 percent thought are fixed by fuel stations, 2 percent were of the view that prices are fixed by other bodies such as the National Petroleum Authority.

Though respondents indicated that LPG is excellent, very good or good in use, 39 percent expressed ignition difficulties, 44 percent complained about leakage challenges while 17 percent thought it is accompanied with general engine problems.

4.2 Assin-South District

Out of the 30 sampled drivers, 86.6 percent and 13.3 percent were male and female respectively. About 33 percent were between the ages 26 and 35 years and 13.4 percent above 56 years. In terms of educational background, 40 percent had basic education (majority), 33.3 percent had sec/voc. tech., 16.7 percent with tertiary education and 10 percent with no formal education.

Taxis were the main means of transportation, constituting 53.3 percent in the district. Mini buses were made up of 33.3 percent and private cars 13.3 percent. About 56.6 percent of the vehicles use gasoline, 26.7 percent gasoil and 16.7 percent autogas. Those who had switched to autogas gave reasons to that effect. Sixty-three percent related the switch to affordability of the fuel, 23.3 percent to good fuel consumption and 13.4 percent to availability. However accessing the gas was fraught with shortages with 80 percent of the respondents attesting. Seventy percent attributed fuel price determination to the government and 30 percent to fuelling stations. Thirty percent had experience shortages for the last 4 years, 23.4 percent for the last 2 and 3 years each, and 13.2 percent since the last one year and 10 percent since the last 5 years. Causes of autogas shortages were attributed to fewer fuelling stations (46.7 percent); increased demand (36.7 percent) and fewer storage tanks in the felling stations (16.6 percent). Thirty percent had used the fuel within 6 -10 years and 11-15 years, 26.7 percent less than 5 years and 13.3 percent between 16 and 20 years though not on continuous basis.

As much as 56.7 percent of the respondents, forming the majority, bought fuel every day; 33.3 percent every week and 10 percent biweekly. Less than GH¢50, GH¢51 -100, GH¢101 -150, GH¢151 -200 worth of fuel were respectively purchased by 16.7 percent, 33.3 percent, 26.7 percent and 23.3 percent of respondents per week. However GH¢51 -100, GH¢101 -150 and GH¢151 -200 worth of the fuel per transaction were bought by 20, 30 and 50 percent respondents respectively. Though majority of the respondents (70) percent indicated that using LPG is very good and 30 percent as excellent, as much as 63.3 percent complained of ignition problems, 23.3 percent leakage challenges and 13.4 percent engine faults.

4.3 Ewutu-Senya District

Majority of the respondents (60 percent) in the district were found to be in the 26 -35 year group. This is followed by 20 percent who were less than 25 years. Thirteen percent of them were in the 36-45 year group while 6 percent each were in the 46 -55 and greater than 56 year groups. All drivers involved were males, with 10 percent having no formal education; 60 percent up to basic education; 20 percent with Sec / voc / Tech education and 10 percent

having up to tertiary education. Majority of the vehicles (60 percent) were taxis, 16.7 were private vehicles while 23.3 percent mini-buses.

Out of the 30 drivers who took part in the study about 24 percent used gasoline-powered vehicles, 30 percent of the vehicles used gasoil while 46.7 used autogas. Majority of the drivers (about 53 percent) attributed reasons for using autogas to affordability, 30 percent gave reasons as less fuel consumption and 17.8 percent attributed to availability. About 50 percent purchased LPG everyday, 43.3 per cent did so once every week while 27 percent bought fuel once every two weeks.

When questioned on the causes of LPG shortages in the district about 37 percent of the respondents each attributed the cause to few fuelling stations or few fuel storage tanks in the filling stations. The remaining 26.7 percent thought LPG shortage is due to increased demand of the product. Meanwhile 93.3 percent of the respondents were of the view that there were autogas shortages in the district. The remaining 6.7 percent thought otherwise.

For the past 3 years, respondents had been experiencing LPG shortages in the district. While 13.3 percent thought shortages had been rampant since the last year, 60 percent felt shortages started about 2 years ago. For 26.7 percent of the respondents LPG shortages have been occurring since the last three years. About 93 percent of those using LPG had done so for not more than 5 years. The remaining had used LPG for between 6 and 10 years.

Forty percent of respondents bought between GH¢101 -150 worth of fuel per day of purchase. Thirty percent bought between GH¢151 -200, 20 percent purchased GH¢51 -100 while the remaining 10 percent bought less than GH¢50. For those who used gasoline/gasoil, 53.3 percent spent between GH¢151 -200, 26.7 percent between GH¢101 -150 and the remaining 20% spent between GH¢51 -100 with non-spending less than GH¢50 on fuel per transaction. The drivers who partook in the study were the view that fuel prices in the country are within the purview of the government (86. 7 percent), and fuel stations (6.7 percent). Though 30 percent of the drivers in the district who took part in the study said using LPG is very good, 66.7 percent indicated that it is good while the remaining 3.3 percent thought it is excellent. About 47 percent did encounter problems with vehicle ignition, 40 percent had problems with leakage while the remaining indicated frequent engine faults when using LPG in their vehicles.

