Developing a Framework for Effective Liquefied Petroleum Gas Marketing and Distribution in Nigeria

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DEDICATION

This dissertation is dedicated to my parents, loving wife and baby boy – **Toritseju Michael Sifo.**

ACKNOWLEDGEMENT

First and foremost, I would like to thank God Almighty, the Creator of Heavens and Earth, for without Him, none of this would be possible.

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ABSTRACT

Despite the huge national energy resource, a large majority of households in Nigeria do not have access to high quality modern energy services. They rely on traditional fuels (wood, dung and crop waste) for cooking. The disadvantages of these fuels are numerous: they produce dangerous emissions that lead to indoor and local air pollution; reduced productivity from hours wasted on gathering wood; their current rate of extraction has led to environmental degradation and deforestation. Transition to a readily available, clean burning modern energy carrier like LPG would resolve many of these issues.

In this dissertation, the barriers that hinder the widespread utilization of LPG in Nigeria are identified and a framework to remove these barriers whilst improving the marketing and distribution of the fuel is proposed. The framework was developed based on the experiences that were used by other countries in improving the distribution and marketing of the product. A case study was used to establish the efficacy of the proposed framework.

Oturkpo, a peri-urban town in the middle-belt region of Nigeria was considered for the case study. Null hypothesis that relates to barriers (like transportation, distribution, affordability, safety, pricing, e.t.c.) affecting LPG marketing and distribution was established. Results relating to these hypotheses from the survey questionnaire were analyzed with chi-square statistical tool.

The result of the analysis was quite revealing. The chi-square values obtained from the analysis of these hypotheses were all above the critical value of 0.005 level of significance at one degree of freedom. Thus, the null hypotheses were rejected and the conclusion was reached that these factors (transportation, distribution, affordability, safety, pricing, e.t.c.) most likely affect the marketing of LPG in Nigeria. These results clearly show the relevance of the conceptualized framework in developing the Nigeria LPG market in Nigeria.

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AEGPL	-	Association Europeaane des Gaz de Petrole Liquefies
Bbl/d	-	Barrels per Day
CBI	-	Cross Border Information
CBN	-	Central Bank of Nigeria
CIA	-	Central Information Agency
CO	-	Carbon-monoxide
CO_2	-	Carbon-dioxide
CPCB	-	Central Pollution Control Board
DPR	-	Department of Petroleum Resources
DRET	-	Department of Resources Energy and Tourism
EIA	-	Energy Information Administration
ESMAP	-	Energy Sector Management Assistance Programme
FEPA	-	Federal Environmental Protection Agency
IAEA	-	International Atomic Energy Agency
LPG	-	Liquefied Petroleum Gas
ML	-	Mega Litres
NALPGAM	-	Nigeria Association of Liquefied Petroleum Gas Marketers
NGL	-	Natural Gas Liquid
NGR	-	Nigeria Gas Report
NISER	-	Nigerian Institute of Social and Economic research
NLNG	-	Nigeria Liquefied Natural Gas
NNPC	-	Nigerian National Petroleum Company
NPC	-	National Population Commission
NO_2	-	Nitrogen Oxide
NPGA	-	National Propane Gas Association
OPEC	-	Organization of Petroleum Exporting Countries
PHCN	-	Power Holding Company of Nigeria
PMC	-	Petroleum Product Marketing Company
PSD	-	Partnership for Sustainable Development
REED	-	Rural Energy Enterprise Development
SME	-	Small and Medium Enterprises

UNDP	-	United Nation Development Programme
USDMN	-	United State Diplomatic mission to Nigeria
USTDA	-	United State Trade and Development Agency
VAT	-	Value Added Tax
WB	-	World Bank
WHO	-	World Health Organization
WSSD	-	World Summits on Sustainable Development
WLPGA	-	World Liquefied Petroleum Gas Association

CHAPTER ONE
RESEARCH INTRODUCTION

1.0 INTRODUCTION

More than 2 billion people in developing countries rely on biomass fuels to meet their heating, cooking and industrial needs; a vast majority resides in rural areas (PSD, 2006). Also, for most low-income households in developing countries, the energy choice for cooking, lighting and heating can be regarded as a *no* choice - their use of fuel is based on what is available and affordable. Typically, these are mainly biomass energy source comprising wood, dung or crop wastes – fuels that posses a negative impact on social, economic and environmental health (REED, 2003: 1).

According to REED (2003: 1), the major driving force of development activities in the energy sector is helping population move from the use of poor quality biomass energy sources to higher quality energy products and services. The revolution in the energy sector produces LPG (Liquefied Petroleum Gas) technology, a safe alternative method use for cooking, heating, etc.

LPG is a generic name for the mixture of hydrocarbons that can change from gaseous to liquid state when compressed at moderate pressure. Although the chemical composition of this gas varies, it is predominantly propane and butane (normally butane and isobutane). With all processes, LPG must be separated from the oil product or natural gas streams as it is derived either as a product from crude oil refining or natural gas or oil production (WLPGA, 2001: 1).

According to WLPGA (2001:1), LPG has the property of becoming liquid at room temperature if moderately compressed and reverting to gas when the pressure is sufficiently reduced. This makes it easy for transportation and storage. For large-scale bulk storage, LPG is generally refrigerated and seaborne transported as a liquid, but locally it is transported and stored in pressurised tanks or bottles.

LPG burns cleanly when compared with other fossil fuels and unsustainable biomass. It produces no particulate matter, low emissions of carbon (II) oxide (CO), unburned

hydrocarbons, nitrous oxide (NO_2), and less carbon (IV) oxide (CO_2) than most other fossil fuels and less than unsustainable biomass.

LPG has higher energy content than the fuels currently in use for cooking. It is about 45.5GJ/tonne – kerosene (43.2 GJ/tonne), fuel-wood (about 15 GJ/tonne), crop residues (13 – 14 GJ/tonne) and dung (12.5 – 13 GJ/tonne). In addition, the higher efficiency of LPG stoves (about 65%) as compared with traditional stoves (about 15%) and even "improved" models of biomass-based stoves (up to 45%), makes the relative efficiency considerable (Antonnete *et al.* 2004: 59).

1.1 BACKGROUND INFORMATION

The use of gas as a domestic fuel can be traced back to 940BC when people in China piped gas through hollow bamboo poles to boil ocean water for salt extraction (Busby, 1999: 1). However, LPG was first produced in 1910 by Dr Walter Snelling, and the first commercial product appeared in 1910 (NPGA: s.a.). Today, it accounts for about 3% of the primary energy used in the world.

Nigeria, the largest sub-Saharan country with a population exceeding 130 million people, is the largest oil producer in Africa and the eleventh largest producer of crude oil in the world (Oyebode *et al*, 2004: 131). In 2006, total Nigerian oil production, including lease condensates, natural gas liquids and refinery gain, averaged 2.45million bbl/d. Of this, 2.28million bbl/d of the produce was crude oil (EIA, 2007:2). Nigeria also has the largest gas reserves in Africa and is ranked 7th in terms of global gas reserves. Its natural gas reserves are estimated to be twice its crude oil reserves (Oyebode *et al*, 2007: 162).

Despite this huge national energy resource, many Nigerians still live in homes where biomass based fuels are used as they do not have access to modern energy resource. In Nigeria, LPG is produced in the four refineries. In principal, Kaduna refinery should supply the whole country while the other refineries (Port-Harcourt I and II, and Warri Refinery) should produce for export. However, the refineries have been working in fits and starts and hence, LPG supply has been epileptic (NGR, 1999: s.a.). This irregular supply has had a rebounding effect in LPG growth and development.

The Energy Sector Management Assistance Program (ESMAP), a program sponsored jointly by the World Bank and UNDP to provide technical assistance for environmentally responsible growth, suggested that the following reasons seem to be why LPG use is not encouraged (ESMAP, 2003).

- The high cost of purchasing stove and cylinder keeps the poor out of the market and they have no access to the micro-credit needed to borrow it.
- The unreliable Supply of LPG tends to force people to use solid fuel for backup cooking in as much as they must cook everyday.
- The inadequate access to LPG equipment and insufficient distribution network of LPG (distribution is mainly through cylinders and not pipelines).

1.2 PROBLEM STATEMENT AND SUBSTANTIATION

Although, the major use of LPG in Nigeria is for domestic fuel purposes, most Nigerians do not have easy access to this gas. Research has shown that the dominant energy source for cooking in the rural areas is fuel wood and charcoal energy (Anozie *et al.* 2004: 1288) and it has been estimated that over 70% of the Nigerian population live in the rural areas (CBN/NISER, 1992). This shows that the present energy policy in the country has made no impact at all in the cooking energy sector. It promotes the use of wood energy and thereby not ensuring cleaner air for the country and does not provide alternative energy sources like LPG that is cleaner and safe for domestic use.

At present, the LPG industry in Nigeria is highly fragmented with few large national business and many small local operators. This is because the industry has suffered economically through the dramatic contraction of its market and profitability in recent years. Most of the big companies have been forced to abandon development strategies in order to concentrate on survival and potential investors are skeptical about entering the industry due to the irregularity in price and the uncertainty in supply.

LPG consumers in Nigeria face a market in which supply is uncertain and prices are extremely volatile. Final selling prices are effectively set by an ineffective regulated informal sector and many take advantage of a real or contrived scarcity to raise prices arbitrarily.

Unavailability and uncertainty regarding future prices to a large extent has discouraged prospective consumers. Shell, a major company in LPG marketing and distribution in Nigeria, withdrew from the market, others have closed down and the surviving marketers tend to be ticking over, at best (WB/ESMAP, 2004). This shows that the policy put in place by government has not been supportive of the LPG industry and its actual and potential customers.

At the signing ceremony of the grant awarded by the United State Trade and Development Agency (USTDA) to the Nigerian Government in July 2005 to provide technical assistance in the restructuring of Nigeria's policy and regulatory framework for liquefied petroleum gas (LPG), Nigeria's Minister of State for Petroleum Resources, Dr. Edmund Daukoru said that over the years, consumption level of domestic LPG has witnessed a steady decline from over 100,000MT (Metric Tonnes) in the early 1980s to 54,000MT in 2004 against a fast growing population. This translates into 0.4Kg per person per year - the lowest in Sub Saharan Africa. This therefore shows a near collapse of the sector (USDMN, 2005).

Also, the U.S high commissioner to Nigeria (Ambassador Campbell) at the ceremony reiterated that in Nigeria, economical and safe cooking gas is a concern for all as not even the average person has little access to this gas for daily use. Dr. Edmund Daukoru emphasized that there is need for an appropriate policy and regulatory frame work for the LPG sector (USDMN, 2005).

Recently, as part of the effort to radically rehabilitate the energy sector, President Umaru Musa Yar'Adua inaugurated the Oil and Gas Committee under the auspices of the National Energy Counsel on the 7th of September 2007 in Abuja (Onourah, 2007). The committee is charged with the responsibility of reviewing the present ***national oil and gas policy, energy master plan, long term projects, marketing of oil and gas products etc*** and advice the president on strategic policy directions for the oil and gas industry.

In the light of this, it is therefore necessary that a research project on *Developing a Framework for Effective LPG marketing and Distribution in Nigeria* be carried out. The resultant output of this research will be recommended to this committee.

1.3 RESEARCH AIMS AND OBJECTIVES

The aim of this research is to look at the present LPG market in Nigeria, analyze the factors militating against the provision of equitable household access to LPG (i.e. to examine what constitutes hindrance to desired in-country patronage and utilization) the price tag of the commodity and qualities LPG has over household fuels and develop strategies that will ensure effective supply and distribution of LPG to consumers.

Several policies put in place by different countries that has yielded results will be considered with a view of developing a viable and effective framework in Nigeria. The objective of this research will be to:

- investigate and identify reasons for LPG market failure in Nigeria
- develop strategies for reviving Nigeria domestic LPG market
- streamline LPG distribution at affordable prices, especially to areas of the country where the use is not encouraged
- propose a framework aimed at promoting competition for growth of LPG market stand

1.4 BENEFICIARIES

The outcome of this research analysis and recommendations will benefit:

- the researcher through the knowledge that will be gained in researching this project
- the gas marketing companies/marketers and private investors
- the LPG industry, the government and the public to enable them understand the role of LPG in expanding the nations economy

1.5 THESIS ORGANIZATION

In the chapters that follow, the concept, findings as well as the recommendations and conclusions of this research work are presented.

Chapter two deals with the literature review vis-à-vis LPG marketing, distribution and the energy sector in Nigeria as it relates to domestic fuel.

Chapter three will look at the steps taken in the development of the proposed LPG marketing and distribution framework for Nigeria. This chapter will focus on the effective and successful framework put in place by other countries that has helped in promoting the use of LPG over other domestic energy source that are harmful to the users and the environment with a view of developing a framework that is suitable for the Nigeria LPG market.

Chapter four will look at the method used in collection of data. Data will be got from literature sources and empirical investigation during this project execution. The literature sources are from oil and gas handbooks, oils and gas journals and reports, and reliable internet sites. The empirical investigation is basically through questionnaires (that will relate to LPG distribution pattern, marketing, pricing, etc) and analysis of Nigeria LPG data in open literatures and journals from energy and oil and gas institutes.

Chapter five will deal with the analysis of results and discussions on the findings in the report from the questionnaires that were used in the research survey. This chapter will look at the effect of the conceptualized framework in the LPG market in Nigeria based on the result and analysis from the questionnaires.

Chapter six concludes the research work with recommendations and conclusions.

CHAPTER TWO

NIGERIA LPG MARKET

2.0 LITERATURE REVIEW

2.1 Liquefied Petroleum Gas (LPG)

The term LPG is widely used to describe two prominent members of a family of light hydrocarbons called "Natural Gas Liquids" (NGLs): propane (C_3H_8) and butane (C_4H_{10}). The other two members of the NGLs family, ethane and condensates, have their own distinct market. In a gaseous state at normal atmospheric pressure and temperature, LPG becomes a liquid at 15°C when the pressure is lowered to between 1.7 and 7.5bar (AEGPL, 2007: 5). This gives them a considerable advantage over other fuels because they can be easily transported and stored in the liquid state.

LPG is an environmental friendly source of energy with a wide range of applications: domestic (heating, cooking, hot water production), industrial, agricultural, catering throughout the world. When LPG is burnt it produces the cleanest emissions of all oil-based products, with low carbon dioxide output (AEGPL, 2007:5).

2.1.1 LPG Composition

Although the exact composition of LPG is not fixed, it usually consists predominantly of propane (C_3H_8) and butane (C_4H_{10}), with a small proportion of propylene (C_3H_6) and butylenes (C_4H_8). Commercial LPG also contains traces of lighter hydrocarbons like ethane (C_2H_6) and ethylene (C_2H_4) and heavier hydrocarbons like pentane (C_5H_{12}). The table below shows the percentage composition of a typical LPG.

Table 2.1 Composition of a typical LPG (CPCB, 2008)

% Composition	LPG
Ethane	0.2
Propane	57.3
Butane	41.7
Pentane	1.4

2.1.2 Properties of LPG

Due to the fact that LPG is rich in hydrocarbons, it evaporates at normal pressure and temperature; therefore it is canned under pressure. LPG is quite popular because it can be moved in cans and utilized in places far from the place of production. To allow thermal expansion of LPG the cans are not filled with LPG to the brim, approximately 15% to 20% is kept empty so that even if the volume of LPG increases it does not exert much pressure on the walls of the can (Ganguly, 2008).

Normally, LPG is stored in liquid form under pressure in a steel container, cylinder or tank. The pressure inside the container depends on the type of LPG (commercial butane or commercial propane) and the outside temperature.

At the initial stage of using LPG, some of the pressure in the container is released, thereby causing some of the liquid LPG to boil and produce vapor. Heat is needed to convert the liquid to vapor (known as the latent heat of vaporization). As the liquid boils, heat energy is drawn from the surroundings. This is the reason why LPG containers feel cold to touch and why, if there is a heavy off-take, water or ice may appear on the container.

The pressure will return to the equilibrium value for the surrounding temperature when you stop using LPG. The pressure of the LPG in the container varies with the surrounding temperature and it is usually much higher than is needed by the appliances that use it; it needs to be controlled to ensure a steady supply at constant pressure. This is done by a regulator, which limits the pressure to suit the appliance that is being fuelled. It is a colourless and odourless gas to which foul-smelling mercaptan is added so that leak can be easily detected.

It is important to note that LPG should be stored away from sources of ignition and in a well-ventilated area, so that any leak can disperse safely since it is highly inflammable. Another reason why care should be taken during storage is that LPG vapour is heavier than air, so any leakage will sink to the ground and accumulate in low lying areas and may be difficult to disperse. The table below shows the properties of LPG.

Table 2.2: Properties of LPG

	Propane	**Butane**
Chemical Formula	C_3H_8	C_4H_{10}
Liquid Density	0.505	0.575
Gas Density	1.5	1.95
Ratio Gas/Liquid	274	230
Atmospheric boiling ptc	-42	-2
Specific heat liquid	0.62 Btu/deg	0.58 Btu/deg
Latent heat vaporisation	358 KJ/Kg	372 KJ/Kg
Flammability limit	2.2-9.5%	1.8-8.5%
Auto temp. Ign	470°C	410°C
Mole weight	44.10 Kg/K/mole	58.12 Kg/K/mole
Freezing point	-187.7°C	-138.4°C
Critical temperature	96.7°C	152.1°C
Critical pressure	42.5 bar	38 bar
Litres per tonne	1965 – 2019	1723 – 1760
Octane number	<100	92
Relative density of liquid	537 – 543	406 – 431
Maximum flame temperature	1980	1990
Ratio of gas volume to liquid volume	274	233
Soluble in water	Slight	Slight
Colour	Colourless	Colourless

*(**Source**: Cheresources Inc., 2002. Information on Crude distillation, Chemical Engineers' Resource Page, Cheresources Inc., available at www.cheresources.com/refining.htm)*

2.1.3 Production of LPG

LPG is a derivative of two large energy industries: the processing of natural gas liquids and the refining of crude oil.

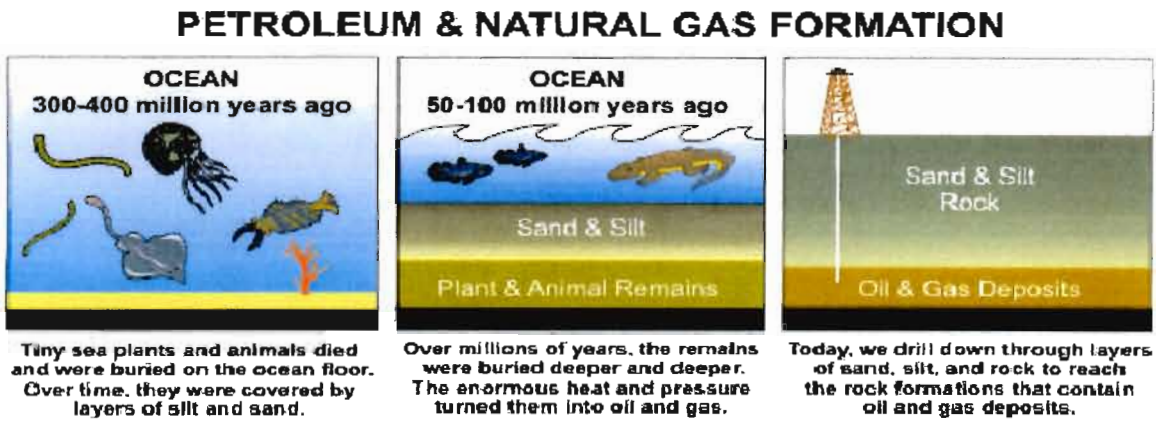


Figure 2.1 Formation of Natural Gas under the Earth Crust (EIA 2005b)

2.1.3.1 Natural Gas Processing

When natural gas is drawn from the earth, it is a mixture of several gases and liquids. Commercial natural gas is mainly composed of methane, but it also includes other light hydrocarbons like ethane, propane and butane in such proportions that its quality is in conformity with the market where it is distributed.

Propane boils at -44°F and ethane boils at -127°F. Separation from methane is accomplished by combining increasing pressure and decreasing temperature. The natural gas liquid components recovered during processing include ethane, propane and butane and other heavier hydrocarbons. Worldwide, gas processing is the source of approximately 60% of LPG (Kidnay et al, 2006).

2.1.3.2 Crude Oil Refining

In an oil refinery, propane and butane along with other gases are also produced during crude refining as a by-product of the process that rearrange or break down the molecular structure to obtain more desirable petroleum compounds. LPG represents between 1% and 4% of the ton of crude oil processed. Refining is the source of approximately 40% of LPG produced worldwide (CPCB, 2008). The figure below shows the refining process of crude oil.

