ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF MANAGEMENT

EXECUTIVE MBA PROGRAM

Examining the challenges towards utilization of Liquefied Petroleum Gas (LPG) in Ethiopia

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SIGNED DECLARATION

I, the undersigned declare that this Research Project is my original work. Furthermore, all sources of materials used for the thesis had been duly acknowledged.

Name: _____

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Place: Addis Ababa University

CERTIFICATION

This is to certify that Alexander Teka Bizuneh has done a study on the topic "Examining the challenges towards utilization of Liquefied Petroleum Gas (LPG) in Ethiopia". This study is his original work and all the sources of materials used for the thesis had been duly acknowledged.

Advisor's Name: Asres Abitie (PhD)

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Place: Addis Ababa University

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Abstract

The usage of traditional fuels is severely affecting the health of people and also the environment as a result of pollution and deforestation. Liquefied Petroleum Gas (LPG) is a clean, environmental friendly, efficient and portable energy option which can be a savior to the health and environmental problems. This requires shifting from the use of traditional fuels to LPG. However, the utilization of this noble fuel is very low in Ethiopia. The purpose of this study is to examine the factors which make the utilization of LPG very low and propose solutions to make the supply reliable, the product more affordable and also make fast transition from traditional fuels to LPG. Literature review is made to identify the factors which need to be considered. The study adopted mixed type research methodology. Hence, both qualitative methods of data collection and analysis as well as quantitative analysis using questionnaire are used. The information from primary and secondary sources is then used to conduct the assessment. Data was gathered thorough questionnaire and interview from all target population which are supervisors of all retail stations and distributors of companies distributing LPG in Addis Ababa, Ethiopia. Raw data were analyzed with the help of both descriptive and inferential statistics. Descriptive charts and percentages as well as inferential tools such as correlation and regression analysis are utilized in the study. The major factors which the study identified as influencing the utilization of LPG in Ethiopia are regulatory & policy gaps, infrastructure, capability of distributors, awareness and ICT & Collaboration. Thus, the study recommended that the Government needs to work on developing clear Policies and regulations on LPG business and operations, create awareness and promote LPG to benefit from the industry. The government should also consider subsidizing the product especially to the lower class society and encourage investment in the sector by setting clear policies & regulations, availing the required foreign currency, tax exemption on importation of LPG gadgets and accessories such as stove, cylinder, regulator, hose, etc. Improving the overall infrastructure in order to achieve better supply and affordability of the LPG sector is also important. It is also recommended that LPG companies should consider using latest ICT and other technologies as well as collaborate on LPG related issues for better results. Moreover, the ultimate goal that requires the government's utmost attention, which is a strategy on scaling up (Large scale transition) to switch from traditional fuels to LPG within a certain period is recommended.

Key words: Ethiopia, LPG, utilization, policy, transition

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List of Abbreviations/Acronyms

ARI	Acute Respiratory Infection
CO_2	Carbon dioxide
EEU	Ethiopian Electric Utility
EPSE	Ethiopian Petroleum Supply Enterprise
HAP	Household Air Pollution
IAP	Indoor Air Pollution
IEA	International Energy Agency
LMICs	Low and Middle Income Countries
LPG	Liquefied Petroleum Gas
MoMPNG	Ministry of Mines, Petroleum and Natural Gas
MoT	Ministry of Trade
NCDs	Non Communicable Diseases
NGL	Natural Gas Liquids
NOC	National Oil Company of Ethiopia P.L.C.
OPEC	Organization of Petroleum Exporting Companies
SE4All	Sustainable Energy for All
HSE	Health, Safety & Environment
SPSS	Statistical Package for Social Sciences
UN	United Nations
WLPGA	World LPG Association
WHO	World Health Organization

Chapter One: Introduction

This research paper examines the challenges which limit utilization of LPG in Ethiopia. LPG is a clean fuel which can benefit the wider society's health risks related with the use of traditional fuels (wood, charcoal, etc.), and also in terms of environmental protection due to its low emission levels and its contribution to reduction of deforestation. There are eight Sub sections discussed in this chapter: Background of the study, statement of the problem, motivation of the study, research questions, objectives of the study, Scope of the research, limitations of the research, and significance of the research.

1.1. Background of the study

Crude oil is the unrefined state of oil. It is produced from a reservoir and mainly consists of hydrogen and carbon. It can be refined to get many products which can be used for different purposes. Some of the end products that can be processed from the crude oil are: diesel, gasoline, bitumen, lubricating oil, liquefied petroleum gas, and many others (Broni-bediako & Dankwa, 2013).

LPG (Liquefied Petroleum Gas) is a portable, clean and efficient energy source. It is readily available to consumers around the world. LPG is primarily obtained from natural gas as well as oil production. Its unique properties make it a versatile energy source that can be used in many different applications (WLPGA, n.d.).

LPG is a mixture of butane (C4H10) and propane (C3H8). It can be stored or transported separately or as a mixture. Butane and propane exist as gases at normal room temperature and atmospheric pressure. When subjected to moderate pressures at ambient temperature, or sub-zero temperatures at ambient pressure, they become liquids (Matthews, 2011).

LPG is a clean burning, efficient, portable & versatile fuel. It is produced as a by-product of natural gas extraction and crude oil refining. It can be up to 5 times more efficient (high calorific value) than traditional fuels. It produces less air pollutants than kerosene, wood or coal, emits about

20% less CO2 than heating oil and 50% less than coal. It also reduces black carbon emissions (Cecelski & Matinga, 2014).

LPG is one of the most common and alternative fuels used in the world. It is increasingly gaining popularity as a preferred fuel for commercial, industrial, and domestic purposes. This could be credited to its reliability, portability, and efficiency. It also burns clean without producing smoke and with low pollutant emissions. These inherently clean properties are especially important to reduce indoor air pollution. Therefore, LPG is a major contributor to the better health and sanitation of people as compared to traditional wood fuel such as fire wood and charcoal (Broni-bediako & Dankwa, 2013).

According to Cecelski & Matinga (2014), worldwide, almost 3 billion people depend on solid fuels, traditional stoves, or cooking and heating on open fires. Those people are exposed to high levels of health damaging pollutants. These include small particulate matter and carbon monoxide. According to the WHO, household air pollution is responsible for 7.7% of global mortality (4.3 million deaths). This is mostly in Asia and Sub-Saharan Africa. In 2010, household air pollution from solid fuels was the third leading risk factor for global disease burden next to high blood pressure, tobacco smoking including second hand smoke, and contributed to 4.3% of the global disease burden.