4.4 Twifo/Hemang/Lower-Denkyira District

Forty drivers partook in the study. About 88 percent were male and 12.5 percent female. Twenty percent were below 25 years old; 25 percent between 26 and 35 years; 20 percent between 30 and 45 years; 20 percent between 46 and 55; and 15 percent over 56 years. Twenty percent of the respondents had no formal education, fifty percent had up to basic education, 22.5 percent had Sec/Voc/Tech and about 7 percent had tertiary education. Taxi cabs, private cars and min bus drivers took part in the study. While 47.5 percent belonged to the former, 17.5 percent and 35 percent belonged to the two latter categories respectively. Among the vehicles concerned, 47.5 percent run on gasoline, 35 percent on gasoil while the remaining 17.5 run on autogas. For those who had switched to autogas the reasons given were affordability (50 percent); availability (12.5 percent) and low consumption (37.5 percent). While 50 percent agreed to LPG shortages in the district 37.5 disagreed. About 12 percent, however, were uncertain. Majority (45 percent) of the respondents had been experiencing LPG shortages for the past 4 years. Twenty-five percent each had been experiencing LPG shortages for the past 2 and 3 years. Only 5 percent had experience shortages for the past 5 years. For those using LPG 55 percent had used LPG for the past 5 years, 37.5 percent for between 6 and 10 years and 7.5 percent between 11 and 15 years.

Shortage of LPG were attributed to fewer fuelling stations (60 percent), increased demand (15 percent) in the district as well as fewer storage tanks (25 percent) in the fuelling stations. While 70 percent bought autogas every day, 22.5 percent bought autogas every week and 7.5 percent buying autogas weekly. The drivers were of the view that fuel prices are determined by the government (87.5 percent); fuelling stations (10 percent) and NPA (2.5 percent. For those running on LPG, 15 percent spent less than GH¢50 per transaction, 17.5 percent spent between GH¢51 -100; 57.5 percent spent between GH¢101 and GH¢150; and 10 percent between GH¢151 -200. In comparison with vehicles using gasoline/gasoil, 15 percent spent GH¢51-100; 25 percent spent GH¢101 -150; and 60 percent spending GH¢151 -200 on fuel per transaction. Though majority of the respondents (37.5 percent) were of the view that using LPG was satisfactory, 27.5 indicated that LPG was generally good and 10 percent indicating it was excellent. However 47.5 percent thought it was fraught with leakage problems. Forty five percent expressed indignation of ignition challenges while the remaining 7.5 percent complained about engine fault challenges.

4.5 Gomoa-East District

Forty-two drivers in the district were involved in the study. About 90 percent out of them were male while the remaining 9.5 percent were female. Majority of them (37.7 percent) were in the 26 -35 year group. The remaining, in the less than 25, 36 -45, 46 -55 and greater than 56 year groups, were 21.4 percent 31.4 percent, 7.7 percent and 2.4 percent respectively.

In terms of highest educational attainment, majority (40.5 percent) were up to basic school education. About 36 percent had up to Sec/Voc/Tech education, 7.1 percent up to tertiary education while 16.7 had no formal education. Among this distribution 71.4 percent were taxi cabs, 19.5 percent mini bus and 9.5 percent private car drivers. About 45 percent of the vehicles run on gasoline 33.3 percent on gasoil while 16.7 percent use autogas. Drivers had switched to autogas for various reasons. While 66.7 percent attributed the reason to affordability, 19.5 percent was due to lower consumption while the remaining 14.8 percent was because of availability. But shortages of the gas exist in the district as well. About 76.2 percent of the respondents agreed to this assertion with 19.1 percent disagreeing and the remaining uncertain. About 42 percent of the respondents indicated that shortages had been in existence for the past 3 years, 19.1 percent each within 2 and 3 years while 14 percent agreed that shortages had been occurring for the past five years.

The drivers in the district have been using Autogas for some time now. Sixty-nine percent have used LPG gas for less than 5 years; 26.2 percent between 6 and 10 years; and 4.8 percent between 11 and 15 years. Sixty-nine percent also bought fuel every working day while 21.4 percent bought the autogas once every week. The remaining 9.5 percent did so once every two weeks. Majority of the drivers (64.3 percent) spent between GH¢101-150 on autogas per transaction; 26.2 percent between GH¢51-100 per transaction and 4.8 percent each buying less than GH¢50 and between GH¢151-200 per transaction. Comparatively, majority of the respondents (64.3 percent) purchased gasoline/gasoil worth GH¢151-200 per transaction. Those who bought between GH¢51-100 and GH¢101-150 were 4.8 percent and 30.9 percent respectively; with 85.7 percent, 11.9 percent and 2.4 percent indicating the prices of fuel is determined by government, fuel stations and NPA respectively.

In spite of the advantages of Autogas, respondents had some misgivings about its use. Though 35.8 percent each claimed its use was very good and good with 23.8 percent and 46 percent claiming it is satisfactory and excellent respectively, 85.7 percent claimed it was associated with ignition difficulties. While 11.9 percent recognized leakage problems, 2.4 percent of the respondents claimed it creates general engine challenges.

4.6 Twifo-Atti/Mokwa District

Thirty drivers were sampled from the district made up of 93.3 male and 6.7 percent female. Age distribution consists of 40 percent and 13.3 percent within the 36 -45 year and 26 -35- as well as 46 -55- year categories respectively. Ten percent were less than 25 years and 13.4 percent greater than 56 years. Majority of the respondents had basic school education. About 33.3 had Sec/Voc/Tec qualification while 16.7 percent were tertiary graduates. The remaining percent had no formal education.