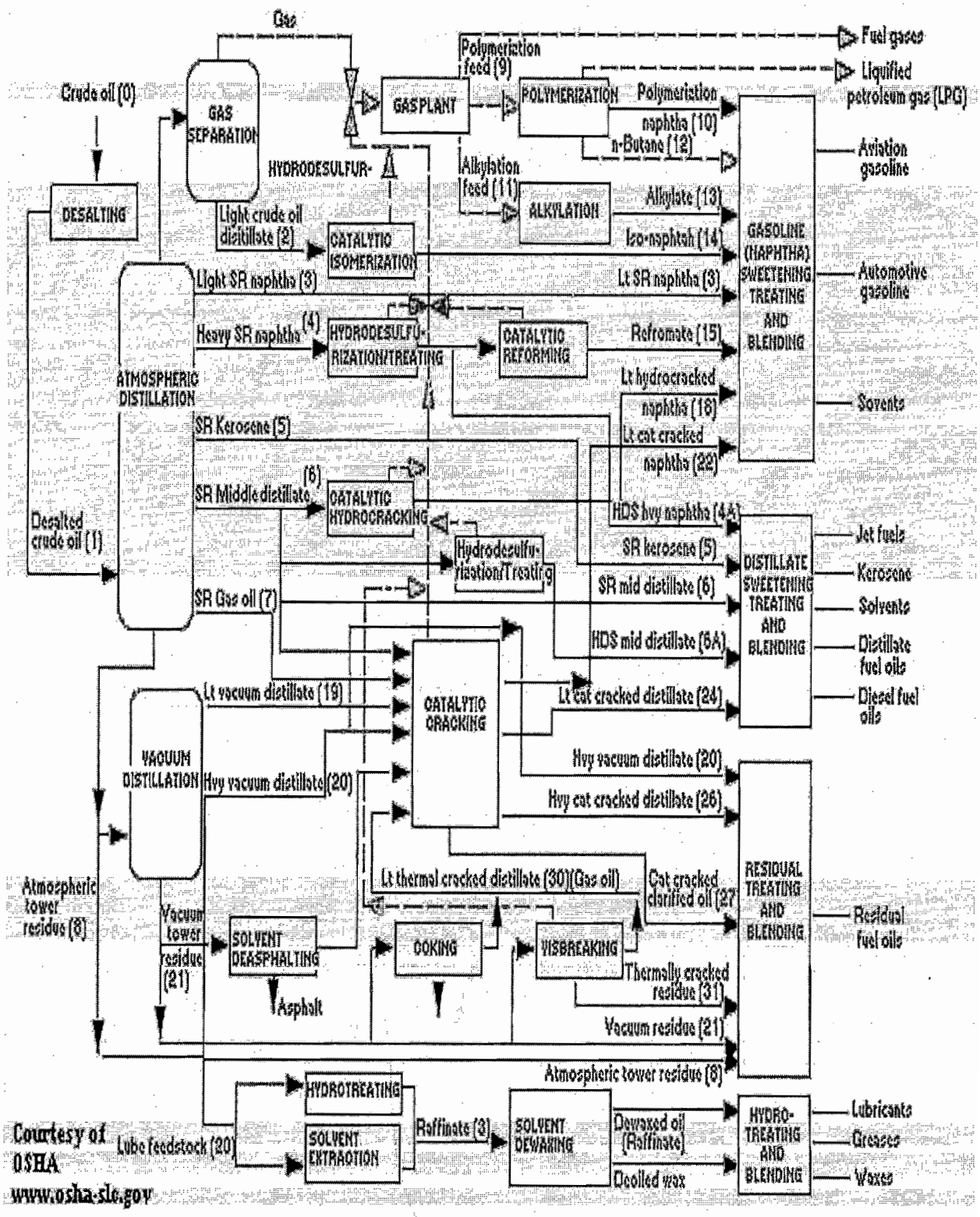


Figure 2.2 Crude oil refining process

2.1.4 General LPG Use

LPG is a multi-purpose energy. There are lots of applications, from cooking, heating, air conditioning and transportation, to cigarette lighters and even the Olympic torch. Below are some major applications of LPG.

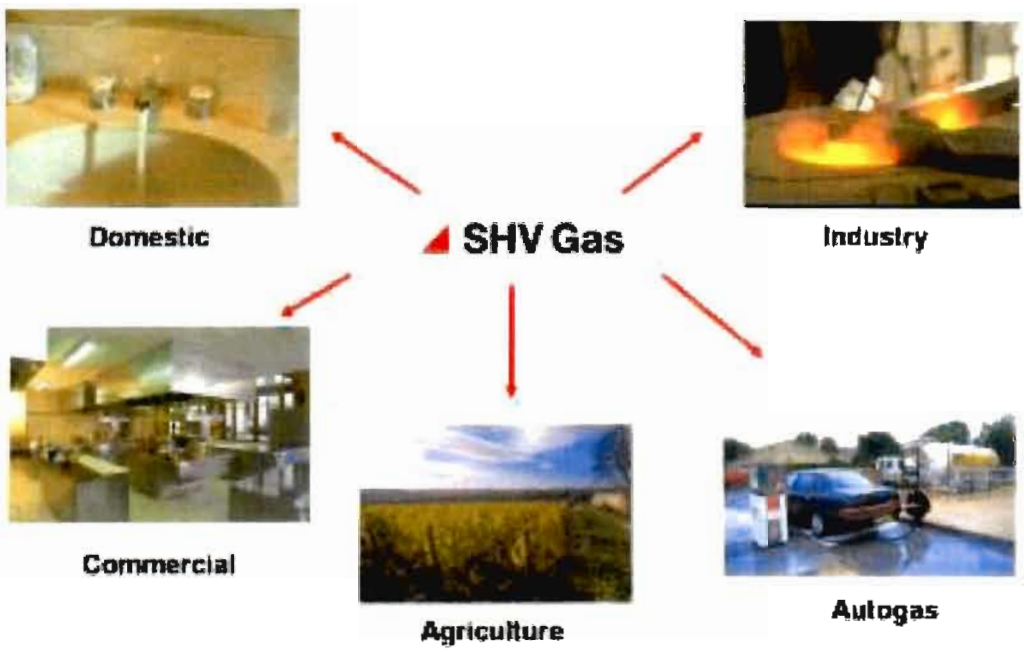


Figure 2.3 Applications of LPG (courtesy of www.shvgas.com)

2.1.4.1 LPG as Coolant in Refrigerators and Air-conditioners

Chlorofluorocarbons (CFCs) and hydro-chlorofluorocarbons, (HCFCs) are currently used as coolants in refrigerators and air conditioning units but research has shown that they have effect on stratosphere Ozone and contributes immensely to global warming (Wuebbles, 1995).

The performance of LPG as an alternative refrigerant to CFC 12 in domestic refrigerators was studied and it showed that LPG worked for more than two years without making any modification to the refrigerator. It was also concluded that the use of LPG as a replacement refrigerant can contribute to the solution of ozone depletion problem and global warming potential (Alsaad, 1997: 8).

2.1.4.2 LPG as Auto Gas

LPG is being used as an alternative fuel in vehicles for the past 50 years. Today, there are about 9 million vehicles in many countries, primarily in Turkey, Italy, Netherlands, Australia, Japan etc. that run on LPG. It is more attractive to consumers (mostly commercial vehicle owners) than the other fuels like gasoline and diesel because of its lower retail price and its synchronous usage with other types of fuels.

In addition, LPG powered vehicles produce less pollutants by their exhausts in comparison with gasoline and diesel-fuelled vehicles, which encourages some countries to use it; for example, about 60% less CO, 30% less HC and 20% less NO_2 in comparison with gasoline (Ristovski et al, 2005).

LPG has become a serious alternative for gasoline because of its low maintenance costs, suitability for new and applicable technologies, economic market price, and environment-friendly characteristic (Karamangil, 2006).

2.1.4.3 Use of LPG in Agriculture

As a highly portable, modern and environmentally friendly energy source, LPG plays an integral role in the development of agriculture. It is used in crop-drying, thermal desiccation, insect repellent and the fuelling of farm vehicles.

2.1.4.4 LPG Use in Industries

Due to its flexibility in terms of storage and distribution, LPG has become a convenient and readily available energy source in off-grid regions that would not otherwise be able to support industrial activity. It is an important source of energy for wide range of industries including cement manufacturing, food production, metallurgy, etc.

2.1.4.5 Domestic Use of LPG

Due to its high calorific value LPG is particularly suitable for cooking, heating and lighting in the home. There are numerous advantages in the use of LPG as a source of cooking. It burns cleanly, preserving the quality of food and preserving indoor air quality. It also allows for precision temperature control thereby, facilitating a more convenient and effective cooking experience (Wijayatunga, 2001: 2221).

2.2 LPG MARKETING

Marketing is one of man's oldest activities and yet it is regarded as the most recent of the business discipline. It links two basic functions in the community, namely those of production and consumption. LPG marketing does not fall short of this definition as the activities involved in marketing requires the production of the gas from either the fractional distillation of crude oil or from the processing of natural gas to the final consumer.

2.2.1 Global Trend of LPG Marketing

Worldwide, about half of LPG produced is used in the residential and commercial sector, with statistics in most countries not distinguishing the two sectors. Most, however, is thought to be used in households. In 2003, about 103 million tonnes were used in these sectors, which is equivalent to 122 million tonnes of oil, or just 2% of all oil and gas consumption – 1.3% of all primary energy consumption (WLPGA 2004).

The international LPG industry has expanded rapidly over the years and undergone many profound changes. New markets for LPG have emerged in many locations, and LPG consumption is increasing in virtually every region of the world. Utilization of LPG as fuel in residential and commercial markets is rising particularly in many developing countries as access to LPG is expanded and markets are liberalized (Otto, 2005).

In the past, LPG in international trade was basically a regional business: traders from the Middle East find a better market for their product in Japan; LPG produced in South America (mainly from Venezuela) is exported to countries in that region and to North America. The European traders of the product sell their product within the Western Hemisphere. Each regional trade at that time had its own pricing structure, shipping, and buyers and sellers. This regional marketing eventually changed due to supply increases in the Middle East (Shelley, 2003: 174).

LPG marketing went global in the late 1970's when the middle east suppliers (mainly the national oil companies) built LPG plants to process gas that were previously flared. This increased their production output thereby creating the need to find new buyers for this increased output. The expansions in LPG production capacity which

occurred in the Middle East at that period was quite staggering-from a total of 6million tons of installed capacity in 1975 to 17million tons by 1980 and 30 million tons by 1985 (Shelley, 2003: 186).

Apart from the increased LPG production in the Middle East, there was also increase in LPG production in other parts of the globe. New plants were being built in Australia, Algeria, North Sea and in Venezuela. Therefore, the 1980's was a period of tremendous export supply expansion of LPG in the world.

Table 2.3: LPG Export Supplies (million tons)

Country	**1975**	**1980**	**1990**
Middle East	5	11	19
Far East	1	2	4
Africa	-	-	4
Europe	1	1	4
Western Hemisphere	1	2	2
Total	8	16	33

***(Source:** shelley, 2003.)*

Asia is the now the largest LPG market in the world, having overtaken the US in the early 2000's. The region, along with the Middle East at 7.1%, also has the highest growth rates – with India at 10.7%, South East Asia at 7.1% and the Far East at 4.1% (Otto, 2005). A significant proportion of Asian growth in LPG is attributable to the increase in Chinese demand, which currently stands at 21 million tonnes per annum, and which is projected to reach anything from 28 – 37 million tonnes by 2010 (Hoare *et al.*, 2005).

In Africa and in poor countries of Asia, lack of LPG distribution infrastructure and the high cost of LPG and gas stoves have been sighted as an impediment to greater LPG penetration in the rural areas. Majority of the poor families do not save enough, thus making it impossible to spend huge sum of money, for example in the purchasing of gas stoves (Sanga, 2003: 15).

2.2.2 World LPG Price

The world price of LPG increases with the approach of the Northern Hemisphere winter and decrease to some extent during the Northern Hemisphere autumn and summer. However, it is noteworthy that there appears to be a trend over the longer term for gradually rising LPG prices. This partially reflects the steadily increasing world demand for LPG, particularly in Asia.

In countries such as China and India, demand for LPG has increased significantly in recent years. Also, in Australia, LPG consumption has increased from less than 100ML in 1975 to approximately 4,037ML in 2006–07 (DRET, 2007:4).

In general, the World prices of LPG moves in line with crude oil prices, although as with most commodities it does have its own supply and demand parameters, which is a critical determinant of price. Most worldwide producers use a set Saudi Aramco Contract Price (Saudi CP) as a world marker price upon which exports and domestic sales to wholesalers (marketers) are negotiated (DRET, 2001:4). The reason for this is that there are few other world quoted prices and Saudi Arabia is the world's largest producer of LPG. World market prices of crude oil and LPG have increased substantially over the years. Fig 2.4 below shows the Saudi Aramco Contract LPG Price (butane, $ per ton)

Notes: Saudi Aramco Contract is a benchmark LPG price. The price of propane differed only very slightly from that of butane over the period shown in the chart.
Source: LPG Australia, available at www.lpgaustralia.com.au.

2.2.3 World LPG Supply

World LPG supply is in a strong expansion cycle. This is as a result of enhanced processing and rising oil-refinery throughput. New LNG production in Trinidad, Nigeria, Angola and elsewhere has resulted in added LPG volume being produced. Also, burgeoning South American natural gas output is expected to boost LPG supply in that region. The growth in production of LPG will probably outstrip that of most other oil products, since natural gas processing - now the largest source of LPG - is increasing more rapidly than crude oil processing.

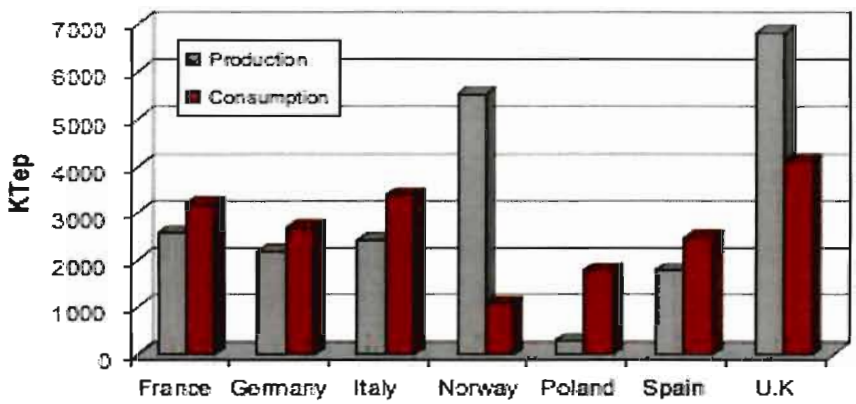


Fig 2.5 European LPG supply/demand (***Source:*** *WLPGA Statistical Review of Global LPG, 2004.)*

Rising natural gas production will add to the amount of gas that is processed and boost the supply of propane and butane. As markets develop, reduced flaring of natural gas in many countries will also boost LPG supply; Saudi Arabia and Nigeria that flare gas the most, both plan to phase out the practice (WB & WLPGA, 2002).

As in many other regions across the globe, the residential/commercial and chemical sectors dominate demand. In fact, Asia is also the largest residential/commercial LPG market in the world and this trend will continue. Experts predict that Asian residential/commercial LPG demand will reach 60 million tonnes by 2010. This figure is 3 times higher than the projected demand of the next largest residential/commercial market, Latin- America (Ibid *et al.*, 2005).

Ken Otto of "Purvin and Gertz" in his presentation delivered at the 2005 World LPG forum in Shanghai China said "With the growing dominance of natural gas in China's largest cities, the Chinese residential/commercial LPG market will expand into small and medium sized towns as well as into suburban and rural areas" (Otto, 2005). Chinese experts also foresee growth in the autogas and cutting gas markets, as well as the development of new applications for LPG, such as LPG air conditioners and spray propellant (Otto, 2005).

Concerns over the availability of adequate supplies of LPG are diminishing with current predictions that LPG supplies will expand rapidly in Asia and globally over the next 5 years. Given that supplies should rise faster than demand, market pressure should reduce and price moderate. The expansion of supply will also support additional growth across Asia in coming years (Otto, 2005).

2.3 HISTORICAL BACKGROUND OF NIGERIA

The Federal Republic of Nigeria is the largest country in Africa in terms of population. It was created during the colonial period in the nineteenth century. Nigeria got her independence in 1960, and became a republic in 1963 *(EIA 2005a)*. It is a member of the Commonwealth of Nations and OPEC. The official language is English with 250 other languages. It is made up of 36 states with Abuja as the Federal Capital Territory. These are further divided into approximately 774 local government areas. The map of Nigerian is shown in figure 2.4.

2.3.1 The Geography of Nigeria

Nigeria has a population of about 140million based on 2006 census *(Olori, 2007)*. It has an area of 923,800 square kilometres occupying about 14% of West Africa land scale *(EIA 2005C)*. It is bordered on the north, east, and west by Niger, Cameroon, and Benin Republic, respectively. The Atlantic Ocean forms the southern boundary. The country lies between 4°N and 14°N and between 3°E and 15°E which is within the tropics. It makes her to experience high temperatures throughout the year. The Average maximum temperatures vary from 32°C along the coast to 41°C in the far north, while mean minimum figures range from 21°C in the coast to under 13°C in the north *(EIA 2005b)*.

Figure 2.6 Map of Nigeria *(CIA 2007)*

2.3.2 Nigerian Domestic Energy Sector

Nigeria is blessed with high quantities of different primary energy resources. These resources are well distributed throughout the country. Nigeria energy resources comprise renewable and non renewable energy resources such as crude petroleum oil, natural gas, coal, tar sand, uranium, solar, wind, hydro, and biomass. The common forms of domestic energy in use in Nigeria are fuel wood, kerosene, liquefied petroleum gas (LPG) and electricity.

2.3.2.1 Electricity

The Nigeria power sector operates well below its estimated capacity and is characterized by incessant power failure. To compensate for this anomaly in power supply, household, commercial and industrial sectors are increasingly using privately operated diesel generators. The state electricity company, Power Holding Company of Nigeria (PHCN), the sole provider of electric power suffers from large transmission losses (due to constant vandalizing of its properties) and poor collection rate that takes a toll on their finance. Currently, only 10% of rural households and 40% of total

population have access to electricity. Nigeria electricity consumption per capita is 111 kWh, which is one of the lowest in sub-Saharan Africa *(CBI 2003)*.

2.3.2.2 Fuel wood

Fuel wood is the least expensive energy source in Nigeria and because it is readily available it has become the dominant household energy source for cooking. This is a dangerous situation because the deforestation effects caused by fuel wood burning are not desirable.

The burning of wood in simple stoves leads to emissions of CO, CO_2, NO_2, hydrocarbons (HCs) and particulate matter. These emissions has influence on the greenhouse effect and locally the population may be affected by chronic lung diseases, heart conditions, lung cancer, diseases of the respiratory tract, childhood diseases, and increased infant mortality (De Koning *et al*, 1985).

Nigeria's rate of deforestation is very high, ranking ninth in the world and has reduced the forest from about 20% of its total land size to just 9.61% (FEPA, 1992). The continued rapid loss of forest cover would be ecologically, environmentally and economically disastrous for the nation.

Fig 2.7 Around three billion people are still primarily dependent on biomass fuels and coal for their everyday household energy needs.

2.3.2.3 Kerosene

Kerosene is a liquid fuel that is obtained as one of the by-products of the fractional distillation of crude oil and it is used for cooking in pressurised stoves or in normal stove with wick burners. It has a heating value of around 44.75GJ/tonnes. Kerosene is the main source of lighting in countries with poor access to electricity like Nigeria. This has led to its penetration in the rural areas than LPG. Kerosene vaporises easily and burns more neatly than the solid fuels.

Apart from its environmental effect, the major set back in the use of kerosene as household fuel in Nigeria is in terms of safety. Kerosene offers little succour, given the high rate of explosions arising from its use. A major kerosene explosion disaster occurred in oil-producing Nigeria in October 2001. Statistics from the Lagos State University Teaching Hospital shows that in a 25-day period (12th October to 6th November, 2001), one hundred and twenty-five burn patients were treated at the hospital. All but two of the patients sustained fire/flame burns resulting from explosions caused by the use of kerosene in hurricane lantern and cooking stove (Sanni, 2005).

2.3.2.4 LPG

LPG is used principally as a cooking fuel in Nigeria with little application in the construction industry for welding. Despite some of the advantages it has over other domestic fuels, LPG experiences a low level patronage in Nigeria. Preliminary investigation reveals that the high price and its unavailability are the major reasons for the low level patronage.

In January 2008, the price doubled with a corresponding disequilibrium in the disposable income of the domestic consumer. This is quite worrisome for a country that accounts for 24 billion cubic meters (0.84 trillion cubic feet) of associated natural gas or 36% of globally flared gas (Igbikiowubo, 2008). The table below shows the level of penetration of LPG and other fuels in selected countries.

Table 2.4 Percentage Penetration of LPG, Kerosene and Electrical Power in selected countries

Country	LPG	Kerosene	Electrical Power	All non-solid fuels
Brazil	92.3	0.1	1.6	92.8
Nicaragua	29.0	1.8	1.0	31.7
South Africa	7.9	43.2	45.8	85.8
Vietnam	22.3	8.0	13.1	33.0
Guatemala	44.9	5.5	2.0	50.1
Ghana	5.4	1.1	0.4	6.9
Nepal	1.6	7.1	0.3	9.0
India	16.0	7.9	0.2	24.3

Source: World Bank (2003)

2.4 NIGERIA LPG

For the purpose of this research, the LPG industry in Nigeria shall comprise the players in the marketing and distribution chain - traders and shippers, road haulage contractors and manufacturers/vendors of LP Gas cylinders, tanks, appliances, and ancillary equipment.

2.4.1 LPG Production in Nigeria

The downstream petroleum sector in Nigeria (the industry providing processed petroleum products to Nigerian consumers and businesses) has long been dominated by the government as represented by an integrated, government-owned oil company called the Nigerian National Petroleum Company (NNPC) with its refineries, pipelines, and depots. NNPC is involved (directly, and through subsidiaries and joint ventures) in all aspects of the oil and gas industry in Nigeria.

NNPC is the sole owner of the four refineries in Nigeria, two in Port-Harcourt (Rivers State), one in Warri (Delta State), and one in Kaduna with a total nominal refining capacity of 440 kilo barrels per day (kbd). The four refineries are characterized as follows:

- Old Port Harcourt refinery that is decrepit and not producing, although it has a nominal capacity of 60 kbd;
- The new Port Harcourt refinery was commissioned in 1989 with a processing capacity of 145 kbd of crude oil per day;
- Warri Refinery was commissioned in 1978 and upgraded to a capacity of 125 kbd in 1987;
- The Kaduna Refinery was commissioned in 1980 and expanded to 110 kbd of processing capacity in 1986; crude oil to the refinery is delivered through a 700 km pipeline from the Escravos Terminal in Delta State.

LPG production in the normal sense is merely incidental to the mainstream operations of the refineries but often LPG must be removed (to a greater or lesser extent) in order to meet product specifications, notably that of gasoline, or Petroleum Motor Spirit (PMS). This therefore implies that LPG production is a primary function of crude oil process runs. The total LPG production capacity from all four refineries when operating at full capacity is currently pegged at 200,000 tonnes yearly (Alexander, 2002). Over the past number of years there have been ongoing maintenance problems in the refineries, which have resulted in serious shortfalls in the production of LPG at the refineries. This is reflected in the Nigerian Oil Industry Statistical Bulletin, which summarizes the total LP Gas production at the refineries as follows:

- 1997—27,440 tons
- 1998—114,320 tons
- 1999—88,820 tons
- 2000—14,930 tons
- 2001—42,810 tons

Report made available on a visit to three of the four refineries summarizes the supply/production situation as follows:

- **Warri Refinery:** In 2001, the total production of LPG was 3010 tons, and at the end of November 2002, total production was 5,482 tons. At 90 percent capacity, that is, at a crude charge of 15,410 tpd, LP Gas production at Warri should reach 3.5 percent, that is, 540 tpd. The total production figures for 2001 and 2002

reflect the ongoing maintenance difficulties at Warri, which have continued over the years.

- **Port Harcourt (PH) Refineries:** The old refinery has not been working for some time now, so all LPG is produced from the new refinery. At 90 percent crude charge of 18,500 tpd, LPG production from the new refinery is around 3.34 percent, that is, 620 tpd. However, during 2002, about 50 percent of the LPG produced was flared. This was because of problems with evacuation priority for LPG at the jetties, jetty loading arm problems, and inadequate storage to deal with the build up of LPG.