Acute lower respiratory infections in children under five, and ischemic heart disease, stroke, chronic obstructive pulmonary disease and lung cancer in adults are some of the health problems linked to household air pollution from use of solid fuels. Household solid fuels smoke is a risk factor for low birth weight, perinatal mortality, asthma, cataracts, tuberculosis, asthma, and adverse pregnancy outcomes, as well as cardiovascular disease. Women and children in developing countries are the most exposed to solid fuels smoke while men bear a larger burden of disease than women due because of larger underlying disease rates among men. As such men, women and children will all benefit from decreasing household air pollution (Cecelski & Matinga, 2014).

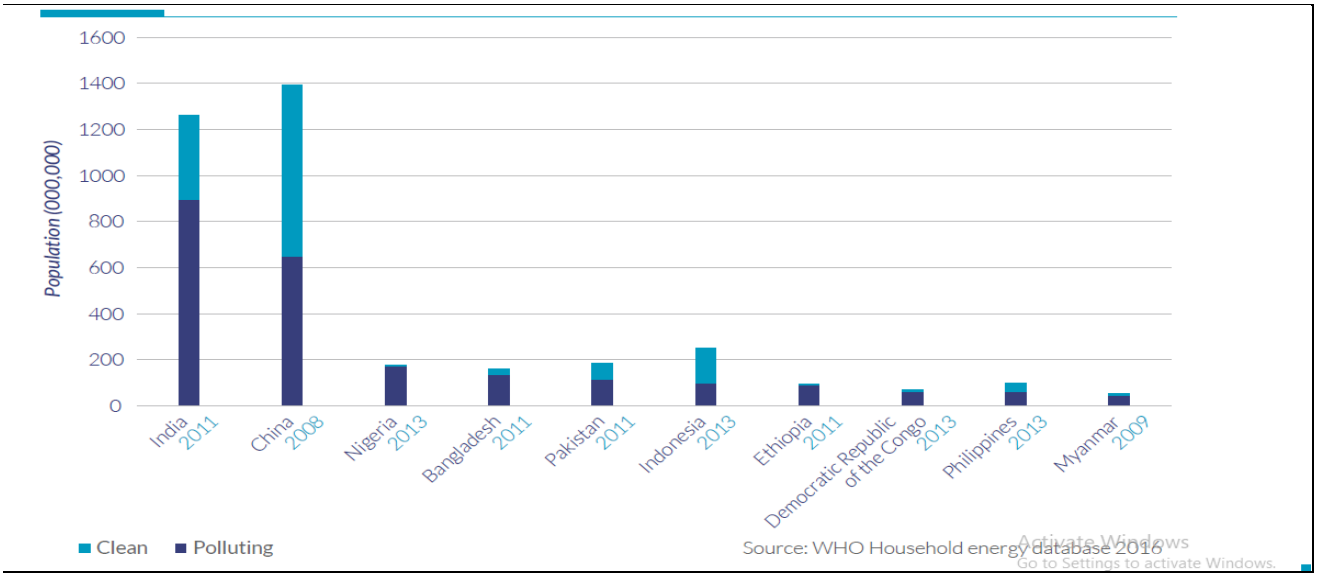
On virtually all indicators of health impacts, LPG offers a far better advantage than traditional biomass fuels. These include indoor air pollution and fuel collection health impacts. Also, it significantly reduces indoor air pollution (IAP). A research conducted on exposure response with respect to child pneumonia reveals that compared to fan stoves, simple improved stoves chimney,

and open fires, LPG is the only fuel whose emissions are below the critical level, which is 10µg per m3. Hence, the research indicates that LPG is the most likely to yield health benefits. Biomass burning, in contrast to LPG, typically releases 19 times more emissions per meal (Cecelski & Matinga, 2014).

A research which was conducted in West Bengal, India identified that LPG users had consistently better health outcomes than biomass users. The same research states that exclusive and consistent use of LPG can be difficult - the reason being low incomes, unreliable supply of LPG, cultural preferences and safety fears related to LPG use. Nonetheless, any considerable investment on clean fuels and clean stoves (such as LPG) would repay itself many times over in reductions in ill health and economic benefits according to WHO. More than 95% of these benefits are accounted for time gains from reduced illness, fewer deaths, less fuel collection and shorter cooking times. There is a considerable amount of physical burden and drudgery in collecting, transporting and processing biomass, which leads to health impacts and accidents. Women firewood collectors suffer from various issues such as headaches, back aches, neck aches, bruises and animal attacks. Prolapsed uterus and degeneration of the cervical spines have also been reported (Cecelski & Matinga, 2014).

A research conducted in Gondar, Ethiopia identified that eighty percent of rural women cooked indoors using biomass fuel without ventilation. Compared to other groups, rural women reported two to three times more respiratory disease in their children and in themselves. Even though they are aware of the negative effect of smoke on their own health, only 20% of participants realized it caused problems in children. Also, 13% thought it was a cause for concern. The participants, once aware of adverse effects, were willing to change cooking practices. But they were unable to afford cleaner fuels (Edelstein et al., 2008).

As can be seen on figure 1.1 below, a very high proportion of the population rely on polluting fuels in Ethiopia.



Source: WHO (2016)

Figure 1.1 - Top 10 populations using polluting fuels as primary energy source for cooking, based on most recently available national survey data.

In developing countries, affordability and availability have historically been the main obstacles to wider use of LPG. Predominant usage is concentrated to the upper half of the income groups in low and lower middle income countries, especially in urban and suburban households. LPG, however, is increasingly penetrating to lower income households in emerging economy countries. Through deliberate policy, governments in Brazil, Indonesia, Thailand, Vietnam, Ghana, Senegal, and Morocco have achieved good results. This was made possible by promoting development of LPG infrastructure, by providing pricing and equipment packages, etc. which make LPG accessible to middle and sometimes even lower income households in urban, suburban and even rural areas. If other obstacles could be reduced, there are still many households of the three billion people without access to clean cooking energy who could afford to switch to LPG (Cecelski & Matinga, 2014).

In Ethiopia, LPG supply was started by four international Oil companies. Those companies, which had a monopolistic right over the Ethiopian oil market for 50 years are Shell, Mobil, Total and Agip. In the last 12 years, however, other local Oil Companies started joining the Market. These include Yetebaberut Petroleum, National Oil Company of Ethiopia (NOC), Dalol Oil, TAF Oil and Gomeju. (WAAS, 2018). There are seven companies in Ethiopia today which are involved in LPG business and which import, store, fill/bottle and distribute LPG. These are: Alied Energy, Iran Merfic, Ghion Gas, Nile Petroleum, NOC, Total Gas and WAS Ethiopia.