In the district mini bus is predominantly used followed by taxis. While 46.6 percent of the respondents were mini bus drivers 43.3 percent drove taxis. The private cars constituted 10.3 percent. About 56 percent of the vehicles run on gasoline, 26.7 percent on gasoil and 16.4 percent on autogas. Fifty percent of those who had switched to autogas attributed it to affordability; lower consumption (36.7 percent) and 13.3 percent to availability. Though the gas is patronized according to the drivers, there were frequent shortages. About 63 percent agreed to this while 36.7 disagreed. While 43.3 percent attributed shortages to fewer fuelling stations, 36.7 percent and 20 percent respectively attributed to fewer storage tanks and increase in demand. About 33.3 indicated they had been experiencing LPG shortages for the last 3 years; 26.7 percent since the last two years and 5 years; 10 percent since the last four years and 3.3 percent since the last year. Majority of the respondents (46.7 percent) had used autogas between 6 and 10 years with 26.7 percent; 20 percent and 6.6 percent using the gas less than 5 years, 11-5 years and 16-20 years respectively.

Sixty percent of the participants in the district purchased LPG everyday; 33.3 percent every week and 6.7 percent every two weeks with the majority (96.7 percent) claiming fuel prices are fixed by the government. In monetary terms 50 percent of the drivers purchased between GH¢101-150 worth of LPG per transaction while 23.3 percent bought less than GH¢50 per transaction. About 16 percent and 10 percent purchased between GH¢51-100 and GH¢151-200 respectively.

Comparing with gasoline/gasoil, majority of the respondents (60 percent) patronised between GH¢151-200 worth of fuel per transaction; 26.7 percent between GH¢101-150; and 13.3 percent GH¢51-100. Using Autogas is confronted with leakage (43.3 percent), ignition (40 percent) and engine fault (16.7 percent) difficulties with majority of the study participants (36.7 percent) agreeing that it is very good using it. On the same issue, 33.3 percent, 26.7 percent and 3.3 percent respectively agreed that Autogas was satisfactory, good and excellent to use.

4.7 Cape Coast Municipality

One hundred drivers partook in the study in the district. They were made up of 80 percent male and 20 percent female. Nine percent were less than 25 years, 19 percent between 26 and 35 years, 27 percent between 36 and 45 years, 25 percent between 46 and 55 years and 20 percent more than 56 years. Majority of the respondents constituting 33 percent were basic school certificate holders; twenty six percent had tertiary education, 14 percent had Sec/Voc/Tech education and 6 percent with no formal education.

Majority of the respondents (60 percent) used taxis with 30 percent being private cars and 10 percent mini

bus. Forty nine percent of the vehicles use gasoline, 15 percent use gasoil while 36 percent of the vehicles running on autogas. Autogas-run vehicle drivers attributed shift of fuel to affordability (68 percent), lower fuel consumption (18 percent) and availability (14 percent). Seventy nine percent acknowledged shortages of LPG against 11. While 18 percent had experienced shortages since the last 4 years; 25 percent, 18 percent and 10 percent had seen shortages for the past 3, 2, and I year respectively. Meanwhile 49 percent, 36 percent and 15 percent had used the fuel less than 5 years, 6-10 years and 11-15 years respectively; attributing fuel shortages to fewer fuelling stations (72 percent), few storage tanks at fuelling stations (15 percent) and increased demand (13 percent)

In terms of frequency of purchase 60 percent did so every day, 31 percent every week and 19 percent biweekly. While 47 percent of the respondents purchased between GH51-100 worth of fuel per transaction; 37 percent bought GH¢101-150 per transaction. Eleven percent bought less than GH¢50 and 5 percent between GH¢151 and GH¢200. Ninety six percent of the respondents were of the view that fuel prices are determined by the government, 3 percent by fuelling stations and 1 percent by NPA. When compared with those using gasoline and gasoil, about 96 percent purchased GH¢151-200 while 4 percent bought between GH¢100-150 worth of fuel per transaction. Though using LPG is associate with ignition difficulties (41 percent), leakage problems (43 percent) and engine faults (16 percent), majority (39 percent) agreed that its use was very good, good (36 percent), satisfactory (16 percent) and excellent) 9 percent.

4.8 Mfantseman-East Municipality

The study sampled 42 drivers from this district; 92.8 percent male and 7.2 percent female. Age distribution among the respondents was 16.7 percent below 25 years; 38.7 percent between 26 and 35 years; 23.9 percent between 36 and 45 years; 9.5 percent between 46 and 55 years and 7.1 percent above 56 years. About 48 percent of the drivers had no formal education; 33.3 had basic education; 16.7 percent were sec/voc/tech school graduates while 9.5 percent was tertiary institution graduates.

Taxis constituted 71.4 percent, private cars 19 percent and the remaining 9.5 percent mini buses. While 42.9 percent each of the vehicles use gasoline and autogas the remaining 13.3 percent dwelt on gasoil. About 60 percent of the autogas users attributed fuel shift to affordability; 23.8 percent to lower fuel consumption and 16.7 percent to fuel availability. However about 60 percent reported of autogas shortages in the district while 12 percent disagreed to autogas shortages in the district. Since the last 5 years, 12 percent claimed to have witnessed autogas shortages in the districts. Seven percent, 4.8 percent, 12 percent and 35.7 percent respectively encountered 4, 3, and 2 and 1 year autogas shortages within the district. The drivers had used the fuel between the last 5 years (73.8 percent), 6-10 years (23.8 percent) and 11-15 years (2.4 percent).