- **Kaduna Refinery:** If all units (i.e., FCC unit, distillation unit, and the Merox unit) are operating 100 percent of installed capacity, the total production of LPG will be about 200,000 tons per year. The reality is that the refinery has suffered a succession of major problems (most recently a fire which affected the operation of the FCC unit) and, in recent years, there have been long periods during which LPG was not available. The FCC was scheduled for resumption in the first half of 2004 but this was not achieved. During 2002, 1,617 tons of LP Gas was supplied to the market while 26,631 tons was flared. The equivalent figures for 2001 were 56 tons supplied to the market and 13,926 tons flared (NNPC, 2004).

The report above shows that all four refineries suffer from a range of problems; which, in recent years, have resulted in serious shortfalls in the production of refined products. These shortfalls, in turn, have resulted in enormous expenditure on imported oil products like LPG and the loss of expected revenue from exports.

The irony in LPG production in Nigeria is that the country produces 4 Million tons of LPG yearly through independent or smaller potential gas producers, but the paltry 58,000 tons she uses is imported from neighbouring Republic of Benin (Williams, 2007). All refined petroleum products sold in Nigeria today are imported, because Nigeria's refineries are shut down or operating at a fraction of its capacity while that produced by independent or smaller potential gas producers is mainly for export.

2.4.1.1 LPG Importation

Though an exporter of LPG, Nigeria has had to resort to the importation of significant amounts of LPG to make up the shortfall in the domestic market. This is due to the non-functioning of refineries, lack of storage capacity and constraint of local marketers to access gas terminals. Official records on the volumes of LPG imported into Nigeria and from what countries are not available (Oyebode et al, 2007).

As a result of the shortfall created by this gross capacity under-utilization of the refineries, about 2.61 million metric tons (41.6%) of refined petroleum were imported annually for domestic consumption between 1970 and 1995 (CBN, 1995).

The situation of importation was very pathetic in 2000 because that year recorded the highest petroleum products import of 7.25 million metric tons (see Fig 2.2 below); this was as a result of low refineries capacity utilization of only 35% with total production of 4.427 million metric tons for the year.

Petroleum products imports (1997-2004) in metric tons

Year	1997	1998	1999	2000	2001	2002	2003	2004	Ave 1997-2004
PMS	1,061,856	2,507,009	1,987,474	4,144,347	3,857,093	4,036,484	5,404,163	5,696,400	3,586,853
DPK	0	655,619	171,482	1,155,399	433,295	404,896	637,620	418,240	484,569
AGO	185,296	515,958	465,248	195,2732	117,156	94,351	1,146,685	170,280	580,963
Total	1,249,149	3,680,584	2,626,203	7,254,478	4,409,545	4,537,733	7,190,471	6,496,390	4,680,569

Source: NNPC Annual Petroleum Bulletin, Various Issues (1997-2004) (Nigerian National Petroleum Corporation, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004).

Fig 2.2 Petroleum Product Imports (1997-2004) in metric tons

Between the year 2000 and 2005, over $2 billion was being spent on petroleum products importation into the country. This was confirmed by a statement credited to the NNPC's Group Managing Director, Engineer Funsho Kupolokun in July 2005 (Oduniyi, 2005). This unwholesome development turned Nigeria into a net importer of petroleum products, which betrays her status as the sixth largest exporter of crude oil in the world.

LPG is subject to 37 percent import duty (inclusive of levies), with this, the landed price does not allow for market expansion. The landed cost is around N52, 000

(US$400 @ 130N per US$) per ton, excluding any demurrage delays or costs. This huge cost associated with importation of petroleum products is a major reason for government emergent deregulation and the hike in prices of petroleum products from 26 to 48 % at the end of 2003 (Iyayi *et al*, 2007).

Companies that have imported LPG in the past few years (including NALPGAM, on behalf of the marketers), have suffered at a considerable loss financially; because once product became available from the refineries, they were left with their product, or having to sell at the refinery price which is a far cry from the total cost of importation. This trend has been on over the years. Therefore, importing LPG is not a long term viable option.

2.4.2 LPG Pricing in Nigeria

In the past, the government involvement in the downstream petroleum sector was not only through ownership of infrastructure, but also through regulation of wholesale and retail prices. The retail end was 100% private until the government opened filling stations in Abuja and Lagos. Until September 2003, the government through its Petroleum Product Pricing and Marketing Committee (PPPMC) set wholesale and retail prices for petroleum products, and also fixed the margin for the private retailers.

The rationale for price fixing was that Nigerian consumers should have access to cheap fuel at a uniform price across the country. The goal of supplying cheap petroleum products to the country was not achieved: demand was not met, large quantities of subsidized Nigerian products were smuggled to neighbouring countries and outside of Lagos and Abuja, and petroleum products were for the most part only available in the informal market at higher prices (Okogu, 1995: 378). Liberalization at end of September 2003 ended the retail price regulation, and marketers started setting prices to cover their operating costs (Iyayi *et al*, 2007).

Since the last quarter of 2007, households in Nigeria have been battling with acute scarcity of liquefied petroleum gas or cooking gas in the market. Investigation revealed that 12.5kg cylinder sold for between ₦2, 500 and ₦3, 000 had gone up by 100%. Even at that price, consumers cannot find the product to buy. Consumers have

to go to as many sale outlets as possible, including gas plants, before getting gas to buy. The result is that marketers are taking advantage of the situation to sell at cut-throat prices, notwithstanding the fact that the LPG sector is deregulated (Kumi, 2008).

Report from the office of the Minister of State for Energy as regard the increase in LPG price disclosed that the prevailing price of gas in the domestic market is coming up at a time the government is set to implement a new pricing/framework for domestic utilization of gas. It further stated that the present situation is due to a multiplicity of factors, including: heightened militancy in the Niger Delta, acts of vandalism of crude oil and gas pipelines, among others, and the refineries have been operating below capacity. Added to this scenario is the lack of proper pricing/policy framework for domestic gas utilization in the country (Igbikiowubo, 2008).

2.4.3 LPG Distribution Structure in Nigeria

Kofler, 1980 defined distribution as that aspect of marketing responsible for transmitting economic goods from the seller to the buyers. Most producers do not sell their goods directly to the final users hence between the producers and users stand a host of marketing intermediaries bearing varieties of names. These intermediaries are referred to as channel of distribution. Distribution can be seen as a marketing function that directs the flow of goods from producers to consumers. It can also be described as an independent function because of an ever increasing physical distance between the producers and the ultimate consumers.

PPMC is a subsidiary of NNPC that is responsible for the sourcing and distribution of petroleum product in Nigeria through a network of pipelines and depots. Licensed marketers are responsible for onward distribution from the depots. The policy objective is to make products available in all parts of the country and at a common price, irrespective of location.

2.4.3.1 Import Facilities

The LPG export facilities of oil multinationals like Chevron, Exxon-Mobil and NLNG were designed only for large-scale cargoes of refrigerated product and are not immediately relevant to the domestic market.

There are berthing facilities for LPG ships at Port Harcourt and Warri refineries that are designed for smaller ships and to handle pressurized cargoes. However, the LPG ship loading arms at Warri have remained unused for some years and are not capable of operation at the moment. The Port Harcourt facility has only one functional ship loading arm that is used for exporting LPG. The second loading arm is mounted on berths that have become inaccessible because of silting and the pipeline linking it to the refinery has been deemed unusable because of heavy corrosion. A third loading arm on one of the outer (accessible but congested) berths is unserviceable (NNPC, 2004).

PPMC's butanization depots at Calabar and Apapa (Lagos) are designed to receive pressurized LPG by sea and have a storage capacity of 1,000 and 4,000 tons respectively. A ship loading arm has been erected at Apapa but not yet commissioned. When LPG is imported, a makeshift temporary ship unloading arrangement is used. Three other companies (Totalgaz, Nidogas, and AP) have independent berthing and LPG storage in Apapa. The largest of these, Totalgaz, has 1,000tons of storage. All were designed to receive LPG by coastal tanker from Warri and Port Harcourt or exceptionally, from abroad.

2.4.3.2 Primary Depots

In a bid to bring petroleum products close to consumers at the same price across the country, PPMC operates a network of "white products" depots, which are supplied by pipeline from the refineries. Along these depots are nine butanization depots (with the exception of the one in Apapa, Lagos). These butanization depots are part of the primary distribution system, but dedicated to a single product - LPG. Arguably, the independent import terminal facilities of Totalgaz, Nidogas, Unipetrol, and AP are also primary depots.

The function of these butanization depots is to receive LPG in bulk and make it available to licensed marketers for local distribution in bulk and in cylinders. The nine butanization depots are located at Apapa (Lagos), Calabar, Enugu, Makurdi, Ibadan, Ilorin, Kano, Gombe, and Gusau. All have 1,000 tons of LPG storage capacity, except Apapa, which has 4,000 tons cylinders.

Over the years, the white products depot system has proved highly successful as the conduit for the primary distribution of refined product. It has eased congestion at the refineries and on the roads while helping to ensure availability of products, at a common price nationwide. The butanization depots were planned to follow this operational model but that LPG supply should be by coastal tankers and by road in the initial phase.

Consideration for the use of railway system to supply the inland depots was shelved during the conception of the project as it was not seen as sufficiently robust for safe, efficient LPG transportation. The use of pipeline was also shelved as it would be sometime before LPG volumes would be sufficient to warrant pipeline transportation. Apart from the Apapa (Lagos) and Calabar butanization depot, all other depots have not been brought into operation, principally because of lack of supply from the refineries. It should be worthy to note that these butanization depots are central to the revival of the LPG sector in Nigeria.

2.4.3.3 Marketers and Distributors Facilities

Apart from the major LPG depots (i.e. Total, African Petrol (AP), and Nidogas import terminals/plants in Lagos), there are over 200 LPG plants nationwide as shown from data gotten from NALPGAM. These plants have capacity ranging from 7 to 339 tons but most of them are not in operation presently.

2.4.3.4 LPG Transportation

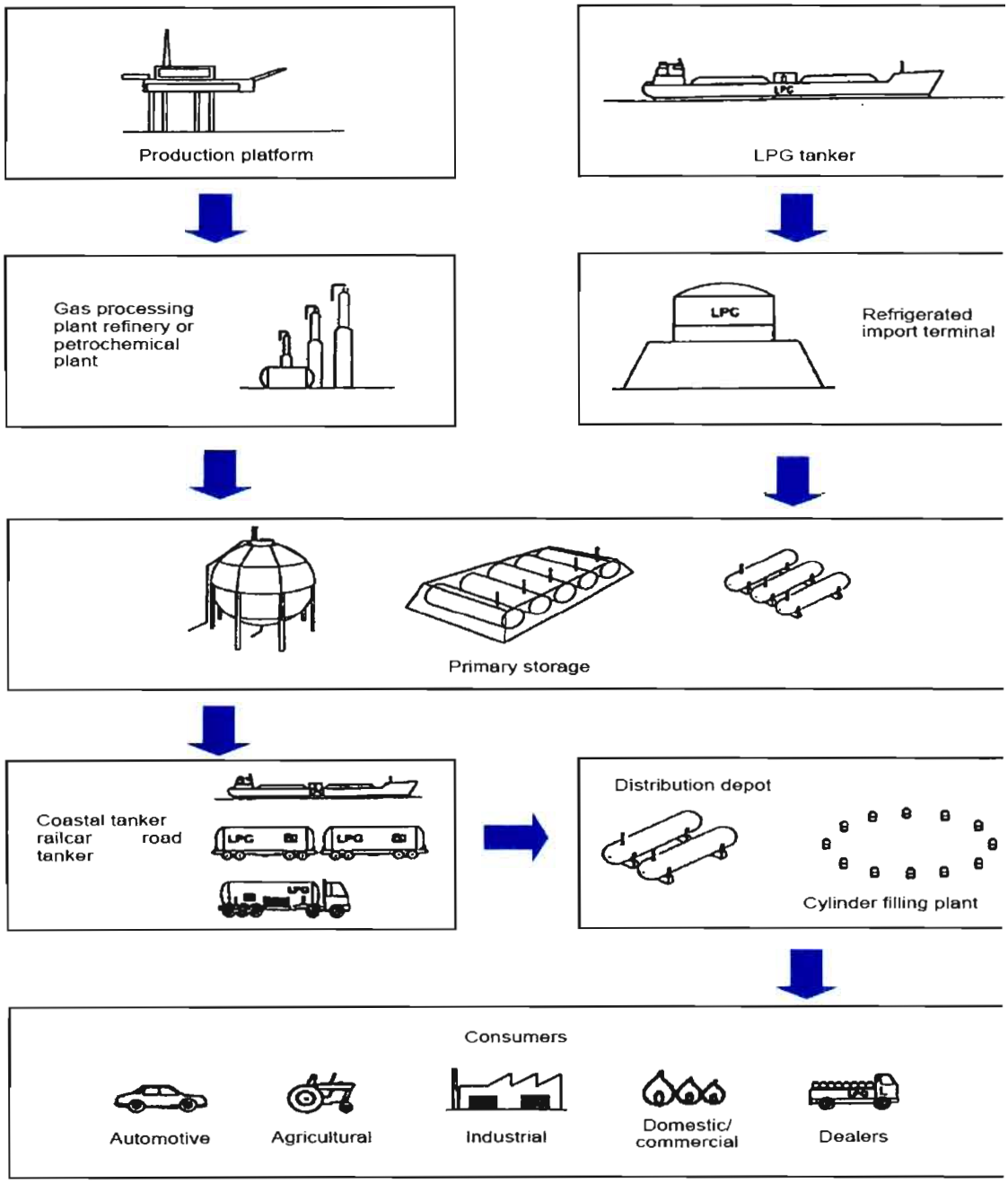
The transportation of LPG in Nigeria can be broken down into coastal and inland transportation.

- **Coastal transportation of LPG:** There is an established pattern of transporting LPG by ship from the coastal refineries to receiving facilities in Apapa and neighbouring countries. This has been the pattern of supplying Lagos and its hinterland over the years. Recently, coastal transportation pattern has changed with problem of limited refinery supply and harbour congestion. In a workshop held by NALPGAM in 2005, a participant (Mr Mofe Boyo) whose company (Unipetrol) is active in importing LPG spoke of a 20-day turnaround time for ships at Lagos port, with consequent costs of

demurrage on the loaded product (Alexander, 2003). LPG is sometimes exported from Port Harcourt using the one ship loading arm that is operational and accessible.

- **Inland transportation of LPG:** Given the limitation of the railway system in Nigeria, inland transportation of LPG in Nigeria is by road and this is likely going to be the situation in the immediate future. Transporting LPG by road over long distance is not ideal. Most distributors use general-purpose trucks to transport LPG in cylinders. This is not safe because LPG cylinders are meant to be transported in trucks designed and equipped for that purpose.

In terms of LPG transportation in Nigeria and considering the geographical spread of the country, it can be concluded that the infrastructure for movement of LPG in Nigeria is inadequate for handling the distribution of the product. The road network is poor and this is the major means for the movement of LPG. There is also the problem of non-availability of good tank wagons for movement of the product. Road transportation of LPG also involves about 15 to 20 times the specific energy use as through pipelines and about 5times the energy use of rail (Antonette *et al.*, 2004). Fig 4 below shows a typical distribution pattern of LPG.



ce: Adapted from LP Gas Association's *LPG Technical Fundamentals*.

Fig 2.9 Typical LPG Distribution Chain

So far, it can be said that the refining, petrochemical, and transportation sectors of the oil industry in Nigeria, are controlled by government and indigenous operators, and is an area in which government has made considerable investment over the years. However, the downstream sector is beset by a non-commercial pricing environment, and lack of resources to maintain and manage the available infrastructure properly.

The focus of the government's policy on the downstream sector can be summarized as follows: to maintain self-sufficiency in refining and to ensure regular and uninterrupted domestic supply of all petroleum products at reasonable prices; to establish infrastructure for the production of refined products for export.

The oil marketers in the downstream sector in Nigeria are divided into two segments: the majors and the independent Nigerian marketers. Currently, the independent marketers number over 500, with a market share of less than 30%. The downstream sector has been a major problem for the country over the past 3 to 4 years, as the NNPC has found it impossible to maintain the country's 4 refineries, and to provide adequate supply of PMS, Diesel, and Kerosene nationwide. Large segments of the distribution system are in urgent need of maintenance.

The surprising thing about the whole issue of LPG in Nigeria is that the scarcity of the product is not only as a result of non-availability of gas, but more with the dearth of infrastructure to facilitate the distribution of the product nationwide.

At the 20th edition of the World Liquefied Petroleum Gas Association (WLPGA) forum held in Cape Town, South Africa, in October 2007, Celia Onitiri, the president of Nigeria National LPG association taking advantage of the fact that Emmanuel 0. Odusina, Nigeria's new energy minister, was one of the Cape Town forums delegates, made an impassioned plea for the Nigeria government to address both the lack of a suitable regulatory framework and enforcement that currently creates the major barriers to growth in LPG consumption in Nigeria. She suggested that if an average family consumes 12.5kg of LPG a month, Nigeria, with a population of roughly 150m people, is capable of consuming over 5.62m tons of LPG a year (Williams, 2007).

This has further buttress the fact that Nigeria has a viable market for LPG and what is needed is a framework for effective marketing and distribution of the product.

CHAPTER THREE

CONCEPTUAL FRAMEWORK FOR LPG MARKETING IN NIGERIA

3.0 FRAMEWORK

Energy is vital for social and economic development and directly impacts local, national and global environmental conditions. The government of any country has the potential to contribute to the goal of widening access to clean and sustainable energy services. This can be achieved by putting in place dynamic policy initiatives that will develop and enhance clean energy services and where these policies are in place, the strategies to translate them into actions should be available.

In most developing countries (Nigeria inclusive), the existence of weak institutional framework has been identified as part of barriers preventing the implementation of clean energy efficient policies and strategies (Osuji, 2003:8).

This dissertation therefore intends to develop a framework that will promote an effective LPG marketing and distribution in Nigeria. The rationale for promoting LPG is because of its unique mix of environmental, operational and economic advantages over other fossil fuels in addressing rising emissions of noxious and greenhouse gases.

LPG burns completely, and emits significantly less pollutants than most conventional fuels (AEGPL, 2007:5). LPG is a proven modern fuel that is particularly suited to countries such as Nigeria, which lack comprehensive, functioning, natural gas and electricity supply networks.

3.1 STEPS FOR PROPOSED FRAMEWORK

At this point, it is imperative to look at what a framework is before developing the steps for the proposed framework. A framework is a basic conceptual structure used to solve or address complex issues. A conceptual framework is used in research to outline possible courses of action or to present a preferred and reliable approach to an idea or thought (Kakutani, 2009).

The steps in the proposed framework intend to consider the areas stated below based on the peculiar situation of the LPG state in Nigeria:

- National Gas policy and regulation as regard LPG
- Infrastructure development and capacity building
- Management of demand and supply dynamics
- Industrial LPG market
- Domestic LPG market

Fig 3.1 Proposed Steps for LPG Framework

3.1.1 National Gas Policy and Regulations

The support of the government is highly needed in establishing and sustaining any development in energy (LPG inclusive) market. According to the report made available by WB/ESMAP (2004:79) concerning the LPG sector in Nigeria, it was

stated that the Nigeria government policy has not favoured the LPG industry and its actual and potential customers.

There exist wide ranges of options within the normal policy framework that can be used by policymakers to promote the development of a sustainable LPG marketing and distribution network. The role of the government in achieving this is simply by setting up an appropriate portfolio of targeted policies to satisfy both present and future energy demand in a sustainable way.

The use of fiscal and financial incentives; regulatory and legislative measures; and technology development are some of the approaches governments can deploy policy wise to promote LPG marketing and distribution. A breakdown of these approaches is shown below;

3.1.1.1 Fiscal and Financial Incentives

- **Excise duty exemption and tax rebate on LPG and its accessories:** A common policy in sub-Sahara Africa is the high taxation of petroleum based product to raise government revenue. In order to keep the cost of LPG low and affordable for rural and poor households, it is imperative to keep taxes out of the running cost of selling LPG and its appliances. These taxes inflate the price of modern fuel and often act as barrier to transition. In Tanzania, for instance, 60% of the price of LPG is accounted for by taxes and distribution charges (Sanga *et al.*, 2005). This shows that the price of LPG in urban market is high enough to discourage even the wealthy buyers. Fuel taxation is applied in different ways and at different levels in countries around the world to meet governments' varying objectives. The major objectives that the government of most countries pursue through fuel taxation include environmental goals, fuel security and assistance to particular industries. It is therefore important that any fuel (and/or its accessories) that delivers better air quality and contribute to greenhouse objectives should benefit from lower rate of excise duty or its complete exemption. LPG as an environmental friendly fuel should be granted this benefit by any government. In Turkey for example, lower tax

rate on autogas led to an estimated 500% increase in the number of autogas vehicles within a space of two years (1997-1999) (WLPGA, 2001:23). In addition to a subsidy on LPG, the government of Burkina Faso introduced forest taxes and levies in a bid to drive up the market price of firewood, which is by a long way the main fuel of choice in both rural and urban settings. This led to a slight increase in LPG consumption (Schlag, 2008: 12). This has further shown that the lower the rate of duties and taxes on LPG relative to other alternative fuels that are not environmental friendly, the bigger the financial incentives for consumers to switch fuel.

- **Grants and soft loan:** Research has shown that LPG appliances are more sophisticated and therefore more expensive when compared to the appliances of other conventional fuels like kerosene, charcoal, fuel wood etc. (WLPGA, 2005: 8). Most consumers will rather remain enslaved to their traditional cooking method that are less expensive or will not add to their limited finances. This was one of the barriers identified in the report on LPG promotion in Senegal (Sokona *et al.*, 2003: 39). It is therefore imperative that government should subsidise the upfront cost of purchasing LPG equipments by the use of soft loans or grants. This was also the recommendation made by Schlag *et al.* in their review on "Market Barriers to Clean Cooking Fuel in Sub-Sahara Africa". They reported that a properly allocated fuel subsidy on stove will encourage the adoption of clean cooking fuels like LPG (Schlag, 2008: 16).

3.1.1.2 Regulatory and Legislative Approach

- **Attach financial value or penalty on pollution generated by each fuel base on the effect on the environment**: The government of any country has the responsibility to discourage activities that produces noxious or greenhouse gases and to ensure that polluters are penalised for the harm they cause to the environment. WLPGA proposed that the placing of financial penalty by government on pollution cause to the environment will be a better approach to help reduce the emission of noxious and

greenhouse gases to the environment. The association further highlighted that this will also help to create a level playing field for every alternative fuel to demonstrate its comparative benefits thereby allowing the market to determine which fuel is most attractive for consumers (WLPGA, 2001:20).