This study will try to find the factors affecting the level of utilization of LPG in Ethiopia, identify the gaps and aims at providing the solutions.

1.2. Statement of the Problem

One of the three pillars of the UN Sustainable Energy for All (SE4All) initiative is increasing household use of LPG. It is identified to be one of several pathways in meeting the objective of universal access to clean cooking and heating solutions by 2030. SE4All and the WLPGA announced in October 2013 a goal to transition one billion people from traditional fuels to LPG. A multi stakeholder partnership was formed with the objective of building on best practices and sustainable business models. The intention was to overcome the multitude of policy, market regulation, business environment and local financing bottlenecks which limit the ability of governments and the private sector to meet the need for LPG. (Cecelski & Matinga, 2014).

In order to meet our most basic needs such as cooking, boiling water, lighting and heating, energy is highly essential. Energy is also a prerequisite for good health. This is a reality that has been largely ignored by the world community. Still, wood, dung, coal and other traditional fuels are being burnt in the homes of more than three billion people in the world. This results in indoor air pollution, which is responsible for more than 1.5 million deaths a year. Most of those are young children and their mothers. Every day, millions of people suffer with difficulty in breathing, chronic respiratory disease and stinging eyes. (Eva Rehfuess, 2006).

There are advanced combustion biomass stoves, which show substantial emissions reductions over traditional stoves. However, they cannot yet match emission levels from LPG. Locally manufactured stoves, which are usually cheap, dominate the market in many countries (including China, Ghana, Ethiopia, India, Sri Lanka and Kenya). These stoves are fuel efficient. However, they still have high air pollution emissions. Many past stove programs and even some current programs distribute cook stoves built by local artisans. Data from both laboratory and field settings suggest many of the stoves currently on the market are effectively fuel saving but have limited benefit in terms of emissions (WHO, n.d.).

WHO (2016) state that household air pollution is the single most important environmental health risk factor worldwide. Based on estimates of solid fuel use for cooking in 2012, exposure to HAP causes 4.3 million premature deaths each year. Of those deaths, 3.8 million are caused by non-communicable diseases (NCDs): HAP is estimated to cause 25% of all deaths from stroke, 15% of deaths from ischemic heart disease, 17% of deaths from lung cancer, and more than 33% of all deaths from chronic obstructive pulmonary disease in low- and middle-income countries (LMICs). Exposure to HAP is responsible for close to one quarter of the disease burden from cataract, which is the leading cause of blindness in LMICs.

Traditional biomass fuels, such as wood, dung, charcoal, or crop residues, are used by about 95% of the population of Ethiopia to meet household energy needs. Harmful smoke emitted from the combustion of biomass fuels results in indoor air pollution. This pollution is responsible for more than 50,000 deaths annually. It also causes nearly 5% of the burden of disease in Ethiopia (Sanbata et al., 2014). According to Asfaw (2012), it was possible to identify that households in Addis Ababa, Ethiopia consume more than half a million tons of wood in the form of fuel wood and charcoal. About a hundred thousand tons of animal manure are also consumed.

Using traditional fuels is the cause of indoor air pollution, massive deforestation, soil erosion and waste of energy. LPG can be the answer for the chronic health and environmental problems resulting from the extensive use of traditional fuels. However, shortage of supply and affordability make it difficult to enable the population have access to this clean fuel. The various literature, press releases, and studies for sub - Sahara Africa and Ethiopia indicate the main reasons for this shortage of supply and affordability are poor infrastructure, storage & bottling capability of

distributors, and lack of attention from governments to prioritize LPG & incentivize investment. LPG is needed in households, hospitals, industries, and hotels.

However, according to the Reporter (2018), local LPG markets in Ethiopia are being severely under-supplied and there is shortage of the product almost in every major town.

As per data obtained from the Global Economy.com regarding LPG consumption for 192 countries, the average consumption for Ethiopia during the period between 1980 and 2012 was 0.12 thousand barrels per day. The world average during that period was 37.97 thousand barrels per day. Also, data from Index mundi.com states LPG consumption in Ethiopia in 2019 was 0.2 thousand barrels per day. This data implies that use of LPG in Ethiopia is very low. i.e., Ethiopia is one of the countries with the lowest level of utilization of LPG.

According to Ato Tadesse Tilahun, CEO of National Oil Ethiopia PLC (NOC), "LPG should attract our attention and focus from both environmental aspects and as a business case. From environment aspect, deforestation is destroying the fertility of our land and health of our people. Ethiopia's LPG energy mix is by far the lowest in the world. Its consumption per year is about 15,000 tons while that of neighboring Kenya's consumption per year is over 350,000 tons. This shows that there has not been any effort to promote the importance of this energy to the people. Hence, this is a big business opportunity. It is important to invest in LPG business and promote public awareness to shift to the use of LPG instead of charcoal, which is affecting the health of our people and environment."

Therefore, given the clear evidence on the health and environmental damages posed by burning of traditional fuels, the main purpose of the research is to examine the factors which influence the utilization of LPG. This fuel, being a clean, environmental friendly, efficient and portable energy option, why is the utilization so low regardless of its benefits? The study tries to propose solutions to be used by the government, businesses and investors to develop strategies and make a planned transition from traditional fuels to LPG. It is also a huge business opportunity for investors.

1.3. Motivation of the study

As discussed in the previous sections and the literature review, most households use traditional fuels which pose immediate health risks, and in the long run, environmental problems (emissions, global warming, deforestation, soil erosion). LPG, which is a clean, environmental friendly, efficient and portable energy alternative is readily available. Yet, the utilization of this noble fuel is very low in our country. The researcher is motivated by the need for a cleaner environment, healthier and productive population, and better quality of life. To this regard, the study will try to contribute in identifying the factors which make the utilization of LPG very low and propose solutions to make fast transition from traditional fuels to LPG.

1.4. Research Questions

The below are the basic research questions which the study tries to answer:

- How do policy and regulatory issues influence LPG business?
- What is the effect of logistics infrastructure on supply and affordability of LPG?
- What is the influence of the capability of bulk distributers on supply of LPG?
- What is the awareness level of consumers to switch from traditional fuels to LPG, in relation to health benefits and safety?
- To what extent does ICT and collaboration among distributors affect supply of LPG?