On the frequency of purchase of gasoil and gasoline, 73.8 percent purchased the fuel everyday, 21.4 percent did so every week and 4.8 buying it bi-weekly. Majority of respondents (73.8 percent) bought between GH¢151-200; 19 percent between GH¢¢101-150 and 7.1 between GH¢51 and GH¢100. For those using LPG, 19.1 percent of the drivers bought GH¢151-200 per transaction, 59.5 percent purchasing GH¢101-150; 14.3 percent spent GH¢51-100 while 7.1 spent less than GH¢50 worth of fuel. Majority of the respondents (52.4) believe that fuel prices were determined by government, NPA (28.6 percent) and fuelling stations (19.1 percent). Though 35.7 percent each indicated ignition problems and engine fault difficulties and 28.6 percent complaining of leakage challenges; all respondents expressed between satisfaction and excellent in the use of autogas.

4.9 Efutu Municipality

Forty two drivers were sampled from the Efutu Municipality. The male was 88.1 percent and female 11.9. age distribution was 26-35 years (45.3 percent), 36-45 years (23.8 percent), less than 25 years (16.7 percent) 46-55 (9.5 percent) and above 56 years 4.7 percent. Majority of the respondents (38.1 percent) had no formal education, followed by basic education (38.1 percent), tertiary education (16.7 percent) and sec/voc/tech (9.5 percent)

About 71 percent of vehicles considered were taxis, 19.5 percent private cars and 9.5 percent being minibuses. These vehicles run on gasoline (42.9 percent), gasoil (19.5 percent) and autogas 38.1 percent. Drivers who had shifted to autogas attributed it to affordability (90.5 percent) and less fuel consumption (9.5 percent) with none of them citing availability. Autogas shortages have been occurring in the district as well. For example, 83.3 percent consented to this and 14.3 percent in the negative. Reasons given include fewer stations (52.4 percent), fewer storage tanks at fuelling stations (35.6 percent) and increased demand (12 percent). For the past 5 years, 19.1 percent of the respondents in the municipality had witnessed shortages; about 24 percent had experienced shortages for the past 4 years, 26.2 percent for the last 3 years; 19 percent the last two years and 12 percent since the last year. In a similar vein, 73.8 percent had used LPG since the last five years; 21.4 percent between 6 and 10 years and 4.8 percent between 11 and 15 years. Participants were of the opinion that the prices of fuel are fixed by government (73.8 percent), fuelling stations (14.3 percent) and NPA (12 percent).

Thirty eight percent of drivers bought Autogas everyday; 35.7 percent every week and 26.2 percent every two weeks. Meanwhile 45.3 percent bought GH¢151-200 per transaction; 40.5 percent buying GH¢101-500; and 14.3 percent buying between GH¢51-100 per transaction of LPG. In the case of gasoline and gas oil, 85.7 percent

purchased GH¢151-200; 9.5 percent bought GH¢51-100 and 2.4 percent each buying GH¢101-150 and up to GH¢50. Although all the drivers indicated using autogas was satisfactory (9.5 percent) good (31 percent), very good (21 percent) and excellent (28.6 percent) they were of the view that it had problems with ignition (42.9 percent), leakage (42.9 percent) and engine fault (14.2 percent).

4.10 Agona-West Municipality

Ninety three percent male and 7 percent female partook in the study made of one hundred sampled drivers in the municipality. The sample comprised of 49 percent aged between 36 and 45 years; 29 percent between 26 and 35 years; 10 percent below 25 years; 9 percent above 56 years and 3 percent between 46 and 45 years. Those with basic education were 41 percent; sec/voc/tech, 28 percent; tertiary, 26 percent and no formal education 5 percent. Majority of the vehicles concerned were taxis made of 59 percent; private cars and mini buses were 18 and 23 percent respectively. Forty three percent use gasoline, 40 percent of run on autogas and 27 percent gasoil. The use of autogas was related to affordability (53 percent), availability (15 percent) and lower consumption (32 percent) of the fuel. Drivers comprising 85 percent were of the opinion that shortages of he fuel do occur. Fifteen percent however thought otherwise. Autogas shortages according to the respondents were due to fewer fuelling stations in the district (44 percent), fewer fuelling storage tanks (29 percent) and increased demand 27 percent. Majority of the respondents (36 percent) had been experiencing shortages for the past three years. This is followed by the past 4 years (28 percent); the last one year (27 percent); the last two years (5 percent) and the last five years (4 percent). On the period within which respondents had used autogs about 68 percent had done so for less than five years, 19 percent between 6 and 10 years and 13 percent between 11 and 15 years.