- **Avoid long administrative procedures in authorizing LPG plant and storage facilities:** Creating industries or enterprises in most West African countries has been described as too long and arduous. This was the case put forward by Akuffo *et al.* in their write up on "Policy Recommendations for Energy SME Development in Africa". They highlighted that the procedures for energy entrepreneurs who sell LPG are relatively too long and daunting. Putting together the different legal papers and licenses (company registration, license for VAT, trading license, energy regulatory board certificate, authorisation from fire service, approvals for telephone and water supply) is seen as time consuming and costly (Akuffo et al, 2008:10). Although, the running of LPG business is risky and requires careful safe guards and strict adherence to safety standards, it is also necessary that these processes be reduced to the barest minimum and also maintains standards. This can be made possible by reducing regulations, simplify bureaucratic processes, develop zoning and site plans that would serve as a guideline and direction to encourage potential energy investors. The local licensing authorities liaising with government agencies can work towards reducing the duration of obtaining permits, licensing and approval before starting an LPG business.

- **Safety Standards:** Safety is a legitimate concern for policy makers everywhere. Safety problems and the associated perceptions of fire have been described as likely barriers to the use of LPG (WLPGA, 2005:32). Safety standard is therefore an important area of responsibility for governments in partnership with LPG providers and end users. It is advisable that government should review/update existing safety standards and also adopt appropriate standards. Correct media, correct message and repetitive impact can help overcome negative perception of LPG. The

introduction of safety as part of the school work for children and young adults has been described as one of the means of passing safety messages in areas of low literacy (WLPGA, 2005:32).

3.1.1.3 Technology Development Programmes

The use of gas stoves that will suit the needs of household has been identified as one of the barriers to LPG use (Sokona *et al.*, 2003: 37). A typical example of this development was the experience in Senegal where the gas stove originally used was attached to a 12kg or 38kg cylinder by a flexible tube and a metal exhaust valve. This design was not only seen as too costly but also ill suited to the cooking habits of the Senegalese.

A more robust model that adapts to the standard of the Senegalese cooking utensils and practices was locally developed with the burner being the only imported material used. Barnes *et al.* highlighted that one of the successful ways that has helped stove programmes to succeed was the collaboration of government with local artisans and the mobilization of the local economy in the design phase of a stove (Barnes *et al.*, 2004: 242). By revising the design based on the input from potential users, an ideal design stove compatible with user's preference can be achieved.

Fig 3.2 The Diamber II Local LPG designed stove (Adapted from The Senegal Diambar Stove Project by Dr Eric Hyman *et al.*).

According to (Ouerdraogo, 2005), the high capital cost associated with fuel switching has been described as a hindrance for households to adopt the use of modern fuels like

LPG. He further stated that in Ougadougou (the capital of Burkina Faso), the cost of LPG equipment required for cooking is said to be about nine times more than a 12kg supply of the gas itself.

With regards to the barriers relating to technology development programmes, it is necessary for any government to support the research, development, demonstration and deployment of LPG equipments (e.g. Cylinders and appliances) technology that are trustworthy, proven and "fit for purpose" (i.e. in terms of household usage needs, local distribution, environmental and climatic conditions).

This support can be through voluntary agreements with Original Equipment Manufacturers (OEM) or through direct funding of such developments. The essence of this support should be to help alleviate the high cost of clean household fuel equipment.

3.1.2 Infrastructure Development and Capacity Building

Underdeveloped infrastructure has been described as one of the major impediments to the distribution of clean cooking fuel in sub-Sahara Africa (Schlag *et al.*, 2008: 14). The lack of investment in modern energy infrastructure has also been described as what is retarding broader access to modern carriers (particularly to low-income groups in remote rural areas), keeping millions of people at low standards of living. Schlag *et al.* highlighted these problem are mainly felt in the rural areas where transport infrastructure (e.g. roads) are poorly developed and the lack of an extensive distribution network complicates efforts to offer modern alternatives to traditional fuel in sub-Sahara Africa (Schlag et al, 2008: 14).

In Nigeria, inadequate facilities have consistently impeded evacuation when LPG was available at the refineries. Also, inland transportation infrastructure for LPG is underdeveloped (lack of access to existing infrastructure due to bad roads). The butanization depots and some LPG plants have been left idle and are in various states of disrepair.

Coastal shipping and road transport incur high costs due to lack of space for berthing in the only functional jetty in Lagos and lack of access to existing infrastructure due

to bad roads. These were the infrastructural problems described as major impediments to LPG distribution and utilization in Nigeria by Effiong (2009) in his report on "How to grow domestic LPG in Nigeria".

Based on the report made by WB/ESMAP (2004: 80) on LPG in Nigeria, there is an extensive distribution infrastructure capable of supplying a much enlarged market but these infrastructure needs rehabilitation. Also, the need to introduce other means like rail and pipelines for transporting LPG is vital for the sector to recover as the only means of inland distribution is practically through road transport.

Ensuring long-term investment in modern energy infrastructure to satisfy modern energy demand has been described as a key step to enhance sustainable energy development. Long term investment is highly a government led initiative as it requires capital availability, an attractive market environment and long term financing. Brazil has been successful in providing LPG to about 90% of its households (Antonette D'Sa, 2004: 47). This achievement was possible because the government of Brazil has been relatively successful in attracting and providing investment, both for industrial and energy sector development and for infrastructure.

A stable economic and energy regulation environment, and rapid, transparent and fair decision-making processes are basic principles that have been put in place that has encouraged investors to support infrastructural development and capacity building in Brazil (IAEA, 2006: 140). Nigeria can imbibe these principles to enhance her energy (LPG inclusive) sector and also give priority to the developments of ports and transport infrastructure for efficient import and safe distribution of LPG.

3.1.3 SUPPLY AND DEMAND DYNAMICS

Nigeria, with a population of about 140 million, consumes just 80,000 tonnes – 100,000 tonnes of LPG (Adeshina, 2009: 12). Research has shown that if an average family consumes 12.5kg of LPG a month, Nigeria is capable of consuming over 5.62m tons of LPG a year (Adeshina, 2009: 12).

The unrest in the oil rich Niger Delta region; unstable and unpredictable market; and the high cost associated with gas importation were the reasons highlighted for the inadequate supply of LPG to satisfy high demand in Nigeria (Adeshina, 12).
In most countries with LPG supply industry, the supply chain from the import terminal or refinery through to cylinder refilling plants is highly refined and efficient. Each step in the supply chain is made to be fully necessary and streamlined to reduce overhead cost.

Consequently, LPG supply in Nigeria to the market is constrained due to insufficient refining, inadequate ports facilities for imported product and over burdened road system (both domestic and imported LPG is at present transported from production facilities or ports by special tankers to bottling plants all over the country) (WLPGA/WB 2004:84). Effiong (2009) in his report on "How to grow domestic LPG in Nigeria" stated that the use of the jetties and the storage facilities for LPG importers has been the exclusive right of the rich and well-connected.

Many genuine importers and dealers are out of business because of their inability to secure the use of these facilities; many incurred huge demurrage, which they later passed on to buyers. He further highlighted that these constrains have played villain to the noble task of making cooking gas available and affordable to a critical mass of Nigerians(Effiong, 2009).

A long term solution in this regard may involve investors and the government in the building of jetties; provision of vessels that are compatible to the available jetties for loading and discharging of LPG; and the building of more storage facilities. The building of more storage facilities will help reduce the number of vessel trips made and ensure zero-stock out at all times

Based on this situation also, a short term plan should involve the communal use of the limited jetties and storage facilities as this will prevent the heavy weight (major dealers) in the industry from seizing control and dominating the market and overtime assert their dominance by arbitrarily determining the price of the product.

On the inland supply side, there is a need for a wider network of suppliers that will ensure timely and consistent availability of LPG cylinders. The onward distribution of cylinders to local dealers and sub-dealers has been described as a stage in the supply chain where disproportionate operation costs are incurred and losses occur (WLPGA, 2005: 19). Therefore, it is expedient that the LPG market supply chain be created systematically to achieve least-cost cylinder refilling, storage, handling, maintenance, control and fast and efficient supply to end users. Promote the introduction of alternative transportation modes, for example, rail and pipeline for safer and more economical inland supply of LPG.

LPG supply to rural areas in Nigeria has been neglected and a majority of the over 140 million Nigerians are rural dwellers (WLPGA, 2004: 49). Like most rural settings across the world, these rural dwellers live in limitless settings, from being clustered in small hamlets to isolated homes perched on mountain sides or scattered across deltas at major river mouths or wetland regions where river-craft provide the primary link to the outside world. These remote or difficult locations have been described as a hindrance to LPG supply and low population densities preclude economies in investment (WLPGA, 2005: 4).

A private firm known as Ultragaz that exclusively handles LPG supply and distribution in Brazil has been able to break the limitations of rural LPG supply. They are the largest LPG marketer in Brazil with a market share of over 24%, supplying around 1.542 million tons of LPG every year to the industrial, commercial, agricultural and residential markets across the country.

Some 80,000 tonnes of this supply is to the rural residential market (WLPGA, 2005:47). Ultragaz have been able to achieve this much sale because they employ the use of a wide variety of transport, and each geared to local conditions in order to ensure cylinder supply to distributors, points of sale/retailers and end users. They use barges in part of the Amazonian area with sand banks in the dry season, creating special distribution challenges. They use jeeps in areas of poor roads and mountainous terrain. Motorcycles are also used to convey small quantities of cylinders in more local settings (WLPGA, 2005: 47). These supply methods can be used in Nigeria also because the topography is quite similar to that of Brazil.

Also, in rural South Africa where some 80% of the households live in a cluster of mud and thatch dwelling, Totalgaz (a privately owned company with an 11% share of the South African LPG market with about 35% of its sale in the rural residential sector) developed a package to expand their rural household market to support the socio-economic development of the poor in support of South African Government policy. This package is known as the Shesha (Shesha means quick, fast and snappy) package (WLPGA, 2005: 47).

The package consists of a branded 5 kg cylinder and combined cooker top. The cylinder and combined cooker top are robust and very stable; ideally suited to the harsh rural environment. The cylinders are portable and rural householders use wheelbarrows, donkey carts, pick-ups and public transport to return empty and collect filled cylinders from retail outlets. Totalgaz operate on a ratio of around one retail outlet or point of sale per 100 households (WLPGA, 2005: 48). Close proximity and accessibility to a regular supply of filled cylinders is assured in this way.

The Shesha package has shown that smaller cylinders such as the 2kg, 4.5kg and 6 kg cylinders that are easily carried have greatly assisted in the expansion of rural household markets. Larger cylinders requiring special handling will naturally restrict accessibility. This package can be employed in the rural areas of Nigeria to encourage the use of LPG among the rural poor.

Other measures that can be adopted to promote the supply of LPG are the introduction of alternative transportation modes, for example, rail and pipeline for safer and more economical inland supply of LPG. Report from the "LPG Sector Improvement Study in Nigeria" carried out by WLPGA (2004: 95) suggested that an alternative strategic rail or pipeline LPG supply route option must be investigated with a view to implementation once the domestic market consumption increases to beyond approximately 250,000 tons per year. When major towns with high population densities are linked with pipelines, there will be opportunities for LPG cylinder distributors to move into the rural areas.

Adequacy of supply is obviously based on the magnitude of demand. The availability and accessibility of LPG all over the country requires not only enough refining

capacity and/or imports but also the development of adequate storage installations and transport systems, a reliable distribution system, and the avoidance of infrastructure bottlenecks.

3.1.4 Industrial and Domestic Market

The industrial and residential LPG market in Nigeria can be described as very low when compared to that of other West African countries in terms of per capita LPG consumption. This is shown in fig 3.3 below.

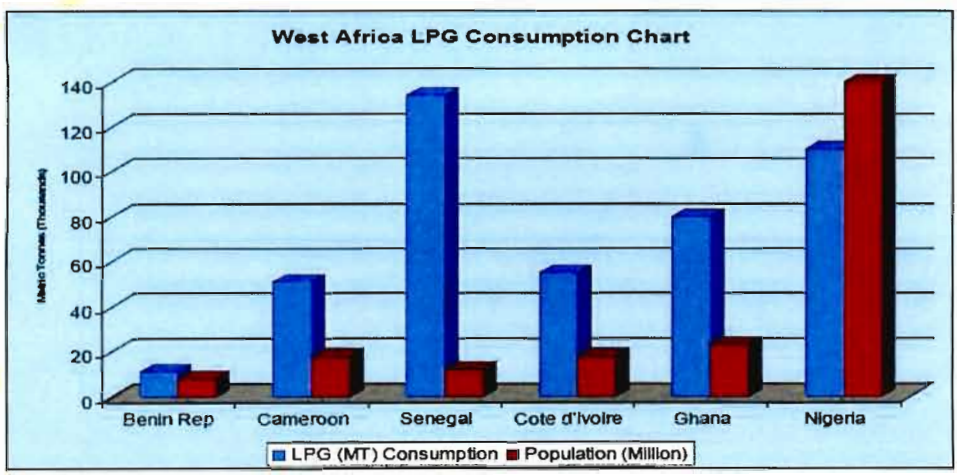


Fig 3.3 West Africa LPG Consumption Chart (Source: UN Data, 2004)

The table below shows the different residential/commercial per capita consumption of LPG in some West African countries.

Table 3.1 West African LPG Consumption

	Total LPG Consumption (MTonnes)	*Percent Res/Comm (%)*	*Res/Comm LPG Cons. (M Tonnes)*	*Population (MM People)*	*R/C LPG Cons. Per Capita (Kg/Year)*
Cameroon	28	95	27	14.9	1.8
Cote D'Lvoire	50	85	43	15.7	2.7
Ghana	40	85	34	19.2	1.8
Senegal	100	98	98	9.5	10.3
Subregional Average	218	92	201	59.3	3.4
Angola	50	90	45	11.7	3.8
Congo, Dem. Rep.	1	90	1	49.6	0.0
Congo, Rep.	4	90	4	2.7	1.3
Gabon	17	90	15	1.2	12.8
Nigeria	58	40	23	125.1	0.2
Other Countries	13	90	12	65.8	0.2
Total West Africa	361	83	301	315.4	1.0

Source: WLPGA, 2004.

From the table, it can be seen that there is substantial LPG market available in Nigeria when compared to Cameroon, Ghana, Cote d'Ivoire and Senegal. The average per Capita LPG consumption for Cameroon, Ghana, Cote d'Ivoire and Senegal whose populations are smaller to that of Nigeria is 3.4Kg/Yr while that of Nigeria is just 0.2Kg/Yr. This is an indication of an immature market sector.

Adeshina (2009) highlighted in his presentation on "Innovation Driving Demand in Africa" that the challenges facing domestic LPG market in Nigeria are mainly the lack of subsidy from the government and unilateral bodies; the low purchasing power of potential LPG users; low awareness of LPG's advantage over other source of energy; perception of LPG as an expensive and dangerous product; insufficient and inappropriate cylinders in circulation (there are 300,000- 400,000 cylinders in circulation and most are in unsafe conditions) (Adeshina, 2009).

Antonette *et al.* (2004: 48) were quick to conclude that based on experiences gotten from most developing countries that have improved their domestic LPG market; the following factors appear to be the driving force that have helped extend the domestic use of LPG (including lower income households):

- Lower prices of LPG through cross subsidies from other distillates, (particularly gasoline)
- favourable relative prices of LPG (in relation to competing fuels like kerosene)
- initial cost financing (instalment payments for the purchase of stove and cylinder deposit)
- smaller cylinders/bottles to target (lower income) households through lower periodic/incremental refuelling bills
- special subsidies to these smaller cylinders/bottles – intended for lower income groups
- restriction on the supply of competing fuels (e.g. kerosene)
- dependable distribution (reliable and more storage, bottling and refuelling units)

It is highly necessary that these measures be employed in Nigeria to boost her immature domestic LPG market. In an environment where the potential clients of LPG are financially constrained, it is important that the value chain of LPG be reviewed to optimise efficiency with the intention of minimising the cost of packaging and distribution of the product.

3.2 PROPOSED LPG MARKETING AND DISTRIBUTION FRAMEWORK FOR NIGERIA

Step 1- National Gas Policy and Regulations

Inputs	Strategy	Indicative Activities	Expected Outcome	Responsibility
1. Fiscal and financial incentives	1. Excise duty exemption and tax rebate	1. Harmonization of energy and fiscal policies to ensure that neither tax, nor tax differentials, impedes LPG sector recovery and access to the poor	1. Reduction in the price of LPG and its accessories	FGN
	2. Introduction of grants and soft loans	1. Viable financing mechanism for intended LPG users (mostly in rural areas) to purchase LPG equipments 2. Inform potential LPG consumers on prices of equipment and recommend means to access credit 3. Create dialogue with industry cooperatives (farmers, bakers etc) to facilitate guaranteed credit access for members, for purchase of LPG equipment	1. Credit available for cylinder and appliance purchase through existing bank credit facilities, including through group/cooperative	FGN\WB\Local Banks

			lending	
2. Regulatory and Legislative approach	1 Introduction of fines and/or penalty on environmental pollution	1. Discourage activities that produces noxious or greenhouse gases 2. Attach financial value or penalty on pollution generated by each fuel base on the effect on the environment	1. Reduction in the use of biomass fuel and thereby reducing environmental pollution	FGN
	2. Avoid long administrative procedures in authorizing LPG plant and storage facilities	1. Reduce regulations, 2. simplify bureaucratic processes 3. develop zoning and site plans that would serve as a guideline and direction to encourage potential LPG investors	1. Simplified start-up requirements for entrepreneurs or investors 2. Attractive & competitive Investment Business environment	FGN/Local Licensing Authorities
	3. Safety Standards	1. Review/update existing national standards 2. Adopt appropriate standards 3. Establish statutory requirements and liability of LPG filling plants 4. Lay down and enforce harmonised operating safety standards both for LPG providers and consumers	1. Increased safety in LPG handling and use Safe and Reliable LPG equipment available in the country	FGN
3. Technology Development Programmes	Research and Development funding to develop ways to integrate LPG into traditional value adding processes	1. Government should collaborate with local artisans in designing stoves that are suitable to the cooking habit of the people 2. Mobilization of the local economy in stove design	1. Availability of LPG equipments that are compatible with the traditional cooking style of the people 2. Reduced cost of LPG equipments	FGN/OEMs

Step 2- Infrastructure Development and Capacity Building

Inputs	Strategy	Indicative activities	Expected Outcome	Responsibility
Infrastructure development	Long-term investment in modern energy infrastructure to satisfy modern energy demand	1. Rehabilitate existing infrastructure (e.g. the nine butanization depot) they can support substantial growth of the industry	broader access to modern carriers (particularly to low-income groups in remote rural areas	FGN
	Set up a stable economic and energy regulation environment	1. Establish a regulatory structure which will facilitate LPG promotion policies that will encourage investors 2. Organize seminars and presentations for financial institutions and prospective investors	High commitment of investors in supporting infrastructure development and capacity building	**FGN**

	Give priority to port developments and LPG transportation infrastructure	1.Encourage investment/participation by professional shipping and transport operators	Efficient importation and safe inland distribution of LPG.	**FGN/LPG industry**

Step 3- Supply and Demand Dynamics

Inputs	Strategy	Indicative Activities	Expected Outcome	Responsibility
Supply and demand dynamics	Establishment of a wide network of suppliers that will ensure timely and consistent availability of LPG	1. Identify financial sources. 2. Identify and involve potential stakeholders.	Sustained and abundant LPG availability together with price competition at the retail level.	**Local banks/LPG industry**
	Introduce new alternative sources of LPG supply	1. Divert LPG destined for export back into the domestic market 2. Arrange for LPG purchase agreements, as required, between the LPG marketers and the gas producers.	Increased availability of LPG for local consumption	FGN/LPG Industry/Private Sector
	Establishment of an effective LPG market supply chain	1. Encourage investment/participation by professional LPG distributors 2. Include local communities in LPG delivery operation	1.Increased and improved supply of LPG 2. Least cost in cylinder refilling 3. Fast and efficient supply to end users	LPG industry
	Establish Pilot LPG supply project for a rural community for possible replication	1. Conduct feasibility study, to include the following terms of reference • Use small 2-3 kg cylinders • Cylinder exchange system • Appropriate proximity to retail outlets	1. Increased and Improved accessibility of LPG mostly in the neglected rural areas	**FGN/** LPG industry
	Introduction of alternative transportation modes e.g. rail and pipeline	1. Link the oil rich Niger Delta region to major cities with pipes or rail lines for easy transportation of LPG	1. safe and more economical inland supply of LPG	**FGN/** LPG industry

Step 4-Industrial and Domestic Market

Inputs	Strategy	Indicative Activities	Expected Outcome	Responsibility
Industrial and Domestic Market	Prioritize subsidies on energy efficient and low-carbon emission fuel	1. Reduced LPG price through cross subsidies from other distillates that has high carbon emissions e.g. gasoline	Favourable relative prices of LPG (in relation to competing fuels like kerosene)	FGN
	Provision of suitable appliance purchase credit	1. Instalment payments for the purchase of stove and cylinder deposit	Lowered appliance access cost	**LPG industry/Local Banks**

	Introduction of smaller and lighter cylinders (2-3kg). mainly for lower income household	1.Design small cylinders mainly for consumers in rural areas 2.Design small cylinders for low income household	Customers regular purchase in quantities that will fit into their household budget	**LPG industry**
	Introduce rail/pipeline distribution of LPG	1. Link the oil rich Niger Delta region to major cities with pipes or rail lines for LPG distribution.	safe and more economical inland supply of LPG	**FGN**/ LPG industry
	Pipe LPG to consumers residence	1.Run LPG distribution pipes to the residence of consumers in major or highly populated cities	Increased and Improved accessibility of LPG Encourage small or medium scale distributors to concentrate on peri-urban and rural areas	**FGN**/ LPG industry/Private Sector

It is necessary to note that this framework is designed based on the peculiar situation of the LPG market in Nigeria and it is designed to suite the Nigeria market. The next chapter will look at the methodology used to measure the validity of this framework based on the information gathered from a semi-urban community that was used as a case study in this research.

CHAPTER FOUR
EMPIRICAL INVESTIGATION

4.0 Research Methodology

The research study required the development of a framework for effective marketing and distribution of LPG in Nigeria. Now that the LPG framework has been conceptualised, it is imperative to look at a practical case where this framework was applied. This chapter focuses on the research design of the empirical investigation of the problem statement with a view to achieving the project objectives.