1.5. Objective of the study

1.5.1. General Objective of the study

The main objective of the study is to examine the factors which make utilization of LPG in Ethiopia a challenge, identify the gaps and recommend solutions.

1.5.2. Specific Objectives

Driven by the main objective as well as the statement of the problem, the below are specific objectives of the study:

- To identify the policy and regulatory gaps which affect the supply and affordability of LPG
- To assess how infrastructure and SC affect the level of utilization of LPG
- To examine the influence of the capacity of distributors on LPG supply
- To describe how the level of awareness in relation to the health benefits and safety issues is related to decision to shift from traditional fuels to LPG
- To identify the influence of ICT and collaboration on supply of LPG

1.6. Scope of the Research

The study will examine the challenges which affect utilization of LPG in Ethiopia. To this end, it will identify the main gaps which affect supply and affordability of LPG, while trying to raise the awareness level on the huge benefits of LPG which also helps as a driving force to get more attention towards its utilization. It will also recommend solutions to the gap. The study would have been more comprehensive if it encompasses other cities than Addis Ababa. However, due to limited time, resources and wide geographical area of the country, the study was delimited to retail stations and main distributors in Addis Ababa only.

1.7. Limitations of the Research

One of the limitations in conducting this research is the effect of COVID-19 which made it difficult to collect data within the initially planned period. Time constraint and shortage of resources (published materials, data) especially in Ethiopian context could have an effect on the quality of the paper. In addition, the study (sampling) is limited to Addis Ababa. Even though the main distributors' network is concentrated around Addis Ababa and we can generalize the finding countrywide, the study would have been more comprehensive, had it been possible to cover more cities.

1.8. Significance of the Research

LPG, despite its huge benefits, is highly overlooked in Ethiopia. This study will significantly contribute to identify the challenges which limit utilization of LPG. It will help to improve the policy and regulatory gaps, infrastructural limitations, increase the capability, efficiency, collaboration, and innovativeness of distributors, and will raise the awareness level of the population, authorities, and business people, hence encouraging more investment. This study will contribute highly in drawing more attention towards the sector and hence, will help to improve supply and affordability of this unique fuel. Transition from traditional fuels to the clean LPG is a noble cause for the sake of the population and this research can be a good motivation. All stake holders (oil companies/ distributors, government, industries, hospitals, hotels, households, investors) can gain a lot of information and ideas from this study. It can also serve as a reference for researchers for further studies.

Chapter Two: Literature Review

This chapter discusses the benefits of LPG, why it should be seriously considered as vital energy option, and the challenges related to why there is shortage, drastically limiting its utilization. The factors related with infrastructure, capability, supply chain, regulatory & policy issues, ICT, Collaboration and awareness are described. Conceptual framework used to conduct the study is also included in this chapter. Many literatures, journals, books, reports and data have been reviewed by the researcher in preparing this literature review.

2.1. LPG and the LPG industry

There are three origins of LPG. Approximately 60% is recovered during the extraction of natural gas and oil from the earth. The remaining 40% is produced during the refining of crude oil or made from renewable and waste materials. LPG is thus a naturally occurring by-product. LPG, in the past, was destroyed through venting or flaring (i.e. the burning off of unwanted gas), wasting the full potential of this exceptional energy source (WLPGA, n.d.).

According to OPEC (2013), the refining process of petroleum adds value. Value is added by converting the crude oil, which in itself has little end use value, into a range of refined products including transportation fuels. Maximizing the value added in converting crude oil into finished products is the primary economic objective of refining. The basic refinery operation includes; fractional distillation (separation), process thermal cracking (changing size), catalytic process, treatment, formulation (changing shape) and blending. Refined Petroleum products include: Liquefied petroleum gas (LPG) and compressed natural gas (CNG), motor spirit /petrol (MS) of all grades and naphtha, aviation spirit, solvents of all types, aviation turbine fuel (ATF), light diesel oil (LDO), super kerosene oil (SKO), high speed diesel (HSD), Furnas oil (FO) of all grades, lubricating oils and greases including base oil, wax of all grades and bitumen.

WLPGA (n.d.) describes LPG as: portable, clean and efficient energy source which is readily available to consumers around the world. This energy source is primarily obtained from natural

gas and oil production. It is also produced increasingly from renewable sources. Its unique properties make it a versatile energy source which can be used in many different applications.

The distribution of LPG from production to End users is summarized below (WLPGA, n.d.).

Step one – Production

The production of "field grade LPG" is the result of the treatment of NGLs. This treatment is necessary to produce: a) Oils that are suitable for transport to refineries and b) Natural gases that correspond with commercial specifications (WLPGA, n.d.).

Step two – Transportation

While crude oil is transported from the production sites to refineries by tankers or pipelines, LPG is transported to storage terminals by large LPG carriers, pipelines or train (WLPGA, n.d.).

Step three - Refining and Storage

Propane and butane can result from oil refining processes. LPG storage terminals store products that are imported in large quantities (WLPGA, n.d.).

Step four – Transportation

The LPG is then delivered by train, road, coastal tanker or pipeline to cylinder filling plants and intermediate-size storage areas (WLPGA, n.d.).