Majority of the respondents (57 percent) purchased autogas every day. While 36 percent does so every week, 7 percent does so every two weeks. With 44 percent buying GH¢151-200 LPG per transaction, 33 percent bought GH¢51-100; ten percent purchased GH¢101-150 while 3 percent bought up to GH50. Comparatively, 83 percent of the respondents bought between 151 and 200 Ghana cedis worth of fuel, 15 percent between GH¢101 and GH¢150 and 2 percent between GH¢51 and GH¢100. Generally, 41 percent of the respondents indicated autogas was a good fuel, 27 said it was very good while 16 percent each expressed it was excellent and satisfactory, though they also expressed misgiving; ignition challenges (74 percent); leakage (20 percent) and engine fault characteristics (6 percent).

4.11 Comparative analysis

Table 1 shows the combined district and metropolis/municipal distribution of the data collected from the study. About eight percent female and nine percent female were involved in the study in districts and metropolis/municipalities respectively while the remaining was male. This implies that there are more female drivers in the metropolis/municipalities (MM) than in the districts though the margin is only one percent. Thus driving in the Ghana can be said to be a predominantly male preserve with more than 90 percent of drivers in the region being male.

Majority of the respondents in the district (3.7 percent) were in the 26-35 year bracket, followed by 31.3 percent in the 36-45 year group. In the MMs however the majority (30 percent) were found in the 36-45 year group followed by 25 percent in the 26-35 year category. Thus about 67 percent of the respondents in the districts were between 26 and 45 years. In the MMs, 55 percent were in the same year group. This is comparable to Ho municipality in the Volta Region of Ghana where majority (52.2 percent) of drivers were between the ages of 31-35, that is, in the 26-35 year group though the proportion in Central Region was higher. Thus in Central Region the core working group of drivers are between the ages of 26 and 45. (Table 1)

The study showed that about 10 percent of the drivers were illiterates with 16.9 percent in the districts and 22 percent in the MMs having tertiary educational background. In the districts about 74 percent of the respondents had either basic or sec/voc/tech education. It was however 45 percent in the MMs. This means that in the districts majority of Sec/voc/tech graduates were fascinated with the driving profession. With the main occupation in the districts being farming most of the youth may prefer this profession instead of farming as farming is generally regarded as job for illiterates and the aged in Ghana, especially among the literates class. Some drivers interviewed had this opinion. They were of the view that driving is more dignified and lucrative unlike farming which usually is at the mercy of the weather and season of the year. This finding is in agreement with Biscoff, Akple, Turkson, & Klomegah (2012) that most drivers in the Ho municipality in Ghana are Junior and Senior High School graduates.

The study also showed that majority of vehicles in the districts (56.4 percent) and MMs (63 percent) were taxis. This is followed by private cars in the MMs (26 percent) and minibuses in the districts (23.8 percent) (refer table 1). This may be explained from the point of view that there are more commercial activities in the MMs than the districts. The populations in the MMs are also higher supporting several commercial and industrial activities. With most salaried workers located in the MMs than the districts, MMs can boast of more middle class and higher class personalities who are likely to patronise private cars than their district counterparts. This finding is however

different from that of Biscoff et al (2012) where only 4.4 percent private cars were recorded in the Ho metropolis. This could be due to low population, higher poverty rate and fewer industrial, commercial and agricultural activities in the municipality and the administrative communities surrounding it. According to the 2010 population census the population of the Volta Region is lower than the Central Region (Ghana Statistical Service, 2010). The result could therefore also be attributed to a reflection of relatively higher population in the Cape Coast Metropolis.

Table 1: Age, gender and highest educational attainment of respondents (figures are in percentages)

AdministrationDistrict	Age (years)					Gender		Highest educational attainment			
	<25	26-35	36-45	46-55	>56	Male	Female	No formal education	Basic	Sec/Voc/Tech	Tertiary
Assin-North District (100)	8	38	38	10	4	89	11	2	26	46	26
Ewutu-Senya District (30)	20	60	13	6	6	100	0	10	60	20	10
Twifo/Hemang/Lower-Denkyira (40)	20	25	20	26	15	87.5	12.5	20	50	22.5	10
Gomoa-East District (42)	21.4	37.7	33.3	3.1	2.4	90.5	6.7	16.7	40.5	35.7	7.1
Twifo-Atti/Mokwa (30)	10	33.3	40	33.3	13.3	93.3	13.3	10	40	33.3	16.7
Assin-South District (30)	10	33.3	30	13.3	13.3	86.6	9	8	42	33.3	16.7
Cape Coast Municipality (100)	9	19	27	25	20	91	7.2	6.6	33	14	26
Mfantseman-East Municipality (42)	16.7	38.1	23.9	9.5	7.1	92.8	11.9	48	33.3	14.2	0.05
Efutu-Municipality (42)	16.7	45.3	23.8	9.5	4.7	88.1	7	38.1	35.7	9.5	16.7
Agona-West Municipality (100)	10	29	39	6	7	93	8.8	5	41	28	26
Districts (Average)	11.4	37.1	31.3	13.6	7.7	91.1	8.1	9.6	38.6	35.3	16.9
Metropolis / Municipalities (Average)	12.0	25	30	14.0	11	91.9	8.1	10	36	19.0	22.0

(Source: field data, 2013)

Thirty-nine percent of vehicles in the MMs and 19.1 percent in the districts use autogas (refer table 1); between 65 and 81 percent still rely on either gasoline or gasoil. From the findings of Biscoff et al (2012) private car drivers do not see the need to shift to autogas since they usually operate in administrative district capital in the MMs and the districts and therefore are of the view that gasoline are efficient and economical. The reason, however, could be that they do not often use their vehicles and a relatively small quantity of fuel therefore suffices. Most of them may use their vehicles to and from work and sending children to and from school as the main vehicular activities for the working day. On week ends vehicles may not be mobile unless to church for some vehicle owners. Expenditure on fuel, for these vehicle owners, may not therefore contribute much to overall expenditure for the month.