Since the research topic is very sensitive, most data are hidden from the public eyes while others are not actually the precise values. Hence, data obtained were gathered by surveying authoritative literature from reliable Internet sources as well as oil and gas journals and reports from NNPC. The numerical data collected are measured under standardised conditions but this does not mean that there were no likely errors of estimation.

This chapter further introduces Oturkpo town where the framework was applied. The general data gathered from questionnaires developed for LPG retailers and household survey will be used to test the validity of some null hypotheses relating to the proposed framework. These null hypotheses are:

- Upfront cost of LPG accessories (cylinders and stove) is not a hindrance to LPG usage in Nigeria.
- Ineffective supply and distribution system does not affect the marketing of LPG in Nigeria.
- The fear of LPG as an unsafe fuel for cooking does not affect the marketing of LPG in Nigeria.
- Instability in the price of LPG is not a hindrance to its usage in Nigeria.
- Unavailability of smaller and lighter cylinders (2-3kg) mainly for lower income household does not affect the marketing of LPG in Nigeria.
- Lower cost of other cooking fuels (biomass based fuel/wood) does not affect the marketing of LPG in Nigeria.
- Lack of soft loans and grants is not an obstacle to LPG utilization in Nigeria.

It is imperative to note that the use of negative hypothesis in this research is because these negative assumptions will be maintained by the researcher with the aim that the analysis of data will provide significant evidence to disprove it. The null hypothesis is often the reverse of what the experimenter actually believes; it is put forward to allow the data to contradict it. This is in line with what was highlighted by Laughlin *et al.* (1996: 131) that "in a negative hypothesis test a person generates or examines evidence that is not expected to have the property of interest if the hypothesis is correct".

4.1 CASE STUDY

4.1.1 Demographic Information

The semi-urban area used is Oturkpo town located 77 km NE of Markurdi (the capital of Benue state of Nigeria) and 315 km from Abuja the capital of Nigeria. Geographically, Oturkpo is situated entirely within the rain forest, and is located between latitude 7.12^0N of the equator, as well as 8.08^0E of the Greenwich meridian (Microsoft Encarta, 2008). From the 2006 Census statistics, the population of Oturkpo was estimated to be approximately 261,666 comprising 133,347 males and 128,319 females (NPC, 2009).

Oturkpo town enjoys a tropical climate with two distinct seasons. These are the rainy season (April - September) and the dry-cold-windy season (October - March). Temperature ranges between 21°C and 28°C with high humidity (Benue State of Nigeria, 2008). Oturkpo along with two other major towns (Markurdi and Gboko) are used to symbolise Benue State, fondly called and addressed as the food basket of the nation. The occupation of the dwellers of this community is primarily peasant farming and small scale agro-allied businesses.

4.2 RESEARCH TACTICS

Research tactics looks at the specific details used in implementing the research work. The research tactics provides a relationship that connects the responses to be collected and conclusions that are to be drawn, to the initial research questions of the study (Yin, 2003: 19). It was impractical to gather required data from every member of the target population (Oturkpo town) due to the large size, geographical location, cost,

and time constraints. Only a sample, a subset of the target population (60 household from the entire population was selected because preliminary research has shown that there is similarity in the energy consumption pattern of the people in Oturkpo), was selected and interviewed. And this sample is sufficiently represented. A sampling plan which addressed the following was prepared:

- Target population
- Sampling unit
- Sampling method
- Sampling frame

4.2.1 Target Population

The first step in selecting a study population is to define the target population. Baridam (1990) defined 'target population' as a finite population - with fixed boundaries - described by time, geography and the characteristics of the individual members composing it, as well as the nature of the variables being studied. This researcher sees the target population as the community of people who possess the information sought by this research study. The following target populations were identified:

- Distributors of LPG (both independent and dependent marketers)
- Retailers of LPG
- Household users of various cooking energy

4.2.2 Sampling Units

A sampling unit is the person, company or product which can be physically identified for interview or measurement on the specific variables identified. So, several household consumers of other cooking energy source in Oturkpo town were identified for interview from within the target population. Others that were considered for interview are;

- Distributors of LPG
- Retailers of LPG

4.2.3 Sampling Frame

For primary data collection, the sampling frame used was the survey took in oturkpo, a peri-urban community, which is used as representative of the whole country. Oturkpo was considered because it is a location that is far from any of the refineries where oil products are more readily available. This is to have a wider representative of what pertains in most part of the country. Also, distributors and retailers of LPG within the middle belt area of Nigeria were considered in the sample frame in other to have responses from LPG marketers.

4.2.4 Sampling Method

In this research, personal judgement and accessibility were the factors that informed the choices of household within the target population that were identified for questioning. Judgmental sampling enabled the researcher to deliberately select the sampling units that are to be included in the study because he feels they are representative of the target population (Baridam, 1990). The reasons for using personal judgement and accessibility are:

- Respondents should be accessible and generally cooperative
- It was necessary to choose persons with particular knowledge of the research area
- Rigorous opinion surveys are not essential.
- Households are located along the same geographical axis thereby reducing the cost of conducting survey

4.3 DATA COLLECTION METHODS

Data obtained in the pursuit of this research came from two sources.

- Primary data source and
- Secondary data source

Primary data are data that are tailored specifically to solve the problem at hand. Primary data were collected through the collection method described below while secondary data already existed in processed form.

4.3.1 Primary Data Collection Methods

Primary data collection in this research work involves the use of questionnaires; unstructured interviews; and the use of internet.

4.3.1.1 Questionnaires

The approach used to gather primary data is the survey approach. The instrument used in this survey approach to gather primary data is the questionnaire. The essence of developing questionnaires is to determine and measure any kind of subjective behaviour such as;

- Evaluations
- Comparisons
- Judgements
- Opinions
- Beliefs
- Attitudes

In this research work, key issues to be addressed in the questionnaires designed for the survey exercise includes determining:

- Countrywide availability and affordability of LPG to consumers, particularly the rural poor
- Changes needed to restore consumer confidence and achieve desired growth in the domestic /household LPG market
- Incentives that might be used to overcome barriers to entry, especially for low-income households
- Hurdles to switching to LP Gas for various consumer categories

The survey questionnaire designed for this research (see annexure 1) is divided into two sections: Part A will be completed by LPG retailers and Part B will be completed by household respondents. The focus of the questionnaire is on:

- household size and profile
- fuel use pattern
- supply logistics
- fuel preference and

- the amounts spent on fuels

Also, since the unit of analysis is on household, the reference income of the entire household was considered, rather than the respondent's income. A copy of the survey questionnaire is attached hereafter within Annex 3 of this report. Each part consists of a set of flexible questions presented to respondents to provide answers.

4.3.1.2 Unstructured Interview

Unstructured interviews and one-on-one interviews were conducted on the issue of LPG marketing with some top members of staff of PPMC, DPR and major distributors of LPG. This is a vital source of knowing the perceptions of LPG stakeholders as regard the marketing of LPG in Nigeria.

4.3.1.3 Internet

The internet was consulted for information.

The advantages derived from the primary data collection methods used include;

- Direct relevance to the problem being researched
- Greater accuracy and reliability of data due to greater control over the collection process

However, it was time consuming and generally more expensive to collect the data as several appointments had to be made to be able to get some retailers and reliable household respondent.

4.2.2 Secondary Data Collection Methods

As said earlier, secondary data used in this research already existed in processed form (i.e. existing data that were generated for some other purpose). These data, some of which came into existence prior to the occurrence of the current study, were guided by similar objectives with those of the present study, thus making them both relevant and useful for analysis in this research. The major drawback of the secondary data used is that it does not lend itself to further manipulation.

4.3 CHI-SQUARE TEST

Chi-square is a statistical test tool that is mainly used to compare observed data with data we would expect to obtain according to a specific hypothesis (Fischer *et al.*, 1996). The chi-square distribution is applied in different fields for carrying out test like the goodness of fit test, test of independence or the contingency test, normality test and other tests based on frequency data. From the data derived from the administered questionnaire, a frequency table was developed and the chi square was used to test the hypothesis.

The chi-square is frequently used in testing a hypothesis concerning the difference between a set of observed frequencies of a sample and corresponding set of expected or theoretical frequencies. It is denoted by the Greek letter X^2. A value known as the calculated chi-square is calculated from the data using chi-square procedure. This is denoted as X^2_{cal}. The calculated chi-square is then compared to a critical value from a chi-square table at the chosen level of significance and degree of freedom. This value is known as the tabulated chi-square and it is denoted as X^2_{tab}. The formula used in evaluation of data using chi-square method is given as:

$$X^2_{cal} = \sum_{i=1}^{n} \frac{(x - \overline{x})^2}{\overline{x}}$$

Where, X^2 = calculated chi-square

n = total number of observation

x = observed value

$\overline{x}$ = expected value

4.3.1 Calculation of the Expected Value

The expected value can be calculated from the contingency table with cell frequencies. A contingency table can be defined as an array of natural numbers in matrix form where those natural numbers represent counts or frequencies (Ezeoguzie, 2005: 51). This table is shown in table 4.1 below:

Table 4.1 Cell frequencies

Row	1	2	column j		Total
1	X_{11}	X_{12}	X_{ij}	X_{1c}	X_1
2	X_{21}	X_{22}	X2	X_{2c}	X_2
:	:	:	:	:	:
1	X_{i1}	X_{i2}	X_{ij}	X_{rc}	X_i
:	:	:	:	:	:
R	X_{r1}	X_{r2}	X_{rj}	X_{rc}	X_r
Total	X.1	X.2	X.J	X.C	Xn.n

Where X_i = frequency total from i^{th} row

X_j = frequency total from j^{th} column

From the frequency table given above (table 4.1), the value of the expected value ($\overline{x}$) is calculated as follows:

$$\overline{x}_{ij} = \frac{X_i \text{ x } X_j}{Xn.n}$$

Where $\overline{x}_{ij}$ = expected value for i^{th} row and j^{th} column.

X_i = frequency total from i^{th} row

X_j = frequency total from j^{th} column

For example, to determine the value of $\overline{x}$ for row 1 column 1, we have;

$$\overline{x}_{11} = \frac{X_1 \text{ x } X.1}{Xn.n}$$

While for row 1 column 2, we have;

$$\overline{x}_{11} = \frac{X_1 \text{ x } X.2}{Xn.n}$$

4.3.2 Degree of Freedom

Degrees of freedom can be calculated as the number of categories in the problem minus 1. The degree of freedom (d.*f*) is used to get the expected frequency and is given by the formula;

d.*f* = degree of freedom = (r-1) (c-1)

Where, r = number of rows

c = number of columns

4.3.3 Test of Hypothesis

Test for hypothesis is the test performed in order to verify whether a hypothesis is true or false. The Null hypothesis is the hypothesis that is being tested and it is denoted as H_O. The hypothesis that we are willing to accept if we reject the null hypothesis is the Alternative hypothesis denoted as H_A.

The decision rule states that H_O is accepted if X^2_{cal} is less than X^2_{tab}. Otherwise, H_A is accepted mathematically.

$X^2_{cal} < X^2_{tab}$ ------ accept H_O

$X^2_{cal} > X^2_{tab}$ ------ reject H_O

4.3.4 Step-By-Step Procedures for Calculating the Chi-Square Test and Testing of Hypotheses

- State the hypothesis being tested and the predicted results. Gather the data by conducting the proper experiment
- Determine the expected numbers for each observational class.
- Calculate X^2 using the chi-square formula.
- Determine the significance of the value using the chi-square distribution table
- Determine degrees of freedom and locate the value in the appropriate column.
- Locate the value closest to your calculated X^2 on that degrees of freedom row.
- Move up the column to determine the p value.
- State your conclusion in terms of your hypothesis.

a. If the *p* value for the calculated X^2 is greater than 0.05, accept your hypothesis. 'The deviation is small enough that chance alone accounts for it.
b. If the p value for the calculated X^2 is lesser than 0.05, reject your hypothesis, and conclude that some factor other than chance is operating for the deviation to be so great.

The analysis and discussion of result of this dissertation will be shown in the next chapter.

CHAPTER FIVE

RESULT ANALYSIS AND DISCUSSION

5.0 INTRODUCTION

Having developed the LPG marketing and distribution framework, it is necessary to look at what effect the conceptualized LPG framework will have in the Nigeria LPG market. This chapter therefore looks at the analysis and discussion of results from two different survey questionnaires that cover both LPG consumers and marketers (distributors and retailers).

The outcome of the analysis of results are compared with the conceptualized framework in a bid to verify what effect the framework will have in the improvement of the Nigeria LPG market. A semi-urban town in Nigeria, known as Oturkpo was selected as a case study to exhibit the effect of the conceptualized LPG framework.

5.1 QUESTIONNAIRE SURVEY: ANALYSIS RESULTS

A structured questionnaire that adapts to the local conditions in Nigeria was developed. This was done after subjecting it through the pre-test and pilot stages. Part A questionnaire, the household survey, was divided into different sections namely;

- household size and profile;
- fuel use pattern;
- supply logistics;
- fuel preference;
- Amounts spent on fuels; and so forth

The part B questionnaire is for LPG distributors and retailers in the regions that supply LPG to the case study area. The questions in this section was mainly related to the factors affecting LPG marketing and distribution in Nigeria. Sample copies of the survey questionnaires are attached hereafter in Annexure 1.

5.2 QUESTIONNAIRE SURVEY: ANALYSIS RESULTS OF PART A QUESTIONNAIRE

The Part A questionnaire which is for household survey was aimed at a total sample size of 60 households; however, 53 household respondents successfully completed a

fill-in questionnaire survey template from which conclusions, interpretations and inferences could be drawn. This high response rate of 88% could be attributed to persistent personal visits to respondents.

Data were collected from individual survey instrument for each household, based on the survey objectives iterated in the previous chapter. The collected data were synthesized and interpreted with the aid of an online survey and analytical software known as survey monkey. The feedback from the questionnaire as analysed by survey monkey is captured in Annexure 2.

5.2.1 Gender Statistics of the Heads of Households

Table 5.1 below gives a description of gender statistics of the survey carried out for household respondents. It shows the age, annual income and monthly household expenditure.

Table 5.1 Characteristics of Household Respondents

Descriptive Statistics						
Gender		**N**	**Mean ($\bar{x}$)**	**Std. Deviation**	**Minimum**	**Maximum**
Male	Age	45	48.56	7.66	34.00	64.00
	Annual Household Income	45	₦521,755.00	226668.00	₦230,000.00	₦1,080,000.00
	Monthly Household Expenditure	45	₦3,575.00	1544.00	₦2,000.00	₦7,550.00
Female	Age	8	42.75	5.23	35	51
	Annual Household Income	8	₦472,125.00	181660	₦230,000.00	₦750,000.00
	Monthly Household Expenditure	8	₦3,550.00	1572.30	₦2,000.00	₦6,800.00

As shown in the table above, the household that has male as head of house dominates over that of female. 45 out of 53 respondents were male. This can be attributed to the cultural practices in this community where widows are inherited by older members of the husbands' family. It is therefore common for most households to have a male head as the breadwinner even if the woman, a widow, is responsible for the family's

upkeep. The significance of this inheritance is mainly to remove the social stigma attributed to women living alone.

Findings has revealed that 48% of the heads of households are civil servants (working in government owned establishment or teaching in government owned schools) 32% are farmers, 11% are traders while 9% are found to be self employed. This suggest that major establishment in Oturkpo are owned by the government.

Furthermore, a sizeable number of respondents have attended at least senior secondary school thereby showing the literacy level of the people in Oturkpo town. However, the income level of male respondents is quite high when compared to that of the female respondents. This could be attributed to the fact that men involve themselves in different jobs that can bring in multiple incomes. The average income for men is ₦521,755.00 while that of women is ₦472,125.00 per annum.

5.2.2 Fuel Use Pattern

About 91% of the households are connected to the national grid. However, respondents expressed a lot of frustration with its usage. Erratic supply and high tariff were the two main constraints mentioned by respondents. About 55% of the households listed irregular supply as the main problem, while 33% reported high tariff as the major problem associated with electricity usage. Kerosene is the fuel most widely used for lighting when there is power outage. None of the respondents use LPG for lighting.

Table 5.2 Percentage Rating of Fuel Mostly Used for Cooking

3. Which of the fuels below do you use most for cooking?

	Response Percent	Response Count
LPG	13.2%	7
Kerosene	60.4%	32
Firewood	26.4%	14
Charcoal	0.0%	0
answered question		53
skipped question		0

The survey report revealed that respondents use multiple source of cooking fuel. Most households alternate their cooking energy depending on cost and availability. Kerosene and firewood are the most used fuel because of their easy accessibility and affordability. As shown in the table 5.2 above, out of the 53 households that were surveyed, 60% indicated kerosene as the fuel of choice they use for cooking, 26% use firewood regularly and only 14% named LPG as the most frequently used fuel for cooking.

Table 5.3 Percentage Rating of Reasons Households Don't Use LPG

7. If your answer to question 6 above is "NO", which of these are reasons why LPG is not your primary cooking fuel? (Tick as applicable)

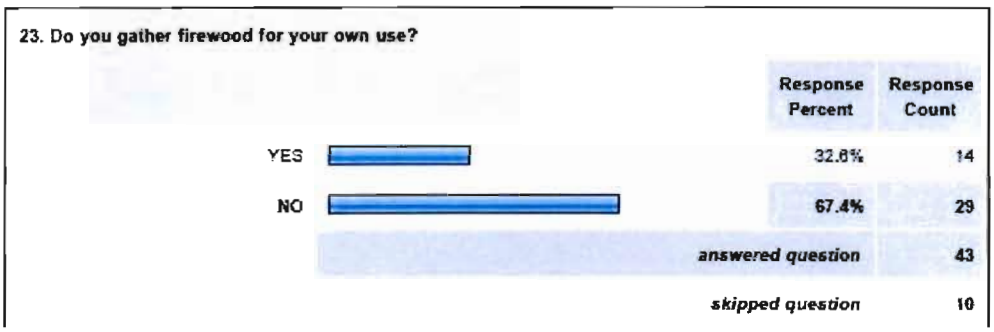
	Response Percent	Response Count
LPG is dangerous; it can cause fire or explosion	26.1%	12
Getting cylinders refilled is a hassle	21.7%	10
Uncertainty in KPG supply	15.2%	7
LPG is expensive	100.0%	46
LPG stoves and cylinders are expensive	93.5%	43
answered question		46
skipped question		7

The survey report as shown in table 5.2 revealed that only 14% named LPG as the most frequently used fuel for cooking. However, it will be worthy to note that 85% of respondents prefer the use of LPG as their choice cooking fuel. The major reason that they highlighted as to the reasons they don't use LPG is that the gas and its accessories (cylinders and stove) is expensive.

5.2.3 Fuel Logistic and Purchase

LPG is not delivered to consumers, it is available only on a self collect basis and some respondents lived some 5 to 10km from the nearest LPG retail outlet. Kerosene however, can be bought at outlets that are very close to respondent's houses.

Table 5.4 Percentage Rating of Respondents who Gather Firewood for Own Use



23. Do you gather firewood for your own use?

	Response Percent	Response Count
YES	32.6%	14
NO	67.4%	29
answered question		43
skipped question		10

Report from the survey carried out revealed that firewood is sold at outlet that is very close to households and does not take more than 5 - 10mins walk. However, table 5.4 above shows that about 33% of respondents with very low monthly income still go to the forest to fetch their own firewood.

On the issue of price, report from the survey revealed that the retail price of a 12.5kg LPG fill is between ₦2,500 and ₦4,000 in Oturkpo. This wide fluctuation in price is also experienced in kerosene that is sold between ₦200 and ₦400 for a 4-litre package. Respondents indicated that the wide fluctuation in price is as a result of product scarcity and it unsettles their fuel usage pattern.

As regard the issue of monthly amount spent on household fuel, the few respondents that uses LPG claim that they spend about ₦5,000 - ₦6,000 monthly on the product while those using kerosene spend about ₦1,500 - ₦2,000 monthly for their household use. This clearly shows why kerosene is the most widely used fuel in this area.

5.2.4 Household Appliances/Expenditures

Household appliances and expenditures considered the cost of LPG stoves, LPG cylinders, kerosene stoves and what consumers are willing to pay for LPG if it was readily available.

Most respondents that have knowledge of LPG claim that they are willing to use LPG if the cost of the stove and cylinder was within their reach. LPG stove prices in the

market as at the time of carrying out this research is between ₦7,500 - ₦8,500 for single burners and ₦12000 - ₦15000 for double burners. Imported, reliable and bigger LPG cookers are sold for a price that is far higher than the monthly income of most respondents. However, the cheapest kerosene stove sell for about ₦600. This has further shown why kerosene is highly preferred to LPG.

Table 5.5 Percentage Rating of Preference for Smaller Cylinders

38. If LPG cylinders and fill were smaller, would you be willing to use LPG?

	Response Percent	Response Count
YES	74.4%	32
NO	25.6%	11
answered question		43
skipped question		10

Table 5.5 above shows that the use of smaller cylinders (i.e. 3kg and 6kg) was preferred by 75% of the 53 respondent. They believe the price of these cylinders will fall within their income. About 78% of respondents claim that they will be willing to pay an unrealistic ₦700 for a 12.5kg LPG fill.

On the issue of soft loans and grant that will cover the upfront cost of LPG, respondents stated that there are no credit facilities in place for household items and they will be ready to take advantage of it if it is available and functioning.

5.3 QUESTIONNAIRE SURVEY: ANALYSIS RESULTS OF PART B QUESTIONNAIRE

Part B questionnaire for LPG distributors and retailers targeted a total sample size of 20 distributors and 25 retailers. However, 20 distributors and 20 retailers successfully completed a fill-in questionnaire survey template from which conclusions, interpretations and inferences could be drawn. This high response rate of 88.9% is due to continual personal visits to respondents and the use of e-mail. The table below shows the number of expected distributors and retailers and the actual distributors and retailers who participated in the study.

Table 5.6 Distribution of respondents

Required Respondents	Distributors	Retailers	Total
Expected Respondents	20	25	**45**
Actual Respondents	20	20	**40**

In this analysis, some hypothesis have been drawn from the factors affecting LPG marketing and distribution in Nigeria. Respondents have been asked to indicate their perception on these factors with respect to each outlined factor on a two-point Likert scale (from 1 indicating agree, and 2 indicating disagree). The hypotheses are;

Hypothesis One

H_O: Upfront cost of LPG accessories (cylinders and stove) is a hindrance to LPG usage in Nigeria.

Hypothesis Two

H_O: Unavailability of smaller and lighter cylinders (2 - 3kg) mainly for lower income household does not affect the marketing of LPG in Nigeria.