Step five - Bottling and Storage

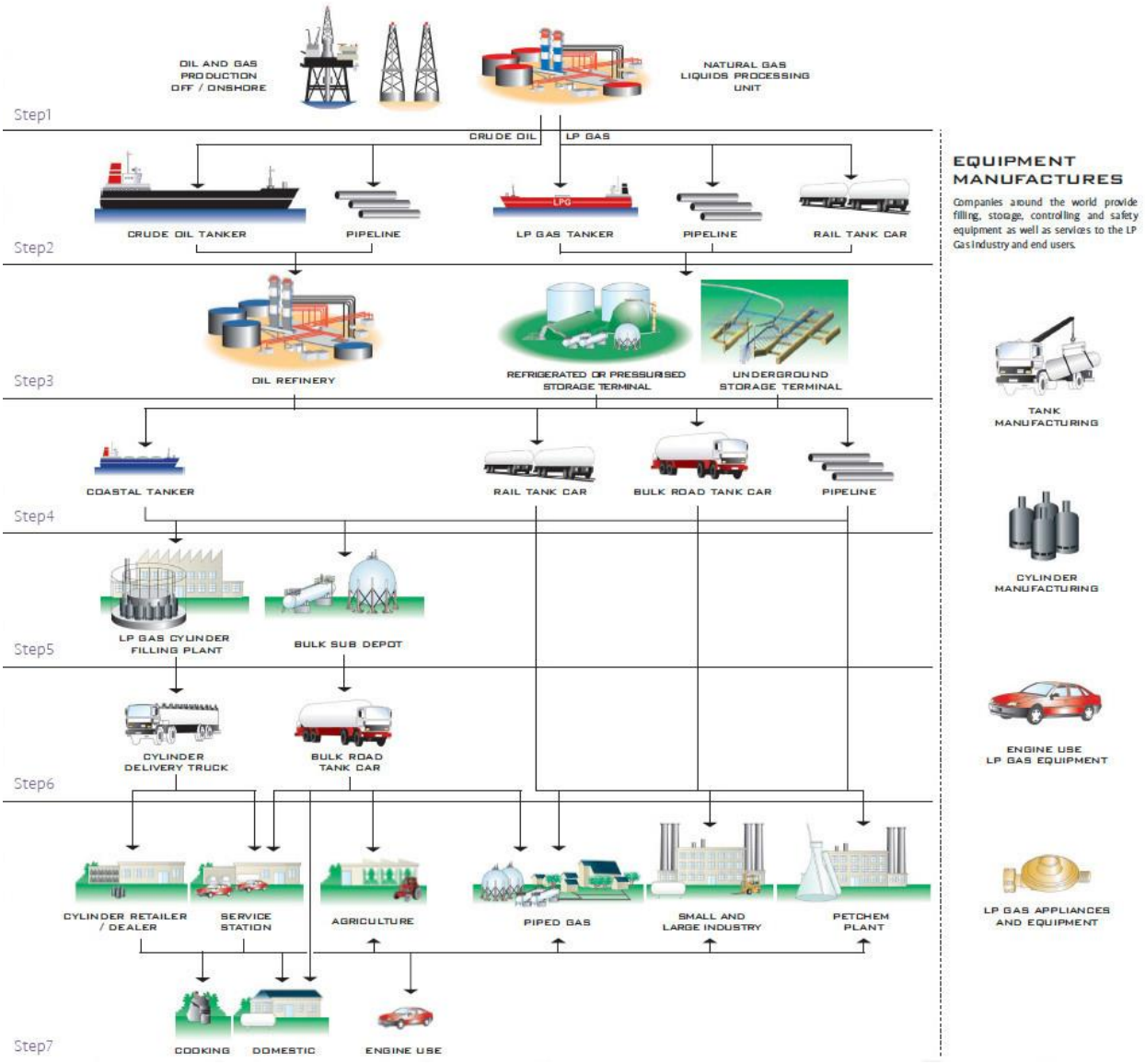
At bottling plants, cylinders are filled with butane and propane. LPG is generally stored in pressurized tanks (spheres or vessels) in intermediary storage centers (WLPGA, n.d.).

Step six – Distribution

Liquefied Petroleum Gas can be transported anywhere, either in cylinders or bulk. Butane and Propane cylinders are transported by trucks from the bottling plant to retailers, as well as to private and professional customers. Small bulk trucks can be used to distribute LPG from the storage centers to various consumers (WLPGA, n.d.).

Step seven - End Users

LPG is easily available to end users. Accessibility is through cylinder sales points such as commercial stores or service stations close to their locations. Customers requiring larger volumes can purchase LPG in bulk (WLPGA, n.d.).



Source: https://www.wlpga.org/about-lpg/what-is-lpg/

Figure 2.1 - LPG distribution steps

According to WLPGA Annual Report (2019), The LPG Industry in 2018 is highlighted below:

Table 2.1 - The LPG Industry in 2018

Production	Increase in Global Growth rate of 3.6%
	Global Production of 317 Million Tones
	Production grew over 10% in both US and Canada
Consumption	9% demand growth in sub-saharan Africa
	Demand in India grew by almost 1 Million Tones
	Vietnam, The Philippines, Srilanka and Nepal all showed 5-10% growth

Source: WLPGA Annual Report (2019)

2.2. LPG – Properties, Benefits, Global Utilization

LPG is an efficient, portable, healthy and environmental friendly energy option. It is a clean burning fuel. It provides smoke free indoor cooking and can also help reduce outdoor and urban air pollution.

As per WLPGA (2016), the benefits of LPG, an exceptional energy are stated as below:

- Portable and accessible
- Efficiently stored as a liquid
- High Energy Value
- Very hot flame
- Clean to store and burn
- Extremely versatile
- Excellent Safety record

“Liquefied Petroleum Gas” is a term used to describe two prominent members of a family of light hydrocarbons called “Natural Gas Liquids” (NGLs). These are propane (C3H8) and butane (C4H10). The term “liquefied gas” may seem a contradiction because all things in nature are either a liquid or a solid or a gas. The unique characteristics of LPG which makes it such a popular and widely used fuel is liquidity. At normal temperature and pressure, LPG is gaseous. But when subjected to modest pressure or cooling, it changes to liquid. When in liquid form, the tank pressure is about twice the pressure in a normal truck tire. This means it is very safe when properly handled. LPG is a derivative of two large energy industries. These are the processing of natural gas liquids and the refining of crude oil. (WLPGA, n.d.).

Propane and Butane are chemically quite similar. However, the difference in their properties means that they are particularly suited to specific uses. Propane’s lower boiling point suits outdoor storage. It is primarily used for central heating, cooking as a transport fuel and various commercial applications. Butane is mainly used in cylinders for portable applications. Examples include: for mobile heaters in the home and for leisure activities such as boats, caravans and barbecues. Often, Propane and Butane will be mixed to get the best energy yields and properties (WLPGA, n.d.).

As explained by Kojima (2011), LPG is a mixture largely of propane and butane. At atmospheric pressure, Propane is a gas above –42 degrees Celsius (C) and butane is a gas above –0.5°C. Propane to butane ration in LPG varies from market to market. LPG, unlike natural gas, settles near the ground if leaked. This nature of settling near the ground increases the chances of explosion. Hence, for safety reasons, LPG is spiked with an odorant to make leak detection easier.

Cecelski & Matinga (2014) state that LPG is a clean-burning, efficient, portable, and versatile fuel, which is produced as a by-product of crude oil refining and natural gas extraction. Therefore, either it is used or wasted. It is consistently among the most efficient heating options and can be up to five times more efficient (high calorific value) than traditional fuels.