A study by Karamangil (2007) in Turkey however gave 88 percent of motor vehicles with LPG being passenger cars including taxis and minibuses. This is in sharp contrast with what is in Ghana as indicated by this study where only between 19.1 and 39 percent of vehicles (taxis, private cars and minibus) use autogas. Respondents gave reasons to shift from gasoline to autogas as affordability (47.4-65 percent), availability (8.5-28.3 percent) and less consumption (24.3-27 percent). This affirms the findings of Biscoff et al (2012) that in Ghana the main reasons for taxis converting from gasoline to autogas is the affordability of the fuel and relatively lower rate of consumption. The authors therefore recommended that government should have a policy that will institutionalise the conversion of LPG, making available the appropriate conversion kits and training. This will help in reducing environmental pollution and save money in the pockets of drivers and passengers as well.

A section of the populace, ranging from politicians to the general pubic are of the view that the shift of gasoline/gasoil to autogas (LPG) has contributed to LPG shortages in the country of recent times (Ampofo, 2010). However Asamoah, Amoakohene & Adiwokor (2012) identified six disruptions in the supply chain of LPG that could cause shortages. These include transportation of the resource, political, financial, location, natural disasters and technical disruptions. In a similar study by Broni-Bediako & Dankwa (2013) five main causes of LPG shortages in Ghana were identified. These are higher demand, technical, natural disasters, financial and location of LPG source from suppliers to retailers. Four of these factors were however categorised as disruptions to the supply chain of the fuel. About 27 percent of respondents in the study in the Tarkwa Metropolis were of the view that shortages of LPG in the municipality were as a result of technical constraints.

According to Kleindorfer & Saad (2005) technical constraints, malfunctions, a systemic failure affects

the supply chain. This author is of additional views. It is of the opinion of the author of this study that human-cantered deficiencies such as strikes, myopic leadership, bribery and corruption, human greed and selfishness could affect the supply chain processes of the fuel.

In identifying the causes of shortages of autogas from the respondents, however three reasons were given (refer table 2). Most of the respondents, between 49 and 64 percent attributed shortages to few refuelling stations in the administrative districts with the fewer percentages from the municipalities and metropolis (MMs). This was followed by fewer storage tanks (21-31 percent) and lastly, increased demand (16-19 percent) (refer table 2). These factors could be attributed to political, financial, location, transportation of the resource and technical disruptions directly or indirectly on one hand or the other or multiples of the factors.

The gravamen of shortages of the fuel can be seen from the point of view that 74 percent (district) and 79 (percent MMs) agreed that there have been shortages of autogas in the administrative districts (table 2). Respondents were of the opinion that shortages have frequently been observed for the past 5 years or so. In the districts 85 percent of the drivers had observed or experienced shortages since the last 2 – 4 years. In the MMs 64 percent consented. The difference in the rural and urban districts could largely be due to proximity from suppliers to the retailers as one of the technical constraints as found by Broni-Bediako & Dankwa (2013) in terms of transportation of the resource (table 2)

From Asamoah et al (2012) commercial users of LPG, including drivers, experience higher frequency of shortages than domestic users of the fuel. This study found that about 70 percent of commercial (drivers) LPG users experience shortages between four and eight times annually. It can therefore be concluded that autogas users in the administrative districts of study could be experiencing four to eight times shortages of the fuel per annum. Asamoah et al (2012) also concluded that the issue of LPG shortage is critical since users could experience shortage for a period of over one month during the year. Ninety percent of respondents in districts have used autogas since the last 10 years, though not on continuous basis. The figure increases slightly to 92 percent in the MMs.

Table 2: Types of vehicles and fuel type used by respondents (figures are in percentages)

Administration District	Vehicle type			Fuel type		
	Taxi	Private	M. Bus	Gasoline	Gas Oil	Autogas
Assin-North District (100)	59	34	7	61	25	14
Ewutu-Senya District (30)	60	16.7	23.3	23.7	30	46.7
Twifo/Hemang/Lower-Denkyira (40)	47.5	17.5	35	49.5	35	17.5
Gomoa-East District (42)	71.4	19.5	26.2	45.2	33.3	16.7
Twifo-Atti/Mokwa (30)	43.3	13.3	46.6	56.7	26.7	16.7
Assin-South District (30)	53.3	13.3	33.3	56.6	26.7	16.7
Cape Coast Municipality (100)	60	30	10	49	15	36
Mfantseman-East Municipality (42)	72.7	19	8.3	42.9	14.3	42.9
Efutu Municipality (42)	71.4	19.5	9.5	42.9	19.5	38.1
Agona-West Municipality (100)	59	18	23	43	27	40
Districts (Average)	56.4	22.8	23.5	50.7	28.7	19
Metropolis / Municipalities (Average)	63.0	26.0	13	45.0	20	39

(Source: field data, 2013)