Hypothesis Three

H_O: The fear of LPG as an unsafe fuel for cooking does not affect the marketing of LPG in Nigeria.

Hypothesis Four

H_O: Instability in the price of LPG is not a hindrance to its usage in Nigeria.

Hypothesis Five

H_O: Lack of credit purchase for customers does not inhibit the use of LPG in Nigeria.

Hypothesis Six

H_O: Ineffective supply and distribution system does not affect the marketing of LPG in Nigeria.

Hypothesis Seven

H_O: Lack of soft loans and grants for LPG accessories (cylinders and stoves) is not an obstacle to LPG usage in Nigeria.

5.3.1 Response Analysis

Table 5.7 below shows the summary of 40 responses from LPG distributors and retailers as regard factors affecting LPG marketing and distribution in Nigeria. The number of responses to each factor and their percentages with reference to the two likert scale are also shown in the table. This analysis was done with the aid of a soft ware tool known as survey monkey. See complete summary of this survey in annexure 3.

Table 5.7 Tabulation of response to factors affecting LPG marketing and distribution

	Agree (1)	Disagree (2)	Rating Average	Response Count
1. Upfront cost of LPG accessories (cylinders and stove) is not a hindrance to LPG usage in Nigeria.	13 (32.5%)	27 (67.5%)	1.68	40
2. Unavailability of smaller and lighter cylinders (2-3kg) mainly for lower income household does not affect the marketing of LPG in Nigeria.	10 (25.0%)	30 (75.0%)	1.75	40
3. The fear of LPG as an unsafe fuel for cooking does not affect the marketing of LPG in Nigeria.	17 (42.5%)	23 (57.5%)	1.58	40
4. Instability in the price of LPG is not a hindrance to its usage in Nigeria.	14 (35.0%)	26 (65.0%)	1.65	40
5. Lack of credit purchase for customers does not inhibit the use of LPG in Nigeria.	11 (27.5%)	29 (72.5%)	1.73	40
6. Ineffective supply and distribution system does not affect the marketing of LPG in Nigeria.	13 (32.5%)	27 (67.5%)	1.68	40
7.Lack of soft loans and	10 (25.0%)	30 (75.0%)	1.75	40

grants is not an obstacle to LPG usage in Nigeria				

5.2 CHI-SQUARE ANALYSIS OF DATA AND TEST OF HYPOTHESIS

The evaluation, analysis of data and test of significance can be carried out with the use of the data presented above from response received in the survey work. The chi-square model will be used in this analysis.

Test of Hypothesis One

The response from distributors and retailers as summarized in table 5.7 will be used to analyze the hypothesis.

H_O: Upfront cost of LPG accessories (cylinders and stove) is not a hindrance to LPG usage in Nigeria.

H_A: Upfront cost of LPG accessories (cylinders and stove) is a hindrance to LPG usage in Nigeria.

Table 5.8 Evaluation of hypothesis one

Choice / Category	Agree (1)	Disagree (2)	Total
Distributors	$x = 3$ $\bar{x} = 6.5$	$x = 17$ $\bar{x} = 13.5$	20
Retailers	$x = 10$ $\bar{x} = 6.5$	$x = 10$ $\bar{x} = 13.5$	20
Total	13	27	**40**

$$X^2_{cal} = \sum_{i=1}^{n} \frac{(x - \bar{x})^2}{\bar{x}}$$

$X^2_{cal} =$ $1.885 + 0.907 + 1.885 + 0.907 + 0.28 + 0.59$

$X^2_{cal} =$ **5.58**

Degree of freedom = (c-1) (r-1) = (2-1) (2-1) = **1**

X^2_{tab} (0.025) at 97.5% limit of significance = 5.024 (refer to annexure 4)

Conclusion:

Since X^2_{tab} is lower than X^2_{cal}, i.e. 5.024 < 5.58, the null hypothesis (H_O) is rejected and the alternate hypothesis (H_A) (i.e. upfront cost of LPG accessories (cylinders and stove) is a hindrance to LPG usage in Nigeria) is accepted.

Test of Hypothesis Two

The response from distributors and retailers as summarized in table 5.7 will be used to analyze the hypothesis.

H_O: Unavailability of smaller and lighter cylinders (2 - 3kg) mainly for lower income household does not affect the marketing of LPG in Nigeria.

H_A: Unavailability of smaller and lighter cylinders (2 - 3kg) mainly for lower income household affects the marketing of LPG in Nigeria.

Table 5.9 Evaluation of hypothesis two

Choice / Category	Agree (1)	Disagree (2)	Total
Distributors	$x = 9$ $\bar{x} = 5$	$x = 11$ $\bar{x} = 15$	20
Retailers	$x = 1$ $\bar{x} = 5$	$x = 19$ $\bar{x} = 15$	20
Total	10	30	**40**

$$X^2_{cal} = \sum_{i=1}^{n} \frac{(x - \bar{x})^2}{\bar{x}}$$

X^2_{cal} = 3.200 + 1.067 + 3.200 + 1.067

X^2_{cal} = **8.533**

Degree of freedom = (c-1) (r-1) = (2-1) (2-1) = **1**

X^2_{tab} (0.025) at 97.5% limit of significance = 5.024 (refer to annexure 4)

Conclusion:

Since X^2_{tab} is lower than X^2_{cal}, i.e. 5.024 < 8.533, the null hypothesis (H_O) is rejected and the alternate hypothesis (H_A) (i.e. unavailability of smaller and lighter cylinders [2 - 3kg] mainly for lower income household affects the marketing of LPG in Nigeria) is accepted.

Test of Hypothesis Three

The response from distributors and retailers as summarized in table 5.7 will be used to analyze the hypothesis.

H_O: The fear of LPG as an unsafe fuel for cooking does not affect the marketing of LPG in Nigeria.

H_A: The fear of LPG as an unsafe fuel for cooking does not affect the marketing of LPG in Nigeria.

Table 5.10 Evaluation of hypothesis three

Choice / Category	Agree (1)	Disagree (2)	Total
Distributors	$x = 3$ $\overline{x} = 8.5$	$x = 17$ $\overline{x} = 11.5$	20
Retailers	$x = 14$ $\overline{x} = 8.5$	$x = 6$ $\overline{x} = 11.5$	20
Total	17	23	**40**

$$X^2_{cal} = \sum_{i=1}^{n} \frac{(x - \overline{x})^2}{\overline{x}}$$

X^2_{cal} = 3.559 + 2.630 + 3.559 + 1.630

X^2_{cal} = **12.793**

Degree of freedom = (c-1) (r-1) = (2-1) (2-1) = **1**

X^2_{tab} (0.025) at 97.5% limit of significance = 5.024 (refer to annexure 4)

Conclusion:

Since X^2_{tab} is lower than X^2_{cal}, i.e. 5.024 < 12.379, the null hypothesis (H_O) is rejected and the alternate hypothesis (H_A) (i.e. the fear of LPG as an unsafe fuel for cooking affects the marketing of LPG in Nigeria) is accepted.

Test of Hypothesis Four

The response from distributors and retailers as summarized in table 5.7 will be used to analyze the hypothesis.

H_O: Instability in the price of LPG is not a hindrance to its usage in Nigeria

H_A: Instability in the price of LPG is a hindrance to its usage in Nigeria.

Table 5.11 Evaluation of hypothesis three

Choice / Category	Agree (1)	Disagree (2)	Total
Distributors	$x = 3$ $\bar{x} = 7$	$x = 11$ $\bar{x} = 13$	20
Retailers	$x = 11$ $\bar{x} = 7$	$x = 9$ $\bar{x} = 13$	20
Total	14	26	**40**

$$X^2_{cal} = \sum_{x=1}^{n} \frac{(x - \bar{x})^2}{\bar{x}}$$

X^2_{cal} = 2.286 + 1.231 + 2.286 + 1.231

X^2_{cal} = **7.031**

Degree of freedom = (c-1) (r-1) = (2-1) (2-1) = **1**

X^2_{tab} (0.025) at 97.5% limit of significance = 5.024 (refer to annexure 4)

Conclusion:

Since X^2_{tab} is lower than X^2_{cal}, i.e. 5.024 < 7.031, the null hypothesis (H_O) is rejected and the alternate hypothesis (H_A) (i.e. instability in the price of LPG is a hindrance to its usage in Nigeria) is accepted.

Test of Hypothesis Five

The response from distributors and retailers as summarized in table 5.7 will be used to analyze the hypothesis.

H_O: Lack of credit purchase for customers does not inhibit the use of LPG in Nigeria.

H_A: Lack of credit purchase for customers inhibits the use of LPG in Nigeria.

Table 5.12 Evaluation of hypothesis five

Choice / Category	Agree (1)	Disagree (2)	Total
Distributors	$x = 9$ $\overline{x} = 5.5$	$x = 11$ $\overline{x} = 14.5$	20
Retailers	$x = 2$ $\overline{x} = 5.5$	$x = 18$ $\overline{x} = 14.5$	20
Total	11	29	**40**

$$X^2_{cal} = \sum_{i=1}^{n} \frac{(x - \overline{x})^2}{\overline{x}}$$

X^2_{cal} = 2.227 + 0.845 + 2.227 + 0.845

X^2_{cal} = **6.145**

Degree of freedom = (c-1) (r-1) = (2-1) (2-1) = **1**

X^2_{tab} (0.025) at 97.5% limit of significance = 5.024 (refer to annexure 4)

Conclusion:

Since X^2_{tab} is lower than X^2_{cal}, i.e. 5.024 < 6.145, the null hypothesis (H_O) is rejected and the alternate hypothesis (H_A) (i.e. lack of credit purchase for customers inhibits the use of LPG in Nigeria) is accepted.

Test of Hypothesis Six

The response from distributors and retailers as summarized in table 5.7 will be used to analyze the hypothesis.

H_O: Ineffective supply and distribution system does not affect the marketing of LPG in Nigeria.

H_A: Ineffective supply and distribution system affects the marketing of LPG in Nigeria.

Table 5.13 Evaluation of hypothesis six

Choice / Category	Agree (1)	Disagree (2)	Total
Distributors	$x = 2$ $\bar{x} = 6.5$	$x = 18$ $\bar{x} = 13.5$	20
Retailers	$x = 11$ $\bar{x} = 6.5$	$x = 9$ $\bar{x} = 13.5$	20
Total	13	27	**40**

$$X^2_{cal} = \sum_{i=1}^{n} \frac{(x - \bar{x})^2}{\bar{x}}$$

X^2_{cal} = 3.115 + 1.500 + 3.115 + 1.500

X^2_{cal} = **9.230**

Degree of freedom = (c-1) (r-1) = (2-1) (2-1) = **1**

X^2_{tab} (0.025) at 97.5% limit of significance = 5.024 (refer to annexure 4)

Conclusion:

Since X^2_{tab} is lower than X^2_{cal}, i.e. 5.024 < 6.145, the null hypothesis (H_O) is rejected and the alternate hypothesis (H_A) (i.e. ineffective supply and distribution system affects the marketing of LPG in Nigeria) is accepted.

Test of Hypothesis Seven

The response from distributors and retailers as summarized in table 5.7 will be used to analyze the hypothesis.·

H_O: Lack of soft loans and grants is not an obstacle to LPG usage in Nigeria

H_A: Lack of soft loans and grants is an obstacle to LPG usage in Nigeria

Table 5.14 Evaluation of hypothesis seven

Choice / Category	Agree (1)	Disagree (2)	Total
Distributors	$x = 9$ $\overline{x} = 5$	$x = 11$ $\overline{x} = 15$	20
Retailers	$x = 1$ $\overline{x} = 5$	$x = 19$ $\overline{x} = 15$	20
Total	10	30	**40**

$$X^2_{cal} = \sum_{i=1}^{n} \frac{(x - \overline{x})^2}{\overline{x}}$$

$X^2_{cal} =$ $3.200 + 1.067 + 3.200 + 1.067$

$X^2_{cal} =$ **8.533**

Degree of freedom = (c-1) (r-1) = (2-1) (2-1) = **1**

X^2_{tab} (0.025) at 97.5% limit of significance = 5.024 (refer to annexure 4)

Conclusion:

Since X^2_{tab} is lower than X^2_{cal}, i.e. $5.024 < 6.145$, the null hypothesis (H_O) is rejected and the alternate hypothesis (H_A) (i.e. ineffective supply and distribution system affects the marketing of LPG in Nigeria) is accepted.

5.4 SURVEY FINDINGS

The key findings from the survey that was carried out on household respondents in Oturkpo and LPG dealers (distributors and retailers) in the middle belt region of Nigeria are;

- Households generally use multiple fuels for cooking and their choice of fuel is based on availability and cost. LPG is not easily available when compared to kerosene that is even hawked in the street. The conceptualized framework recommends that the fuel can be made affordable through product availability by channelling part of the exported LPG into the Nigeria market. This will help to increase the availability of the product.

- The perception of LPG by most respondents is that the fuel is dangerous, toxic and unsafe for household use. This shows that most people (especially those in the rural areas) know about the LPG but have little or no information on the fuel. As recommended in the framework, there is need to create awareness and enlighten people of the benefits of using LPG through television advertisements, signs and billboards, etc.

- Despite the negative perception about LPG, findings from the survey revealed that there is an enormous opportunity to market LPG in Nigeria as most household prefers to use the fuel. Apart from creating LPG awareness, the introduction of credit purchase as recommended in the conceptualized framework will help to alleviate the initial high cost of switching to LPG.

- The 12.5kg cylinder is the major LPG cylinders in circulation. Most respondents with low income stated that the introduction of smaller cylinders (e.g. 3kg cylinders) will encourage the use of the fuel as the price will fall within their income. This is in line with what was recommended in the framework that the use of smaller and lighter cylinders will have good market penetration in rural areas.

- LPG unlike kerosene is only available on a self collect basis. Respondents stated that they will have to travel long distance to get the fuel. The mode of transporting LPG in Nigeria as seen in the analysis has a negative impact in the Nigeria LPG market. For better market penetration there should be a proper local network sales outlet that provides convenient access by customers to the fuel. Also, the introduction of home delivery will be a good method of improving LPG sales because most respondents stated they will be willing to use LPG if it can be delivered to their homes.

The findings from the survey carried out in this research have shown the relevance of the conceptualized LPG marketing and distribution framework in developing Nigeria LPG market. Recommendations that address the identified bottlenecks in the Nigeria LPG market are clearly shown in the conceptualized framework.

CHAPTER SIX
CONCLUSION

6.0 SUMMARY, CONCLUSION AND RECOMMENDATION

This chapter highlights the overall dissertation from chapter one to chapter five. It also concludes the research work with some recommendations and suggestions for further research highlighted.

6.1 SUMMARY

The dissertation was arranged in six chapters. Chapter one delved into the background of the research along with the statement of the research problem. The specific objectives of the research were also enumerated in this chapter.

A thorough review of relevant literature was conducted in chapter two of this research work. The state of the Nigeria LPG market and the bottlenecks in the LPG industry was described. The chapter concluded with the resolve that although the per capital consumption of LPG in Nigeria is very low when compared to other West African countries, there is a viable market for LPG and what is needed is a framework for effective marketing and distribution of the product.

In chapter three, a LPG marketing framework was conceptualized. The framework was developed based on the experiences that were used by other countries in improving the distribution and marketing of the product.

Chapter four considered the research empirical investigation and design. The approach and design used in the study was discussed as well as the population of the study identified. The chapter also presented the questionnaire design; the method of validation; and the reliability of the survey instrument. Survey target, sampling procedure and the research instruments were also explained in detail.

Chapter five analyzed the results and findings of the survey instrument of both part A questionnaire for household respondents and Part B questionnaire for LPG dealers. Chi-square analysis was used to analyze the data for part B questionnaire response and this covered hypothesis one to seven. Interpretations were given to the findings and tabulations were used to present the data.

Finally, in chapter six, conclusions drawn from the analysis of the surveys are documented. Recommendations are made for further study.

6.2 CONCLUSIONS

The main objectives of this dissertation are;

- Investigate and identify reasons for LPG market failure in Nigeria
- Develop strategies for reviving Nigeria domestic LPG market
- Streamline LPG distribution at affordable prices, especially to areas of the country where the use is not encouraged
- Propose a framework aimed at promoting competition for growth of LPG market stand

The survey carried out in Oturkpo town revealed some remarkable results. It shows that LPG is a fuel that has a viable market in Nigeria but the following are reasons for its market failure;

- Lack of right combination of consistent policies to encourage the marketing of LPG
- Ineffective regulations to encourage LPG utilization, and
- Little or no investment in requisite infrastructure

The survey further reveals the inefficiencies in the strategy of marketing LPG in Nigeria. Consumers have to travel long distance to get their cylinders refill; some would wait for a long time for the product to be available (undependable supply); most cylinders in use are old and unsafe for purpose; etc. All these anomalies amongst others have been identified as a hindrance to LPG utilization. The following are some of the proposed strategies to revive the Nigeria domestic LPG market;

- Divert LPG destined for export back into the domestic market
- Introduction of alternative transportation modes e.g. rail and pipeline
- Expand markets to create large demand and hence spread fixed cost over large volume of sales
- Establish Pilot LPG supply project for a rural community for possible replication

Findings from the survey in Oturkpo also revealed that LPG is an expensive fuel option in rural and semi-urban areas. This was attributed to the very low income of a large proportion of the residents in these areas and retail outlets that are concentrated in major cities with little or no presence in the semi-urban and rural areas.

Proposed avenues to streamline LPG distribution at affordable prices includes the introduction of smaller cylinders (3 and 6kg) that will fit into the monthly income of consumers and the establishment of wide network of suppliers that will ensure timely and consistent availability of the product.

Based on the identified reasons for LPG market failure, a framework that aimed to address the peculiar state of the Nigeria LPG market was conceptualized. The designed framework considered inputs that were used by other countries (e.g. Senegal, Brazil, South Africa, etc) to revive their domestic LPG market; streamline LPG distribution at affordable prices; promote LPG utilization (mostly in semi-urban and rural areas); and ensure LPG availability and affordability at all times.

RECOMMENDATIONS

This dissertation has provided an in-depth understanding of the condition as well as the factors hindering the distribution and marketing of LPG in Nigerian. It has also proposed a designed framework for addressing the LPG challenges in Nigeria. It is recommended that;

- this framework be exploited by government in a bid to popularize the use of LPG for the health of the people and environmental protection
- further work be undertaken to build the body of knowledge on how best to exploit these market opportunities in a viable and sustainable manner, for dissemination to interested investors.

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Annexure 1

1. PART A: NIGERIA LPG HOUSEHOLD SURVEY

Household Fuel Usage
Case Study: OTURKPO COMMUNITY

Nigeria is the largest oil producer in Africa and the eleventh largest producer of crude oil in the world. Nigeria also has the largest gas reserves in Africa and is ranked 7th in terms of global gas reserves. Its natural gas reserves are estimated to be twice its crude oil reserves. However, despite this huge national energy resource, many Nigerians still live in homes where biomass based fuels are used as they do not have access to modern energy resource. In Nigeria, LPG (Liquified Petroleum Gas) is produced in the four refineries. In principal, Kaduna refinery should supply the whole country while the other refineries (Port-Harcourt I and II, and Warri Refinery) should produce for export. However, the refineries have been working in fits and starts and hence, LPG supply has been epileptic. This irregular supply has had a rebounding effect in LPG growth and development. The objective of this survey is to investigate and identify reasons for LPG market failure in Nigeria and develop strategies for reviving Nigeria domestic LPG market by proposing a framework aimed at promoting competition for growth of LPG market stand.

Please note that this survey is strictly for academic exercise and will be treated with utmost confidentiality. Thank you for your voluntary participation.

* 1. Household size and profile

Gender:

Age:

Occupation:

Town/City:

Number of Adults in Household:

Number of Children in Household:

Educational Level of Respondent:

Annual Income of Respondent:

2. Tick the fuel(s) you use for cooking

- [ ] LPG
- [ ] Kerosene
- [ ] Firewood
- [ ] Charcoal

3. Which of the fuels below do you use most for cooking?

- ◯ LPG
- ◯ Kerosene
- ◯ Firewood
- ◯ Charcoal

4. Which of the fuels below do you prefer for cooking?

- ◎ LPG
- ◎ Kerosene
- ◎ Firewood
- ◎ Charcoal

5. Have you used LPG as cooking fuel?

- ◎ YES
- ◎ NO

6. Is LPG your primary cooking fuel?

- ◎ YES
- ◎ NO

7. If your answer to question 6 above is "NO", which of these are reasons why LPG is not your primary cooking fuel? (Tick as applicable)

- ☐ LPG is dangerous; it can cause fire or explosion
- ☐ Getting cylinders refilled is a hassle
- ☐ Uncertainty in KPG supply
- ☐ LPG is expensive
- ☐ LPG stoves and cylinders are expensive

8. Are you connected to the National grid (PHCN)?

- ◎ YES
- ◎ NO

9. Is your power supply regular?

- ◎ YES
- ◎ NO

10. How many power cut have you had during the past one week?

11. What do you use for lighting when there is power cut?

2. LPG, Kerosene, Firewood and Charcoal Logistic and Purchase

1. How far is your nearest LPG retail store in Km?

2. Tick as appropriate

- ◎ LPG is delivered to me in my house
- ◎ I go out to purchase LPG

3. Would you like LPG to be delivered to you?

- ◎ YES
- ◎ NO

4. Do you have an LPG cylinder?

- ◎ YES
- ◎ NO

5. How many LPG cylinder(s) do you have?

6. When was your last cylinder(s) re-filled?

7. Would you be willing to pay for LPG if supply is regular?

- ◎ YES
- ◎ NO

8. Can you say LPG supply is regular?

- ◎ YES
- ◎ NO

9. How far is your nearest kerosene retail store in Km?

10. Tick as appropriate

- ◎ Kerosene is delivered to me in my house
- ◎ I go out to purchase kerosene

11. How many litres of kerosene do you buy at a time (in litres)?

12. Do you gather firewood for your own use?

- ◎ YES
- ◎ NO

13. Can you buy firewood in your area?

- ◎ YES
- ◎ NO

14. How far is your nearest firewood retail store in Km?

15. Tick as appropriate

- ◎ Firewood is delivered to me in my house
- ◎ I go out to purchase firewood

16. Can you buy charcoal in your area?

- ◎ YES
- ◎ NO

17. How far is your nearest charcoal retail store in Km?

18. Tick as appropriate

- ◎ Charcoal is delivered to me in my house
- ◎ I go out to purchase charcoal

19. Please fill in the amount of energy consumed per month below

Electricity (Kw/h)	
LPG (Kg)	
Kerosene (Litre)	
Firewood (Kg)	
Charcoal (Kg)	
Others	

20. Please fill in the total cost of energy consumed per month below (in Naira)

Electricity	
LPG	
Kerosene	
Firewood	
Charcoal	
Others	
Total	

3. Household Appliances/Expenditure

LPG and Non-LPG Users

1. When did you buy your LPG stove?

2. How much did you pay for the stove if it was brand new in Naira?

3. How much did you pay for the stove if it was an after used in Naira?

4. Do you have other appliances that run on LPG e.g lights (please specify)?

5. Are you willing to use LPG if it was always available?

- ◎ YES
- ◎ NO

6. Are you willing to use LPG if it was more affordable?

- ◎ YES
- ◎ NO

7. If LPG cylinders and fill were smaller, would you be willing to use LPG?

- ◎ YES
- ◎ NO

8. If LPG stoves and cylinders were more affordable, would you be willing to use LPG?

- ◎ YES
- ◎ NO

9. Are you ready to take soft loans or credit for the purchase of LPG equipments?

- ◎ YES
- ◎ NO

10. Bearing in mind that small cylinder requires frequent re-fill but less cash purchase; tick below the size of cylinder you would prefer.