According to Sepp (2014), LPG is a colorless and odorless non-toxic gas at room temperature. Under modest pressure or cooler conditions, it transforms into a liquid state and can thus be easily stored and transported in cylinders. LPG cylinder, for safety reasons, is only filled with 80% liquid and the remaining 20% contains gaseous LPG. Propane vapor, one of LPG's gases is more than one and a half times heavier than air and can accumulate above the ground. A foul-smelling odorant (typically ethyl mercaptan) is added to help detect leaks and thus reduce the risk of explosion. The same study reveals that gaseous propane and butane take up about 250 times as much space as in the liquid state. In order to conserve space, LPG is pressurized in metal containers at ambient temperature or refrigerated to transport and store as a liquid. Keeping LPG pressurized or refrigerated as well as the associated metal management add considerably to the supply cost of LPG.

According to WLPGA (n.d.), LPG provides multiple benefits. It provides smoke free indoor cooking (clean burning). It also helps to reduce urban and outdoor air pollution. Utilizing LPG produces less CO2 than petrol, heating oil or coal. LPG emits virtually no black carbon or other particulates. Majority of LPG produced is a co product of oil extraction and natural gas. Thus it is inherently resource efficient. LPG also plays a key role in reducing deforestation as well as desertification. About a billion people as well as businesses across the world count on LPG (because it provides instant, reliable, constant and transportable energy). LPG can be a driver for economic growth, especially in rural areas and developing countries. In cities and rural areas both in developed and developing countries, LPG is a key component of a sustainable energy future.

LPG has its own distinct advantages. It can perform nearly every fuel function of the primary fuels from which it is derived. LPG is a highly versatile energy alternative due to the fact that it can be easily liquefied. In addition, LPG has numerous fuelling applications due to a wide variety of packaging and storage options, (WLPGA, n.d.).

Reliance on traditional fuels in Ethiopia, as compared to sub-Saharan Africa and other regions is shown in the below table. LPG and electricity are alternative fuels. According to Addis Fortune (2018), EEU (Ethiopian Electric Utility) announced new electricity tariffs for residential customers. The tariff increase will be implemented in four different phases to ease the burden on customers. The phases will be rolled out over four years, this will be increasing the demand of the LPG. In addition to low access to electricity in rural areas, electric power transmission capability in accessible areas is poor and frequent power outages continue to be a problem.

Table 2.2- Access to clean cooking by region

Access to Clean Cooking, Summary by Region							
	Proportion of the population with access to clean cooking					Population without access	Population relying on traditional use of biomass (million)
	2000	2005	2010	2015	2018	2018	2018
WORLD	**52%**	**55%**	**58%**	**63%**	**65%**	**2651**	**2374**
Developing Countries	**37%**	**41%**	**45%**	**53%**	**56%**	**2651**	**2374**
Africa	**23%**	**25%**	**26%**	**28%**	**29%**	**910**	**853**
North Africa	87%	93%	96%	98%	98%	4	4
Sub-Saharan Africa	10%	11%	13%	15%	17%	905	848
Ethiopia	<5%	<5%	<5%	7%	7%	100	99
Developing Asia	**33%**	**37%**	**43%**	**53%**	**57%**	**1674**	**1460**
China	47%	51%	55%	67%	72%	399	242
India	22%	28%	34%	44%	49%	688	681
Indonesia	12%	18%	40%	68%	68%	85	55
Other Southeast Asia	36%	42%	48%	54%	58%	164	163
Other Developing Asia	22%	26%	27%	33%	35%	337	318
Central and South America	**78%**	**82%**	**85%**	**88%**	**89%**	**57**	**53**
Middle East	**84%**	**91%**	**95%**	**96%**	**96%**	**10**	**9**

Source: IEA, World Energy Outlook-2019, based on WHO Household Energy Database and IEA World Energy Balances 2019

2.3. Overview of LPG Business in Ethiopia

The use of traditional fuels, their effect on health and environment are discussed on the sections above. This section outlines the current LPG business and supply situation in Ethiopia.

The main clean energy sources are electricity and LPG. Taking electricity as the main clean option is not possible. According to Mesfin (2019), there are interruptions often, which are due to inefficiency and incapability of Ethiopian Electric Power Corporation, as is expected from a public enterprise of least developed countries. Starting from May 2019, EEU cut power supply at least for 8 hours per day. Huge power is required for the country, and incapability and inefficiency necessitates scaling up of LPG in households, industries, hotels, etc., to contribute/support the energy demand.

2.3.1. Supply chain Management

Supply chain (SC) is a dynamic process that requires uninterrupted flow of information, materials and funds across multiple functional areas, within and between chain members in order to meet customer's requirements and to maximize their profit. Such dynamic process requires immediate acquisition and constant re-evaluation of partners, technologies and organizational structures (Saad, Udin, & Hasnan, 2014).

The oil and natural gas industry is one of the world's largest and most capital intensive industries. The petroleum supply chain is characterized by a very complex network of companies that are involved in engineering-intensive activities to develop petroleum sources. Broadly classified, a petroleum supply chain can be divided into two segments: upstream and downstream. The upstream segment involves exploration and production of crude oil from onshore and offshore reserves, while the downstream segment predominantly focuses on refining crude oil and marketing the various refined products and derivatives, which are delivered to domestic and industrial consumers (Ahmad, 2016).

The fuel supply chain in Ethiopia comprises: International traders supplying to EPSE, EPSE (the sole importer of fuel in the country), Oil Companies, Retail Fuel Stations, Bulk Fuel Transporters, and Industry Regulators MoMPNG, and MoT. The supply chain for LPG in Ethiopia comprises: MoMPNG, International Oil Traders, Port of Sudan, Djibouti Horizon Terminal, Importers, Bulk distribution Companies, transporters, distributors, retailers.

2.3.2. LPG Logistics infrastructure

Logistics infrastructure consists of roads, railways, airports, sea ports, ICT and energy production (Srivastava, 2006). Dry ports & freight stations as well as warehouses are important components of logistics system. Market structure contributes to efficiency of freight transport and logistics system by connecting producers and consumers (Mesfin, 2019).

Logistics management is the part of SCM that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements (Nowak, 2015).

In Ethiopia the major transportation challenges are having no access to sea (Land-locked country) and back ward transport infrastructure. Due to this the delivery process is expensive and challenging, which hinders the firms' competitiveness of the country (Ayenew, 2016).

Pipeline infrastructure is a good option to solve this problem. Despite the enormous benefits it may bring to the country, Ethiopia has no petroleum pipeline infrastructure so far. There was an official agreement with a US company called "Black Rhino" after a feasibility study was conducted and acceptance was secured for same, however, government has cancelled the deal soon in 2017 due to shortage of finance (The Reporter, 2017).