Generally respondents of the study (about 90 percent) who patronise LPG bought fuel on every working day (table 3). Within the districts, 35 percent, 17 percent, 36 percent and 9.2 percent buy autogas worth less that GH¢50, GH¢51-100, GH¢101-150 and GH¢151-200, respectively. In the MMS, 6, 32, 31 and 27 percent of those who patronise autogas purchase less than GH¢50, GH¢51-100, GH¢101-150 and GH¢151-200 respectively within a day, a week or two (table 3). In contrast with those patronising gasoline/gasoil between 3 and 9 percent, 10-29 percent and 61-87 percent respectively spend GH¢51-100, GH¢101-150, GH¢151-200. Thus averagely, gasoline/gasoil users spend over twice on fuel when compared to autogas users. This finding affirms the findings of Biscoff et al (2012) that gasoline/gasoil users spend twice (or even more) on fuel as autogas users.

Drivers spend a lot on fuel since it is the major running cost of the business. Who determines the cost of fuel is therefore of pertinence to them. When asked of the authority in charge of determining the price of fuel used, between 81 and 86 percent were of the view that government was responsible for that. While 10-11 percent attributed to fuel stations, only 1-2 percent stated the Public Utility Regulation Commission (PURC) as the body responsible. This implies that, in the opinion of the drivers (majority) government is the major authority, to a large extent, that can mitigate the supply and associated cost of autogas and other auto fuels, in the Ghanaian market. Though this in principle is under the strict jurisdiction of PURC, government interventions and manipulations, it

is believed, has always indirectly underpinned the outcome of fuel cost and availability in the market.

Table 3: Reasons of switch, frequency of autogas usage, causes of autogas use and awareness of autogas shortages (figures are in percentages; AF*=Affordability; AV*=Availability; LF*=Low fuel consumption)

Administrative District	Reasons for switch			Frequency of Autogas			Causes of LPG shortage			Shortage of LPG	
	AF*	AV*	LF*	Everyday	Every week	Bi-weekly	Few station	Increased demand	Few storage tanks	yes	no
Assin-North District (100)	31	54	15	70	19	11	56	13	31	79	12
Ewutu-Senya District (30)	53.3	17.8	30	50	43.3	6.7	36.7	26.7	36.7	93.3	6.7
Twifo/Hemang/Lower-Denkyira (40)	50	12.5	37.5	69.1	22.5	7.5	60	15	25	50	37.5
Gomoa-East District (42)	66.7	14.3	19.5	60	21.4	9.5	45.2	19.1	35.7	76.2	19.1
Twifo-Atti/Mokwa (30)	50	13.3	36.7	56.7	33.3	6.7	43.3	20	36.7	63.3	36.7
Assin-South District (30)	63.3	13.3	23.3	60	33.3	10.1	46.7	36.7	16.7	80	20
Cape Coast Municipality (100)	68	14	18	73.8	31	19	72	13	15	79	11
Mfantseman-East Municipality (42)	59.5	16.7	23.8	38.1	21.4	4.8	35.7	28.6	35.7	59.5	12
Efutu Municipality (42)	90.5	0	9.5	57	35.7	26.2	52.4	12	35.7	83.3	14.3
Agona-West Municipality (100)	53	15	32	65.1	36	7	44	27	29	85	14
Districts (Average)	47.4	28.3	24.3	58	25.7	9.2	64	19	31	74	2
Metropolis / Municipalities (Average)	65	8.5	27		31	18	49	16	21	79	13

(Source: field data, 2013)

The study of Biscoff et al (2012) shows that, drivers spend more on gasoline than autogas. For example, it was revealed that over 72 percent of taxi drivers averagely spend about GH¢832 on gasoline in the Ho metropolis as compared to GH¢384 for autogas users; less than half the amount spent on autogas. It is therefore non incongruent to surmise that the shift of drivers to, and consumers in converting gasoline/gasoil designed engines to use autogas is primarily due to financial considerations and motives. If the economy is a free market one, and indeed it is, then this decision might be the best in terms of maximizing their profit margin in the business. Whether this transcends to commercial vehicle owners is a subject of controversy that needs scientific investigations. Drivers therefore need to be encouraged to the use of autogas in their vehicles in order to increase their profit margins while contributing their quota to the national economy through tax contributions.

According to Biscoff (2012) 33 percent of drivers refuel their vehicles on daily basis as against 58 and 65 percent in the present study. The characteristic of autogas facilities not to support daily purchases by drivers an amount that would not completely fill autogas cylinders, in their vehicles, could be one of the primary reasons why some commercial drivers have not converted to the use of autogas in spite of its affordability, lower consumption and availability. Other factors include ignition/starting problems, fuel leakage and frequent engine failure. Thus between 45-50.7 percent, 37-29 percent and 12-12.5 percent of the respondents mentioned ignition difficulties, fuel leakage and engine failure respectively as the challenges associated with the use of autogas (refer table 3). Nevertheless they agreed that autogas, generally is an efficient fuel to use (refer table 3).

It appears there are challenges in installing LPG systems in vehicles in the region. These systems when installed properly with the proper expertise and skills should not create such challenges (Brignall, 2014) as indicate by the respondents. It would therefore be appropriate if installers are given the required training to avoid such technical problems. Technical institutions in the region such as Cape Coast Technical Institute, Aswansi Technical Institute and Cape Coast Polytechnic could organize such programs for these small scale workshop owners to improve upon their technical expertise.