- [ ] 3kg
- [ ] 6kg
- [ ] 12.5kg
- [ ] 25kg
- [ ] 50kg

11. How much cash would you be willing to spend monthly for LPG purchase (in Naira)?

12. Do you have access to low-cost credit?

- ◎ YES
- ◎ NO

13. Is there a low-cost credit organisation in your area?

- ◎ YES
- ◎ NO

14. If yes, is credit available for LPG cooker and cylinder purchase?

- ◎ YES
- ◎ NO

4. PART B: SURVEY INSTRUMENT FOR LPG DISTRIBUTORS AND RETAILERS

Nigeria is the largest oil producer in Africa and the eleventh largest producer of crude oil in the world. Nigeria also has the largest gas reserves in Africa and is ranked 7th in terms of global gas reserves. Its natural gas reserves are estimated to be twice its crude oil reserves. However, despite this huge national energy resource, many Nigerians still live in homes where biomass based fuels are used as they do not have access to modern energy resource. In Nigeria, LPG (Liquified Petroleum Gas) is produced in the four refineries. In principal, Kaduna refinery should supply the whole country while the other refineries (Port-Harcourt I and II, and Warri Refinery) should produce for export. However, the refineries have been working in fits and starts and hence, LPG supply has been epileptic. This irregular supply has had a rebounding effect in LPG growth and development. The objective of this survey is to investigate and identify reasons for LPG market failure in Nigeria and develop strategies for reviving Nigeria domestic LPG market by proposing a framework aimed at promoting competition for growth of LPG market stand.

Please note that this survey is strictly for academic exercise and will be treated with utmost confidentiality. Thank you for your voluntary participation.

* 1. Fill in your personal data in the spaces provided below:

Name:	
Age:	
Gender (Male/Female):	
Type of Outlet (Distributor/Retailer):	
City/Town:	
State:	
ZIP/Postal Code:	
Country:	
Email Address:	
Phone Number:	

2. Fill in the quantity in stock at time of survey for the different sizes of cylinder.

50kg	
25kg	
12.5kg	
6kg	

3. Fill in the number of empty cylinders in stock at the time of survey

50kg	
25kg	
12.5kg	
6kg	

4. Fill in the number of filled cylinders at the time of survey

50kg	
25kg	
12.5kg	
6kg	

5. Fill in the cost in Naira of the different sizes of cylinder

50kg	
25kg	
12.5kg	
6kg	

6. Please indicate your agreement with the following factors that relate to LPG marketing and distribution in your area:

	Agree	Not Sure	Disagree
(a) Upfront cost of LPG is a hindrance to LPG usage.	◯	◯	◯
(b) Lower cost of other fuels (e.g firewood) undermine the use of LPG.	◎	◎	◎
(c) Method of transporting LPG to end users is highly effective.	◯	◯	◯
(d) Supply and distribution of LPG is highly efficient.	◎	◎	◎
(e) Introduction of smaller cylinders (2-3kg) will attract customers (mostly the low income earners).	◯	◯	◯
(f) Fear of LPG as an unsafe fuel discourages its use in households.	◎	◎	◎
(g) Little or no awareness/enlightenment creation on the use of LPG has not encourage its utilization.	◯	◯	◯
(h) Instability in the price of LPG is a hindrance to its use.	◎	◎	◎
(i) Lack of credit purchase for customers inhibits the use of LPG.	◯	◯	◯
(j) Lack of soft loans and grants is an obstacle to LPG usage.	◎	◎	◎

7. Please, write any further comment on the factors affecting the marketing of LPG

LPG survey for Distributors and Retailers4

1. PART B: SURVEY INSTRUMENT FOR LPG DISTRIBUTORS AND RETAILERS

Nigeria is the largest oil producer in Africa and the eleventh largest producer of crude oil in the world. Nigeria also has the largest gas reserves in Africa and is ranked 7th in terms of global gas reserves. Its natural gas reserves are estimated to be twice its crude oil reserves. However, despite this huge national energy resource, many Nigerians still live in homes where biomass based fuels are used as they do not have access to modern energy resource. In Nigeria, LPG (Liquified Petroleum Gas) is produced in the four refineries. In principal, Kaduna refinery should supply the whole country while the other refineries (Port-Harcourt I and II, and Warri Refinery) should produce for export. However, the refineries have been working in fits and starts and hence, LPG supply has been epileptic. This irregular supply has had a rebounding effect in LPG growth and development. The objective of this survey is to investigate and identify reasons for LPG market failure in Nigeria and develop strategies for reviving Nigeria domestic LPG market by proposing a framework aimed at promoting competition for growth of LPG market stand.

Please note that this survey is strictly for academic exercise and will be treated with utmost confidentiality. Thank you for your voluntary participation.

LPG survey for Distributors and Retailers4

1. Please indicate by ticking either Agree/Disagree on how the following underlisted factors affects the marketing and distribution of LPG in your area:

	Agree	Disagree
1.Upfront cost of LPG is not a hindrance to LPG usage.	◯	◯
2.Ineffective supply and distribution system does not affect the marketing of LPG in Nigeria.	◯	◯
3.The fear of LPG as an unsafe fuel for cooking does not affect the marketing of LPG in Nigeria.	◯	◯
4.Little or no awareness/enlightenment creation on the use of LPG is not a hindrance to its utilization in Nigeria.	◯	◯
5.Instability in the price of LPG is not a hindrance to its usage in Nigeria.	◯	◯
6.Unavailability of smaller and lighter cylinders (2-3kg) mainly for lower income household does not affect the marketing of LPG in Nigeria.	◯	◯
7.Lower cost of other cooking fuels (biomass based fuel/wood) does not affect the marketing of LPG in Nigeria.	◯	◯
8.Supply and distribution of LPG in Nigeria is highly efficient.	◯	◯
9.Lack of credit purchase for customers does not inhibits the use of LPG in Nigeria.	◯	◯
10.Lack of soft loans and grants for LPG accessories (cylinders and stoves) is not an obstacle to LPG usage in Nigeria	◯	◯

Annexure 2

Household size and profile Gender:	Age:	Occupation:	Town/City:	Number of Adults in Household:	Number of Children in Household:	Educational Level of Respondent:	Annual Income of Respondent:
male	49	farmer	Oturkpo		3	3 junior middle school	₦370,000
male	39	farmer	Oturkpo		4	1 Senior middle school	₦370,000
male	56	farmer	Oturkpo		5	2 junior middle school	₦320,000
male	40	farmer	Oturkpo		3	2 junior middle school	₦420,000
male	60	farmer	Oturkpo		7	0 junior middle school	₦250,000
male	46	farmer	Oturkpo		4	2 junior middle school	₦380,000
male	52	farmer	Oturkpo		5	4 junior middle school	₦370,000
male	50	farmer	Oturkpo		5	2 junior middle school	₦380,000
male	37	farmer	Oturkpo		4	3 junior middle school	₦320,000
male	51	farmer	Oturkpo		6	3 junior middle school	₦450000
male	43	farmer	Oturkpo		4	3 junior middle school	₦370,000
male	35	farmer	Oturkpo		3	3 junior middle school	₦370,000
female	42	farmer	Oturkpo		3	3 Senior middle school	₦426,000
male	39	farmer	Oturkpo		4	3 junior middle school	₦450000
male	49	farmer	Oturkpo		5	2 junior middle school	₦370,000
male	49	farmer	Oturkpo		5	4 junior middle school	₦320,000
male	43	Trader	Oturkpo		4	4 junior middle school	₦375,000
female	43	Trader	Oturkpo		4	4 junior middle school	₦230,000
male	48	Trader	Oturkpo		7	2 Senior middle school	₦370,000
male	54	Trader	Oturkpo		5	3 junior middle school	₦370,000
male	53	self employed	Oturkpo		5	3 Senior middle school	₦546,000
male	64	trader	Oturkpo		7	2 junior middle school	₦560,000
female	51	self employed	Oturkpo		6	3 Senior middle school	₦750000
male	39	self employed	Oturkpo		3	4 junior middle school	₦230,000
male	46	self employed	Oturkpo		4	3 University Graduate	₦865,000
male	37	self employed	Oturkpo		3	2 junior middle school	₦250,000
male	56	farmer	Oturkpo		6	3 junior middle school	₦380,000
male	35	civil servant	Oturkpo		2	4 University Graduate	₦751000
male	43	civil servant	Oturkpo		5	3 University Graduate	₦675,000
male	48	civil servant	Oturkpo		4	3 University Graduate	₦672,000
male	60	Trader	Oturkpo		9	0 Senior middle school	₦375,000
male	40	civil servant	Oturkpo		4	3 University Graduate	₦748,000
male	42	civil servant	Oturkpo		5	3 University Graduate	₦632,000
male	37	civil servant	Oturkpo		3	3 University Graduate	₦688,000
female	49	civil servant	Oturkpo		5	1 University Graduate	₦632,000
male	34	civil servant	Oturkpo		2	3 University Graduate	₦581,000
male	43	civil servant	Oturkpo		3	3 College level	₦476,000
male	56	civil servant	Oturkpo		4	2 College level	₦546,000
female	46	civil servant	Oturkpo		4	3 College level	₦375,000
male	54	civil servant	Oturkpo		7	0 College level	₦541,000
male	52	civil servant	Oturkpo		6	1 College level	₦375,000
male	43	civil servant	Oturkpo		5	3 College level	₦375,000
female	38	civil servant	Oturkpo		5	2 University Graduate	₦476,000
male	51	civil servant	Oturkpo		2	4 College level	₦876,000
male	37	civil servant	Oturkpo		4	2 College level	₦820,000
female	42	civil servant	Oturkpo		3	4 College level	₦276,000
male	52	civil servant	Oturkpo		3	4 College level	₦920,000
male	39	civil servant	Oturkpo		3	2 College level	₦1,020,000
male	41	civil servant	Oturkpo		2	2 College level	₦1,080,000
female	35	civil servant	Oturkpo		3	2 College level	₦612,000
male	45	civil servant	Oturkpo		4	3 College level	₦576,000
male	54	civil servant	Oturkpo		3	3 College level	₦648,000
male	54	civil servant	Oturkpo		4	3 College level	₦648,000

Tick the fuel(s) you use for cooking				Which of the fuels below do you use most for cooking?				Which of the fuels below do you prefer for cooking?	
LPG	Kerosene	Firewood	Charcoal	LPG	Kerosene	Firewood	Charcoal	LPG	Kerosene
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood				Firewood			Kerosene
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood				Firewood			Kerosene
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood				Firewood		LPG	
	Kerosene	Firewood				Firewood		LPG	
	Kerosene	Firewood				Firewood		LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood				Firewood			Kerosene
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood				Firewood			Kerosene
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene				Kerosene			LPG	
		Firewood				Firewood			Kerosene
LPG	Kerosene			LPG				LPG	
	Kerosene	Firewood				Firewood			Kerosene
	Kerosene	Firewood				Firewood			Kerosene
LPG	Kerosene				Kerosene			LPG	
LPG	Kerosene				Kerosene			LPG	
LPG	Kerosene				Kerosene			LPG	
	Kerosene	Firewood				Firewood			Kerosene
LPG	Kerosene				Kerosene			LPG	
LPG	Kerosene				Kerosene			LPG	
LPG	Kerosene				Kerosene			LPG	
LPG	Kerosene				Kerosene			LPG	
	Kerosene				Kerosene			LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene				Kerosene			LPG	
	Kerosene	Firewood				Firewood		LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood				Firewood		LPG	
	Kerosene	Firewood				Firewood		LPG	
LPG	Kerosene			LPG				LPG	
LPG	Kerosene			LPG				LPG	
LPG	Kerosene			LPG				LPG	
LPG	Kerosene			LPG				LPG	
LPG	Kerosene			LPG				LPG	
LPG	Kerosene			LPG				LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood			Kerosene			LPG	
	Kerosene	Firewood			Kerosene			LPG	

Firewood	Charcoal	Have you used LPG as cooking fuel? YES	NO	Is LPG your primary cooking fuel? YES	NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
		YES			NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
		YES			NO
			NO		NO
			NO		NO
		YES			NO
		YES			NO
		YES			NO
			NO		NO
		YES			NO
		YES			NO
		YES			NO
		YES			NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
			NO		NO
		YES		YES	
		YES		YES	
		YES		YES	
		YES		YES	
		YES		YES	
		YES		YES	
			NO		NO
			NO		NO
			NO		NO
			NO		NO

If your answer to question 6 above is "NO", which of these are reasons why LPG is not your primary cooking fuel? (Tick as applicable)			
LPG is dangerous; it can cause fire or explosion	Getting cylinders refilled is a hassle	Uncertainty in KPG supply	LPG is expensive
			LPG is expensive
			LPG is expensive
			LPG is expensive
LPG is dangerous; it can cause fire or explosion			LPG is expensive
			LPG is expensive
			LPG is expensive
			LPG is expensive
			LPG is expensive
LPG is dangerous; it can cause fire or explosion			LPG is expensive
	Getting cylinders refilled is a hassle		LPG is expensive
		Uncertainty in KPG supply	LPG is expensive
			LPG is expensive
			LPG is expensive
	Getting cylinders refilled is a hassle		LPG is expensive
LPG is dangerous; it can cause fire or explosion			LPG is expensive
LPG is dangerous; it can cause fire or explosion			LPG is expensive
			LPG is expensive
	Getting cylinders refilled is a hassle		LPG is expensive
			LPG is expensive
	Getting cylinders refilled is a hassle		LPG is expensive
LPG is dangerous; it can cause fire or explosion			LPG is expensive
	Getting cylinders refilled is a hassle	Uncertainty in KPG supply	LPG is expensive
LPG is dangerous; it can cause fire or explosion			LPG is expensive
LPG is dangerous; it can cause fire or explosion			LPG is expensive
	Getting cylinders refilled is a hassle	Uncertainty in KPG supply	LPG is expensive
	Getting cylinders refilled is a hassle	Uncertainty in KPG supply	LPG is expensive
	Getting cylinders refilled is a hassle	Uncertainty in KPG supply	LPG is expensive
LPG is dangerous; it can cause fire or explosion			LPG is expensive
	Getting cylinders refilled is a hassle	Uncertainty in KPG supply	LPG is expensive
		Uncertainty in KPG supply	LPG is expensive
			LPG is expensive
			LPG is expensive
			LPG is expensive
	Getting cylinders refilled is a hassle		LPG is expensive
LPG is dangerous; it can cause fire or explosion			LPG is expensive
			LPG is expensive
LPG is dangerous; it can cause fire or explosion			LPG is expensive
			LPG is expensive
			LPG is expensive
			LPG is expensive
LPG is dangerous; it can cause fire or explosion			LPG is expensive
			LPG is expensive
			LPG is expensive
LPG is dangerous; it can cause fire or explosion			LPG is expensive

LPG stoves and cylinders are expensive	Are you connected to the National grid (PHCN)? YES	NO	Is your power supply regular? YES	NO	How many power cut have you had during the past one week? Open-Ended Response
LPG stoves and cylinders are expensive		NO		NO	15
LPG stoves and cylinders are expensive	YES			NO	17
LPG stoves and cylinders are expensive	YES			NO	15
LPG stoves and cylinders are expensive	YES			NO	10
LPG stoves and cylinders are expensive		NO			
LPG stoves and cylinders are expensive	YES			NO	13
LPG stoves and cylinders are expensive	YES			NO	16
LPG stoves and cylinders are expensive	YES			NO	16
LPG stoves and cylinders are expensive	YES			NO	17
LPG stoves and cylinders are expensive	YES			NO	15
LPG stoves and cylinders are expensive	YES			NO	13
LPG stoves and cylinders are expensive	YES			NO	18
LPG stoves and cylinders are expensive	YES			NO	14
LPG stoves and cylinders are expensive	YES			NO	15
LPG stoves and cylinders are expensive	YES			NO	15
LPG stoves and cylinders are expensive		NO			
LPG stoves and cylinders are expensive	YES			NO	13
LPG stoves and cylinders are expensive	YES			NO	15
LPG stoves and cylinders are expensive	YES			NO	17
LPG stoves and cylinders are expensive	YES			NO	15
LPG stoves and cylinders are expensive	YES			NO	12
LPG stoves and cylinders are expensive	YES			NO	17
LPG stoves and cylinders are expensive	YES				14
LPG stoves and cylinders are expensive		NO			
LPG stoves and cylinders are expensive	YES			NO	14
LPG stoves and cylinders are expensive	YES			NO	13
LPG stoves and cylinders are expensive	YES			NO	17
LPG stoves and cylinders are expensive	YES			NO	14
LPG stoves and cylinders are expensive	YES			NO	15
LPG stoves and cylinders are expensive	YES			NO	12
LPG stoves and cylinders are expensive	YES			NO	10
	YES			NO	12
	YES			NO	14
	YES			NO	14
	YES			NO	16
LPG stoves and cylinders are expensive	YES			NO	13
LPG stoves and cylinders are expensive		NO		NO	9
LPG stoves and cylinders are expensive	YES			NO	13
LPG stoves and cylinders are expensive	YES			NO	10
LPG stoves and cylinders are expensive	YES		YES		16
LPG stoves and cylinders are expensive	YES			NO	12
LPG stoves and cylinders are expensive	YES			NO	15
LPG stoves and cylinders are expensive	YES			NO	15
	YES			NO	13
	YES			NO	12
	YES			NO	13
	YES			NO	8
	YES			NO	11
	YES			NO	10
LPG stoves and cylinders are expensive	YES			NO	12
LPG stoves and cylinders are expensive	YES			NO	10
LPG stoves and cylinders are expensive	YES			NO	5
LPG stoves and cylinders are expensive	YES			NO	5

What do you use for lighting when there is power cut? Open-Ended Response	How far is your nearest LPG retail store in Km? Open-Ended Response	Tick as appropriate		Would you like LPG to be delivered to you?	
		LPG is delivered to me in my house	I go out to purchase LPG	YES	NO
candles	15km			YES	
kerosene	15km			YES	
kerosene lamp	15km			YES	
kerosene lamp	10km			YES	
kerosene lamp	15km				NO
kerosene lamp	15km			YES	
kerosene lamp	10km			YES	
kerosene lamp	15km		I go out to purchase LPG	YES	
kerosene lamp		10		YES	
kerosene lamp	15km			YES	
kerosene lamp					
kerosene lamp	15km			YES	
kerosene lamp	15km			YES	
kerosene lamp		15		YES	
kerosene lamp	20km			YES	
					NO
kerosene lamp	15km			YES	
kerosene lamp	15km			YES	
kerosene lamp					
kerosene lamp and candles	10km				
kerosene lamp					
kerosene lamp	10km			YES	
Candle and kerosene lamp	15km		I go out to purchase LPG	YES	
Kerosene lamp					
Kerosene lamp	10km				
kerosene lamp	15km		I go out to purchase LPG	YES	
Kerosene lamp	10km		I go out to purchase LPG	YES	
Kerosene lamp and candle		10	I go out to purchase LPG	YES	
Kerosene lamp	15km				
candles and kerosene lamp	5km	LPG is delivered to me in my house		YES	
kerosene lamp and candles	5km		I go out to purchase LPG	YES	
Kerosene lamp and candles	10km		I go out to purchase LPG	YES	
kerosene lamp	10km		I go out to purchase LPG	YES	
Kerosene lamp	10km				
Kerosene lamp					
Kerosene lamp and candles					
Candles and kerosene lamp	15km				
Kerosene lamp and candles	15km				
Kerosene lamp	10km			YES	
Kerosene lamp	15km				
Kerosene lamp	15km				
candles or kerosene lamp	about 8km		I go out to purchase LPG	YES	
kerosene lamp	10km		I go out to purchase LPG	YES	
Kerosene lamp	15km		I go out to purchase LPG	YES	
Kerosene lamp	5km		I go out to purchase LPG	YES	
Candles and kerosene lamp	10km		I go out to purchase LPG	YES	
candles	10km		I go out to purchase LPG	YES	
kerosene Lantern	15km				
kerosene	5km				
kerosene lantern	10km				
Kerosene Lantern	10km				

Do you have an LPG cylinder?		How many LPG cylinder(s) do you have?	When was your last cylinder(s) re-filled?	Would you be willing to pay for LPG if supply is regular?		Can you say LPG supply is regular?	
YES	NO	Open-Ended Response	Open-Ended Response	YES	NO	YES	NO
	NO			YES			NO
	NO			YES			NO
	NO			YES			NO
	NO			YES			NO
	NO				NO		
	NO			YES			NO
	NO			YES			NO
	NO			YES			NO
	NO			YES			NO
	NO			YES			NO
	NO				NO		
	NO			YES			NO
	NO			YES			NO
	NO			YES			
	NO						
	NO			YES			
	NO			YES			NO
				YES			
	NO			YES			NO
					NO		
YES			1 a monthago	YES			NO
	NO				NO		
	NO				NO		
YES			1 2 weeks ago	YES			NO
YES			1 3 days ago	YES			NO
YES			1 3weeks ago	YES			NO
	NO				NO		
YES			1 3 weeks ago	YES			NO
	NO		1 4 days ago	YES			NO
YES			1 1 week ago				NO
YES			1 2 weeks ago	YES			NO
	NO			YES			
				YES			NO
					NO		NO
	NO			YES			NO
	NO			YES			
	NO						
	NO			YES			
YES			1 1 week ago	YES			NO
YES			2 4 weeks ago				NO
YES			1 5days ago	YES			NO
YES			1 1 weeks ago	YES			NO
YES			2 1 week ago	YES			NO
YES			2 2weeks ago	YES		YES	
	NO						
	NO						
	NO		0				
	NO						