Currently, to transport the imported LPG from terminals to local depots, importers are using trucks which are specially designed for LPG transportation. Data from the LPG importing companies in Ethiopia reveals that the number of LPG trucks in the country is not adequate. The below table summarizes the total number of trucks engaged in LPG transportation from port to local depots.

Table 2.3-Number of LPG transporting trucks from port to local depot

Company	Number of trucks
NOC	18
Ghion Gas	15
Iran Murfic	4
Total Gaz	2

Source: LPG distributing companies, 2021.

2.3.3. Capability of Distributors

LPG distributing companies in Ethiopia own storage depots and refilling facilities. LPG is imported, transported using special trucks, and stored in their respective depots which are located at different locations but mainly concentrated around Addis Ababa.

The LPG which is stored in depots is distributed to customers in two ways: For bulk users, the gas is distributed to customer sites by using bulk vehicle tanks. For cylinder users, the gas is refilled to cylinders inside the depots. Cylinders are imported by the companies, labeled, and sold or leased to customers. Customers then exchange empty cylinders for full ones and pay only for the gas. The capacity of cylinders ranges from 3Kg to 52Kg.

As summarized in the below table, the total storage capacity (1,430MT) is very low compared to the average consumption of the country, which is assumed to be 9,000 MT. With this low storage capacity, coupled with poor infrastructure and shortage of forex, etc. the supply cannot even meet the existing demand.

Table 2.4 - Local storage capacity of Companies

Company	Storage location	Storage capacity
Ghion Gaz	Dukem, Bahirdar	600MT
NOC	Dukem	280MT
Nile Petroleum	Sululta	230MT
Iran Gaz Murfic	Burayu	120MT
Total Gas	Dukem	100MT
WAS Petroleum	Gelan	100MT
Allied Energy	Rented from Nile	Rented from Nile
Total Storage Capacity		1,430MT

Source: LPG distributing companies, 2021

2.3.4. Policy and Regulatory issues

Many countries including Ethiopia signed an agreement to reduce emission of gaseous pollutants. Kyoto protocol, Montreal protocol, Stockholm convention, Copenhagen Summit, South Africa Summit and Paris agreement are some of the multilateral agreements that Ethiopia has taken the lead and signed at the forefront. Accordingly, Ethiopian environmental policy has been crafted to address the environmental issues including pollution. Various legislation including proclamations, regulation and standard guidelines have also been developed (Gulilat, 2018).

According to Beyene (2018), the main environmental law (the Environmental Policy of Ethiopia) serves as a framework for environmental legislation at lower levels of government, especially regional policies. So long as it meets the standards established by the federal environmental policy, regions are permitted to develop their own environmental policy. Regional policies, in theory, may support more stringent environmental standards, but may not set lower standards than the federal law. Indeed, in many cases, regional policies have been simply copied directly from the national policy, such that most written environmental policies are similar across regions. However, some regions are relatively less active than others in terms of practical environmental law enforcement. This is particularly displayed with regards to regulating the environmental impacts of development activities (e.g., requiring Environmental Impact Assessments for proposed industrial expansion).

The Ethiopian Petroleum Supply Enterprise, established in 1995, was the sole entity established to meet the country's demand for petroleum, with the exception of liquefied petroleum gas (LPG), bitumen products, and lubricants (Fortune 2015).

The Industry Regulators for LPG (MoMPNG and MoT) have not focused much on increasing supply and reducing cost of LPG. The infrastructural bottlenecks from port to distribution, which are limiting the supply of LPG have not been given attention. Investment on the supply of LPG, cylinders and accessories has not been encouraged.

Items imported into Ethiopia (unless exempted by law) are subject to a number of taxes. The government levies five kinds of taxes on import items. These taxes are assigned based on priority levels and are calculated in a sequential order. In their sequential order, the taxes are: customs duty, excise tax, VAT, surtax and withholding tax. Taxes on imported goods are collected by the Ethiopian Revenues and Customs Authority (Ethiopian Revenues and Customs Authority, n.d.).

There is no Subsidy policy and LPG is not illegible for Income tax exemption in Ethiopia. In the investment incentives and investment areas reserved for domestic investor's council of Ministers, Regulation no. 270/2012 on the section of Investment areas and income tax exception no. 13 stated that Importation of LPG and bitumen are not eligible for income tax ex-emption.

Reserves of foreign exchange maintained by the government of Ethiopia remain at low levels, which is a longstanding challenge for those seeking to import. All transactions must be carried out through authorized dealers under the control of the National Bank of Ethiopia. There are no free trade zones in Ethiopia (Business, 2010). Currently Foreign exchange shortages due to weak export performance and high demand for foreign currency affect the market.

To address the environmental law and reduce the health issues associated with using traditional fuels, the government is expected to act towards facilitating the financial issues related with importation of LPG, such as prioritizing forex allocation, tax exemption and subsidy. Such actions can be linked with the environmental initiative. A strategy regarding LPG doesn't exist.

2.3.5. ICT and Collaboration

When oil and gas companies make technology decisions independently along their supply chains, difficulties could arise. Thus, their information systems are neither coordinated nor compatible, and information is not readily shared back and forth along the supply chain. Furthermore, adapting a supply chain wide technology strategy can result in multiple benefits for users of the system along the chain. Those are: seeing a single file system, access to all computational servers with high speed data access, connecting to real time high speed visualization, participation in realistic collaboration, and provision of instant service irrespective of the user's location. This also allows the business leaders to manage the enterprise from anywhere (Chima, 2007).

As per Mesfin (2019), the use of ICT in logistics in Ethiopia is almost nonexistent. One area where bar code is used is at cash register of supermarkets. However, it is not connected with inventory or warehousing management system. There is a plan by MoT to introduce tracing and tracking using GPS and software, databases and other logistics ICT applications. It indicates that there is a lot yet to be done in this regard.

A study (Abebe, 2019) indicated that there is a challenge in the end to end supply chain of LPG by supply interruption, absence of integration and collaboration between the main importing companies, absence of information exchange system and controlling policies and standards.

The researcher also believes that lack of collaboration among the industry players contributed to the lack of attention by the government. Use of ICT (In the supply chain, to track vehicles, online data along the SC, etc.) and collaboration of the companies does not exist.

2.3.6. Awareness and Safety

LPG has well defined specifications in the international markets. The appliances for use in households as well as the facilities and equipment for transport, storage and distribution are relatively simple and similar around the world. As such, it is not necessary for developing countries to re-create their own HSE standards and technical specifications for LPG and the chain of supply (Matthews & Zeissig, 2011).