Fifty-nine percent of rural district drivers and 59 percent urban counterparts had used autogas since the last five years or so. Meanwhile 60 percent and 63 percent rural and urban drivers respectively agreed that there have been fuel shortages since the last 5 years (table 4). There is therefore grounds to assert that vehicle drivers do experience autogas shortages in the region; for even those who had used the fuel over 16 years (3 percent) agreed experiencing shortages within the two contrasting settlements (refer table 4).

The benefits of autogas are numerous. It has both environmental and technical advantages. Its advantages

extend from the common man on the street to the governments of nations (US Department of energy, 2003) though the respondents mentioned a few. This could be due to ignorance and low literacy level. There is the need therefore to educate autogas users on the numerous technical and environmental benefits. This may however further increase the patronage of the fuel (Edjekumhene et al, 2007) thus further increasing the possibility of a vicious cycle of shortages.

Table 4: Respondents' period to have used autogas and when they started experiencing shortage of the fuel (figures represent percentage of responses)

Administrative District	Years of shortage					Period of using autogas				
	1	2	3	4	5	<5	6-10	11-15	16-20	Uncertain
Assin-North District (100)	5	19	22	51	3	64	29	6	1	8
Ewutu-Senya District (30)	13.3	60	26.7	0	0	93.3	6.7	0	0	26.7
Twifo/Hemang/Lower- Denkyira (40)	0	25	25	45	5	55	37.5	7.5	0	12.5
Gomoa-East District (42)	4.8	19.1	42.9	19.1	14.3	69.1	26.2	4.8	0	4.8
Twifo-Atti/Mokwa (30)	3.3	26.7	33.3	10	26.7	26.1	46.7	20	6.7	0
Assin-South District (30)	13.2	23.4	23.4	30	10	26.7	30	30	13.3	0
Cape Coast Municipality (100)	10	18	25	29	18	49	36	13	2.2	10
Mfantseman-East Municipality (42)	35.7	12	4.8	7.1	12	73.8	23.8	2.4	0	28.6
Efutu Municipality (42)	12	19	26.2	23.8	19.1	73.8	21.4	4.8	0	2.4
Agona-West Municipality (100)	27	5	36	28	4	68	13	10	7	1
Districts (Average)	6	26	27	32	8.1	60	30	10	3	8.4
Metropolis/Municipalities (Average)	20	13	26	25	12	63	29	10	3.1	8

(Source: field data, 2013)

5.0 Conclusion and recommendations

Movement of people and goods within and across administrative districts in the country has been made feasible through the activities of taxis, private cars and minibuses among others in the road transport industry. The traditional energy used to power these vehicles includes gasoline and gasoil. The coming into use of autogas, though initially was for households in Ghana domestic use, has attracted vehicle users a source of energy. Various factors that have contributed mostly to this shift are affordability, availability and fuel consumption.

Autogas has various advantages. It could be used sustainably as far as the environment is concerned. Its impact on global climate is relatively minimal. Social and economic suitability can also be achieved through the use of autogas as motor vehicle fuel. Autogas also has technical advantages in terms of mechanical and combustion efficiencies such as high octane number. Generally the study has shown that autogas users do regard the fuel as efficient, grading its efficiency from excellent, very good, and good to satisfactory.

The study further showed that drivers who use gasoline and gasoil spend above twice as those who use autogas to power their vehicles. It was found that between 19 percent (within the districts) and 39 percent (in the metropolis/municipalities) of the drivers use autogas to power their vehicles (taxis, private cars and minibuses). This amount can be said to be substantial enough to influence LPG shortages in the areas considered (table 4). LPG shortages in the administrative districts, the region and Ghana in general is therefore a reality, if the results obtained from this study and Biscoff et al (2012) are to be taken into consideration.

There is therefore the need for government to formulate policies to control the conversion of gasoline-fuelled vehicles to autogas, the usage of autogas (Biscoff et al, 2012) by vehicles and introduce tax regimes for vehicles that use the fuel and future users (Lueng, 2011). There is also the need for government to invest in research and development (R and D), codification and standardization and development of infrastructure in the conversion to autogas, use and a regulated market structure in dealing with the gas (Biscoff, et al, 2012) in the transport sector. Other stakeholders such as the Oil Marketing Companies (OMCS) the Tema Oil Refinery (TOR), the Ghana Standard Board (GSB), Ministry of Energy (MoEN), LPG Marketing Companies (LPGMC), Energy Commission (EC), National Petroleum Authority (NPA), etc. should strategize in a round table conference to deal with the frequent shortages of LPG in the country in relation to the supply chain disruptions. Proactive planning is required in this regard (Schmitt & Singh, 2009).

Apart from proactive planning the government as the major financier in handling welfare issues of its people should also be proactive through ministries concerned in dealing with autogas issues in the country in order to avoid future shortages. (Tang, 2006; Kleindorfer & Saad, 2005; Zsidisin, 2004). There must be an integrated and holistic approach, designed in a strategic fashion in dealing with the usage of the fuel in Ghana. This is because spending less on energy and saving the environment thereby could be one of the greatest contributions by man to the service of nature and mankind when auto gas is comparably preferred.

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