How far is your nearest kerosene retail store in Km? Open-Ended Response	Tick as appropriate Kerosene is delivered to me in my house	I go out to purchase kerosene	How many litres of kerosene do you buy at a time (in litres)? Open-Ended Response
	Kerosene is delivered to me in my house		4litres
5km	Kerosene is delivered to me in my house		4litres
5km		I go out to purchase kerosene	20litres
5km		I go out to purchase kerosene	4litres
10km		I go out to purchase kerosene	4litres
5km		I go out to purchase kerosene	4litres
5km	Kerosene is delivered to me in my house		4litres
10km	Kerosene is delivered to me in my house		4litres
		I go out to purchase kerosene	10litres
5km		I go out to purchase kerosene	4litres
5km	Kerosene is delivered to me in my house		4litres
10km	Kerosene is delivered to me in my house		4litres
5km	Kerosene is delivered to me in my house		4litres
10km		I go out to purchase kerosene	10 litres
		I go out to purchase kerosene	10litres
5km		I go out to purchase kerosene	4litres
5km	Kerosene is delivered to me in my house		4litres
5km		I go out to purchase kerosene	4litres
5km	Kerosene is delivered to me in my house		4litres
5km	Kerosene is delivered to me in my house		4litres
10km	Kerosene is delivered to me in my house		25litres
			4litres
10km		I go out to purchase kerosene	10litres
5km	Kerosene is delivered to me in my house		4 litres
5km	Kerosene is delivered to me in my house		4 litres
10km	Kerosene is delivered to me in my house		
10km	Kerosene is delivered to me in my house		4litres
10km	Kerosene is delivered to me in my house		4litres
10km	Kerosene is delivered to me in my house		4litres
5km	Kerosene is delivered to me in my house		4litres
10km	Kerosene is delivered to me in my house		4litres
10km	Kerosene is delivered to me in my house		4litres
10km	Kerosene is delivered to me in my house		4litres
5km	Kerosene is delivered to me in my house		4litres
10km	Kerosene is delivered to me in my house		4litres
10km		I go out to purchase kerosene	10litres
10km	Kerosene is delivered to me in my house		25litres
10km	Kerosene is delivered to me in my house		20litres
5km	Kerosene is delivered to me in my house		4litres
5km	Kerosene is delivered to me in my house		10litres
5km	Kerosene is delivered to me in my house		4litres
5km		I go out to purchase kerosene	12litres
5km	Kerosene is delivered to me in my house		12litres
5km		I go out to purchase kerosene	10litres
5km		I go out to purchase kerosene	10litres
10km	Kerosene is delivered to me in my house		8litres
10km		I go out to purchase kerosene	4litres
10km	Kerosene is delivered to me in my house		4litres
5km	Kerosene is delivered to me in my house		4litres
10km	Kerosene is delivered to me in my house		4litres
10km			4 litres

Do you gather firewood for your own use?		Can you buy firewood in your area?		How far is your nearest firewood retail store in Km?	Tick as appropriate	
YES	NO	YES	NO	Open-Ended Response	Firewood is delivered to me in my house	I go out to purchase firewood
	NO	YES		2km		I go out to purchase firewood
	NO	YES		3km		I go out to purchase firewood
	NO	YES		3km		I go out to purchase firewood
	NO	YES		5km		I go out to purchase firewood
YES		YES		5km		I go out to purchase firewood
	NO	YES		3km		I go out to purchase firewood
	NO	YES		3km		I go out to purchase firewood
	NO	YES		3km		I go out to purchase firewood
	NO	YES		4km		I go out to purchase firewood
	NO	YES		3km		I go out to purchase firewood
	NO	YES		3km		I go out to purchase firewood
	NO	YES		3km	Firewood is delivered to me in my house	
	NO	YES		5km		I go out to purchase firewood
YES		YES		5km		I go out to purchase firewood
YES		YES		2km	Firewood is delivered to me in my house	
YES		YES		3km		I go out to purchase firewood
	NO	YES		3km		I go out to purchase firewood
YES		YES				I go out to purchase firewood
YES		YES		3km		I go out to purchase firewood
	NO	YES				
	NO	YES		2km		I go out to purchase firewood
YES		YES		3km		I go out to purchase firewood
YES		YES		2km		I go out to purchase firewood
	NO					
YES		YES		3km		I go out to purchase firewood
YES		YES		3km		I go out to purchase firewood
	NO					
YES		YES		3km		I go out to purchase firewood
	NO	YES		3km		I go out to purchase firewood
	NO	YES		4km		
YES		YES		4km		I go out to purchase firewood
	NO	YES		4km		I go out to purchase firewood
	NO	YES		3km		I go out to purchase firewood
YES		YES		2km		I go out to purchase firewood
YES		YES		3km		I go out to purchase firewood
	NO	YES		3km	Firewood is delivered to me in my house	
	NO					
	NO	YES		5km		
	NO		NO			
	NO	YES		3km		I go out to purchase firewood
	NO	YES		3km		I go out to purchase firewood
	NO	YES		5km		I go out to purchase firewood
	NO	YES		5km		I go out to purchase firewood

Can you buy charcoal in your area?		How far is your nearest charcoal retail store in Km?	Tick as appropriate	
YES	NO	Open-Ended Response	Charcoal is delivered to me in my house	I go out to purchase charcoal
YES		8km		
YES		2km		
YES		5km		
YES		5km		
	NO			
	NO			
	NO			
	NO			
	NO			
	NO			

Please fill in the amount of energy consumed per month below						Please fill in the total cost of energy consumed per month below (in Naira)		
Electricity (Kw/h)	LPG (Kg)	Kerosene (Litre)	Firewood (Kg)	Charcoal (Kg)	Others	Electricity	LPG	Kerosene
30kw/h		20litres	1000kg			₦500		₦1700
30kw/h		20litres	1000kg			₦500		₦1700
30kw/h		20litres	1000kg			₦500		₦1700
45kw/h		20litres	1000kg			₦750		₦1700
30kw/h		10litres	2000kg			₦500		₦800
30kw/h		20litres	1500kg			₦500		₦1700
30kw/h		25litres	700kg			₦500		₦2200
30kw/h		20litres	1000kg			₦500		₦1700
30kw/h		25litres	700kg			₦500		₦2000
30kw/h		20litres	1000kg			₦500		₦1500
30kw/h		12litres	1000kg			₦500		₦900
30kw/h		15litres	1000kg			₦500		₦1200
30kw/h		20litres	1000kg			₦500		₦1700
30kw/h		20litres	1500kg			₦500		₦1700
30kw/h		15litres	2000kg			₦500		₦1300
		10litres	2000kg					₦670
30kw/h		20litres	700kg			₦500		₦1500
30kw/h		12litres	2000kg			₦500		₦900
30kw/h		20litres	1500kg			₦500		₦2000
30kw/h		20litres	1000kg			₦500		₦2000
30kw/h		25litres	1000kg			₦500		₦2500
30kw/h		25litres	1000kg			₦500		₦2200
45kw/h		30litres				₦750		₦2500
		4litres	2000kg					₦400
60kw/h	12kg	25litres				₦1000	₦2400	₦2200
30kw/h		10litres	1500kg			₦500		₦670
	3	12litres	1500kg			₦1000		₦900
45kw/h	12kg	20litres				₦750	₦2400	₦2000
45kw/h	12.5kg	20litres				₦750	₦2400	₦2000
45kw/h	12.5kg	20litres				₦750	₦2400	₦2000
30kw/h		12litres	1500kg			₦500		₦900
45kw/h	12kg	20litres				₦750	₦2400	₦2000
45kw/h	12.5kg	20litres				₦750	₦2400	₦2000
45kw/h	12kg	20litres				₦750	₦2200	₦2000
45kw/h	12kg	20litres				₦750	₦2200	₦2000
45kw/h		30litres				₦750		₦2500
30kw/h		20litres	1000kg			₦500		₦2000
30kw/h		30litres				₦500		₦2500
30kw/h		25litres	1000kg			₦500		₦2000
45kw/h		20litres	1000kg			₦750		₦1500
30kw/h		25litres	1000kg			₦500		₦1200
30kw/h		10litres	2000kg			₦500		₦800
30kw/h		12litres	1500kg			₦500		₦900
60kw/h	25kg	12litres				₦1000	₦5000	₦900
45kw/h	25kg	12litres				₦750	₦5000	₦1200
45kw/h	25kg	10litres				₦750	₦5000	₦800
60kw/h	25kg	10litres				₦1000	₦5000	₦800
45kw/h	25kg	8litres				₦750	₦6000	₦800
60kw/h	25kg	8litres				₦1000	₦5000	₦600
30kw/h		25litres	500kg			₦500		₦1200
30kw/h		4litres	500kg			₦500		₦1200
45kw/h		25litres	700kg			₦750		₦1200
	45	20litres	700kg			₦750	₦	₦1200

Firewood	Charcoal	Others	Total	When did you buy your LPG stove? Open-Ended Response	How much did you pay for the stove if it was brand new in Naira? Open-Ended Response	How much did you pay for the stove if it was an after used in Naira? Open-Ended Response
₦700			₦2900			
₦700			₦2900			
₦700			₦2900			
₦700			₦3150			
₦1700			₦3000			
₦1200			₦3400			
₦400			₦3200			
₦700			₦2900			
₦400			₦2900			
₦670			₦2670			
₦700			₦2100			
₦700			₦2400			
₦700			₦2900			
₦1500			₦3700			
₦1500			₦2300			
₦1500			₦2170			
₦500			₦2500			
₦1500			₦2900			
₦1000			₦3500			
₦700			₦3200			
₦700			₦3200			
₦800			₦2500			
			₦3250			
₦1700			₦2100			
			₦5600	2 years ago	₦27000	
₦1000			₦2170			
₦1000			₦2900			
			₦5150	3 years ago	₦25000	
			₦5150	3 years ago	₦24000	
			₦5150	2 years ago		₦8000
₦1200			₦2400			
			₦5150	5 years ago	₦20000	
			₦5150	3 years ago		₦10,000
			₦4950	2 years ago		₦7000
			₦4950	4 years ago		₦10000
			₦3250			
₦700			₦2200			
			₦3000			
₦700			₦3200			
₦700			₦2950			
₦500			₦2200			
₦1200			₦2500			
₦1000			₦2400			
			₦6900	2 years ago	₦30000	
			₦6950	5 years ago	₦20000	
			₦6550	4 years ago	₦26500	
			₦6800	4 years ago	₦27,000	
			₦7550	3 years ago	₦30000	
			₦6600	2 years ago	₦35000	
₦300			₦2000			
₦300			₦2000			
₦500			₦2450			
₦500	₦	₦	₦2450			

Do you have other appliances that run on LPG e.g lights (please specify)? Open-Ended Response	Are you willing to use LPG if it was always available? YES	NO	Are you willing to use LPG if it was more affordable? YES	NO
	YES		YES	
	YES		YES	
	YES		YES	
			YES	
		NO		NO
	YES		YES	
	YES		YES	
	YES		YES	
	YES		YES	
	YES		YES	
		NO		NO
	YES		YES	
	YES		YES	
	YES		YES	
	YES		YES	
	YES		YES	
	YES		YES	
		NO		NO
	YES		YES	
		NO		NO
	YES		YES	
	YES		YES	
	YES		YES	
		NO		NO
no				
		NO		NO
no		NO		NO
no				
no				
no	YES		YES	
		NO		NO
no	YES			
no				
no	YES		YES	
no	YES		YES	
	YES		YES	
	YES		YES	
	YES		YES	
		NO		NO
	YES		YES	
		NO		NO
no	YES		YES	
	YES		YES	
no	YES		YES	
yes				
no	YES		YES	
no	YES		YES	
no	YES		YES	
no	YES		YES	
no		NO		NO
no	YES		YES	
no	YES		YES	
no	YES		YES	

If LPG cylinders and fill were smaller, would you be willing to use LPG?		If LPG stoves and cylinders were more affordable, would you be willing to use LPG?	
YES	NO	YES	NO
YES		YES	
YES		YES	
YES		YES	
	NO		NO
YES		YES	
YES		YES	
YES		YES	
YES		YES	
YES		YES	
	NO		NO
YES		YES	
YES		YES	
YES		YES	
YES		YES	
YES		YES	
YES		YES	
	NO		NO
YES		YES	
	NO		NO
YES		YES	
YES		YES	
YES		YES	
	NO		NO
	NO		NO
	NO		NO
YES			
	NO		NO
YES		YES	
YES		YES	
YES		YES	
YES		YES	
	NO		NO
YES		YES	
YES			NO
YES		YES	
YES		YES	
YES			
	NO	YES	
	NO		NO
YES		YES	
YES		YES	
YES		YES	

Are you ready to take soft loans or credit for the purchase of LPG equipments?		Bearing in mind that small cylinder requires frequent re-fill but less cash purchase; tick below the size of cylinder you would prefer.	
YES	NO	3kg	6kg
YES		3kg	6kg
YES		3kg	6kg
YES		3kg	6kg
YES		3kg	6kg
	NO		
YES		3kg	6kg
YES		3kg	6kg
YES		3kg	6kg
YES		3kg	6kg
YES		3kg	6kg
	NO		
YES		3kg	6kg
YES		3kg	6kg
YES		3kg	6kg
YES		3kg	6kg
YES		3kg	6kg
YES		3kg	6kg
	NO		
YES		3kg	6kg
	NO		
YES		3kg	6kg
YES		3kg	6kg
YES		3kg	6kg
	NO		
	NO		
	NO		
			6kg
YES			6kg
YES			
			6kg
YES			6kg
YES			6kg
			6kg
YES			6kg
YES			6kg
YES			6kg
YES			
YES			6kg
	NO		
YES		3kg	
YES			6kg
YES			
	NO		
	NO		
YES			
	NO		
YES			6kg
YES			6kg
YES			6kg

12.5kg	25kg	50kg	How much cash would you be willing to spend monthly for LPG purchase (in Naira)? Open-Ended Response	Do you have access to low-cost credit? YES	NO	Is there a low-cost credit organisation in your area? YES	NO
			₦900		NO		NO
			₦1000		NO		NO
			₦1000		NO		NO
			₦900		NO		NO
					NO		NO
			₦800		NO		NO
			₦800		NO		NO
			₦900		NO		NO
			₦800		NO		NO
			₦700		NO		NO
					NO		NO
			₦700		NO		NO
			₦600		NO		NO
				700	NO		NO
					NO		NO
			₦600		NO		NO
			₦600		NO		NO
					NO		NO
			₦500		NO		NO
					NO		NO
			₦600		NO		NO
			₦600		NO		NO
			₦500		NO		NO
					NO		NO
			₦1000		NO		NO
					NO		NO
					NO		NO
			₦750		NO		NO
12.5kg			₦900		NO		NO
			₦700		NO		NO
					NO		NO
			₦900		NO		NO
			₦800		NO		NO
			₦700		NO		NO
			₦1000		NO		NO
			₦800		NO		NO
			₦700		NO		NO
			₦1000		NO		NO
					NO		NO
			₦1000		NO		NO
					NO		NO
			₦500		NO		NO
			₦500		NO		NO
12.5kg			₦8000		NO		NO
12.5kg							NO
12.5kg			₦800		NO		NO
12.5kg			₦800		NO		NO
12.5kg			₦1,000		NO		NO
12.5kg			₦2000		NO		NO
					NO		NO
			₦600		NO		NO
			₦700		NO		NO
					NO		NO

If yes, is credit available for LPG cooker and cylinder purchase?

YES NO

Annexure 3

LPG survey for Distributors and Retailers4

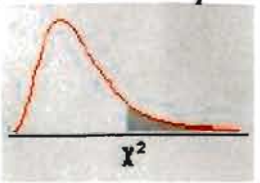
Please indicate by ticking either Agree/Disagree on how the following underlisted factors affects the marketing and distribution of LPG in your area:

	Agree	Disagree	Rating Average	Response Count
1.Upfront cost of LPG is not a hindrance to LPG usage.	32.5% (13)	**67.5% (27)**	1.68	40
2.Ineffective supply and distribution system does not affect the marketing of LPG in Nigeria.	32.5% (13)	**67.5% (27)**	1.68	40
3.The fear of LPG as an unsafe fuel for cooking does not affect the marketing of LPG in Nigeria.	42.5% (17)	**57.5% (23)**	1.58	40
4.Little or no awareness/enlightenment creation on the use of LPG is not a hindrance to its utilization in Nigeria.	30.0% (12)	**70.0% (28)**	1.70	40
5.Instability in the price of LPG is not a hindrance to its usage in Nigeria.	35.0% (14)	**65.0% (26)**	1.65	40
6.Unavailability of smaller and lighter cylinders (2-3kg) mainly for lower income household does not affect the marketing of LPG in Nigeria.	25.0% (10)	**75.0% (30)**	1.75	40
7.Lower cost of other cooking fuels (biomass based fuel/wood) does not affect the marketing of LPG in Nigeria.	7.7% (3)	**92.3% (36)**	1.92	39

8.Supply and distribution of LPG in Nigeria is highly efficient.	12.5% (5)	**87.5% (35)**	1.88	40
9.Lack of credit purchase for customers does not inhibits the use of LPG in Nigeria.	27.5% (11)	**72.5% (29)**	1.73	40
10.Lack of soft loans and grants for LPG accessories (cylinders and stoves) is not an obstacle to LPG usage in Nigeria	25.0% (10)	**75.0% (30)**	1.75	40
			answered question	**40**
			skipped question	**0**

Annexure 4

Right tail areas for the *Chi-square* Distribution



df\area	.995	.990	.975	.950	.900	.750	.500	.250	.100	.050	.025	.010	.005
1	0.00004	0.00016	0.00098	0.00393	0.01579	0.10153	0.45494	1.32330	2.70554	3.84146	**5.02389**	6.63490	7.87944
2	0.01003	0.02010	0.05064	0.10259	0.21072	0.57536	1.38629	2.77259	4.60517	5.99146	7.37776	9.21034	10.59663
3	0.07172	0.11483	0.21580	0.35185	0.58437	1.21253	2.36597	4.10834	6.25139	7.81473	9.34840	11.34487	12.83816
4	0.20699	0.29711	0.48442	0.71072	1.06362	1.92256	3.35669	5.38527	7.77944	9.48773	11.14329	13.27670	14.86026
5	0.41174	0.55430	0.83121	1.14548	1.61031	2.67460	4.35146	6.62568	9.23636	11.07050	12.83250	15.08627	16.74960
6	0.67573	0.87209	1.23734	1.63538	2.20413	3.45460	5.34812	7.84080	10.64464	12.59159	14.44938	16.81189	18.54758
7	0.98926	1.23904	1.68987	2.16735	2.83311	4.25485	6.34581	9.03715	12.01704	14.06714	16.01276	18.47531	20.27774
8	1.34441	1.64650	2.17973	2.73264	3.48954	5.07064	7.34412	10.21885	13.36157	15.50731	17.53455	20.09024	21.95495
9	1.73493	2.08790	2.70039	3.32511	4.16816	5.89883	8.34283	11.38875	14.68366	16.91898	19.02277	21.66599	23.58935
10	2.15586	2.55821	3.24697	3.94030	4.86518	6.73720	9.34182	12.54886	15.98718	18.30704	20.48318	23.20925	25.18818
11	2.60322	3.05348	3.81575	4.57481	5.57778	7.58414	10.34100	13.70069	17.27501	19.67514	21.92005	24.72497	26.75685
12	3.07382	3.57057	4.40379	5.22603	6.30380	8.43842	11.34032	14.84540	18.54935	21.02607	23.33666	26.21697	28.29952
13	3.56503	4.10692	5.00875	5.89186	7.04150	9.29907	12.33976	15.98391	19.81193	22.36203	24.73560	27.68825	29.81947
14	4.07467	4.66043	5.62873	6.57063	7.78953	10.16531	13.33927	17.11693	21.06414	23.68479	26.11895	29.14124	31.31935

15	4.60092	5.22935	6.26214	7.26094	8.54676	11.03654	14.33886	18.24509	22.30713	24.99579	27.48839	30.57791	32.80132
16	5.14221	5.81221	6.90766	7.96165	9.31224	11.91222	15.33850	19.36886	23.54183	26.29623	28.84535	31.99993	34.26719
17	5.69722	6.40776	7.56419	8.67176	10.08519	12.79193	16.33818	20.48868	24.76904	27.58711	30.19101	33.40866	35.71847
18	6.26480	7.01491	8.23075	9.39046	10.86494	13.67529	17.33790	21.60489	25.98942	28.86930	31.52638	34.80531	37.15645
19	6.84397	7.63273	8.90652	10.11701	11.65091	14.56200	18.33765	22.71781	27.20357	30.14353	32.85233	36.19087	38.58226
20	7.43384	8.26040	9.59078	10.85081	12.44261	15.45177	19.33743	23.82769	28.41198	31.41043	34.16961	37.56623	39.99685
21	8.03365	8.89720	10.28290	11.59131	13.23960	16.34438	20.33723	24.93478	29.61509	32.67057	35.47888	38.93217	41.40106
22	8.64272	9.54249	10.98232	12.33801	14.04149	17.23962	21.33704	26.03927	30.81328	33.92444	36.78071	40.28936	42.79565
23	9.26042	10.19572	11.68855	13.09051	14.84796	18.13730	22.33688	27.14134	32.00690	35.17246	38.07563	41.63840	44.18128
24	9.88623	10.85636	12.40115	13.84843	15.65868	19.03725	23.33673	28.24115	33.19624	36.41503	39.36408	42.97982	45.55851
25	10.51965	11.52398	13.11972	14.61141	16.47341	19.93934	24.33659	29.33885	34.38159	37.65248	40.64647	44.31410	46.92789
26	11.16024	12.19815	13.84390	15.37916	17.29188	20.84343	25.33646	30.43457	35.56317	38.88514	41.92317	45.64168	48.28988
27	11.80759	12.87850	14.57338	16.15140	18.11390	21.74940	26.33634	31.52841	36.74122	40.11327	43.19451	46.96294	49.64492
28	12.46134	13.56471	15.30786	16.92788	18.93924	22.65716	27.33623	32.62049	37.91592	41.33714	44.46079	48.27824	50.99338
29	13.12115	14.25645	16.04707	17.70837	19.76774	23.56659	28.33613	33.71091	39.08747	42.55697	45.72229	49.58788	52.33562
30	13.78672	14.95346	16.79077	18.49266	20.59923	24.47761	29.33603	34.79974	40.25602	43.77297	46.97924	50.89218	53.67196