As per the interview with government and company representatives, the down-stream petroleum laws and general regulations of Ethiopia are incomplete as they do not include LPG. Typically, they do not even contain specific provisions for LPG. Moreover, the international standards for quality control and protection of health, safety and environment (HSE) is not adopted to the national level officially. MoT gives the license for LPG investment and MoMPNG gives Accreditation Certificate. However, LPG Supply and distribution is not controlled by a specific government office, i.e., there is no institutional framework to control the supply chain of LPG in Ethiopia. EPSE was established to meet the country's demand for petroleum, with the exception of liquefied petroleum gas (Abebe, 2019).

Regarding the LPG HSE regulation, there is none in national level and it is not adopted from international standards of safety and environment too. As a matter of fact, International standards are applied by some companies but without having a formal legal basis (Abebe, 2019).

Indeed, LPG is potentially hazardous and uncontrolled releases of LPG can have serious consequences in fire and explosion. However the technology for safe use of LPG is well known and risks can be controlled through proper regulation and use. Unfortunately, this is often lacking in many developing countries (WLPGA, 2013).

In a market survey of 400 households in Pemba, Mozambique, 79% believed LPG to be toxic, explosive or dangerous (Sprague, 2007). In fact, a study in South Africa in 2000 indicates that injuries and deaths resulting from fires from using paraffin (kerosene) are 189 times and 200 times respectively more than those resulting from use of LPG.

Table 2.5 - Relative incidence rate of fires due to paraffin and LPG per 100,000t sold domestically each year in South Africa, 2000.

	Homes	Injuries	Deaths
Paraffin (Kerosene)	16,700	1,700	1000
LPG	9	9	5

Source: Cecelski & Matinga (2014)

Not much has been done to raise the awareness level of the public towards the health and environmental benefits discussed, as well as the wrong beliefs regarding safety are not addressed both by the government and distributors.

2.4. The need for Switching from traditional fuels to LPG

The latest estimates from the Institute for Health Metrics and Evaluation put the number of household pollution related deaths globally at around 1.6 million out of a total of 3 million deaths related to poor air quality. Therefore, it is a significant contributor. With 3 billion people around the world relying on solid fuels for cooking and heating in their homes, concentrated in parts of Asia, Latin America, and specifically in Sub-Saharan Africa, it is a problem that requires an urgent solution. Fortunately, there is a solution that is already available in the form of Liquefied Petroleum Gas (LPG) that can go a long way to mitigating this death toll (New African Magazine, n.d.).

In Kenya, about 76% of the population rely on solid fuels for cooking. That is almost exclusive in rural areas where the fuel can be gathered for free. Latest data estimates that almost 17,000 premature deaths are associated with air pollution in homes. This figure is equivalent to 6% of all premature deaths in Kenya. In response to this global burden of disease related to air quality, the World Health Organization (WHO) developed a set of indoor air quality guidelines. As per the recommendation of these WHO guidelines, a rapid scale up of use of clean fuels in countries that depend on solid fuels is essential to achieve safe target levels of pollutants for health (New African Magazine, n.d.).

According to Sanbata et al. (2014a), indoor air pollution from biomass fuel is responsible for 50,320 annual deaths of children under five years in Ethiopia. This figure accounts for 4.9% of the national burden of disease in the country, where acute respiratory infections are the leading cause of mortality among children. As per the same study, there is an association between biomass fuel usage and acute respiratory infection in children. Biomass fuel is a common fuel used for cooking in Addis Ababa, Ethiopia. This study shows strong associations between biomass fuel and prevalence of ARI in children under five years of age.

The burning of biomass fuels causes health problems due to exposure to high levels of indoor air pollution. According to a study carried out in Gondar, 80% of rural women cooked indoors using biomass fuel with no ventilation. Compared to the other two groups, i.e., urban traditional and middle class backgrounds, rural women reported two to three times more respiratory disease in their children and in themselves. (Edelstein et al., 2008).

Incomplete combustion occurs when solid fuels such as wood, charcoal, biomass and kerosene are burned in traditional stoves for cooking and heating homes. This results in emissions of a whole range of health damaging pollutants, including carbon monoxide and polycyclic aromatic hydrocarbons. These pollutants are associated with a range of respiratory diseases and cancers. The pollutants are particles of small diameter of 2.5 microns or less. It is that small size which makes them of particular concern because they penetrate deeply into the lungs and pass through into the bloodstream, which lead to systemic effects. Now there is evidence for the role of this pollutant in a range of health outcomes. This includes pneumonia in children and stroke, ischemic heart disease, chronic obstructive pulmonary disease, and lung cancer in adults. These health impacts are remarkably similar to those seen for exposure to tobacco smoke. Studies have shown that burning fuel in open fires is about the same as burning 400 cigarettes in an hour (New African Magazine, n.d.).

One of the best measures to mitigate the danger of cooking with traditional fuels is LPG. at the point of combustion with LPG, there are almost no particulate matter emissions. This is what makes LPG so clean to use for cooking. In addition, LPG is a relatively simple fuel to scale up to large numbers of society. The infrastructure required to create a large scale LPG industry is relatively affordable for developing countries. The timelines are also much shorter than any form of grid energy. Cylinders of LPG are so portable that it can be distributed even in difficult areas such as townships and remote rural areas. Countries such as India, Brazil and Indonesia with big populations in large topographically complex regions have all managed to achieve high levels of penetration with more than 90% of the respective populations cooking on LPG (New African Magazine, n.d.).

Shifting/switching from traditional fuels and coal to LPG can result in considerable health and environmental benefits at the local, regional and global levels. Indoor air pollution, which affects mainly women and children, can be greatly reduced by utilizing LPG. In Ethiopia, most of the regions are affected by deforestation and desertification. Like most African countries, greenhouse effect, rising of atmospheric temperature, warming, and loss of biodiversity, air pollution, water pollution and soil pollution are some of the problems. In addition, soil degradation, an increase in number of crop failures, reduction of surface water and fresh water problems, wind and ice damage to crops, industrial pollution, hazardous chemicals and pesticides, erosion, coastal and marine

pollution and general climate change etc. are major environmental problems of Ethiopia. (Beyene, 2018).

In order to drive growth in a sustainable LPG market, the lesson from global experience is that there must be government support at an extremely high level. In India, for example, getting LPG for cooking to the poor has been a priority of the Modi Government since he was elected in 2015. In Indonesia also, the big kerosene to LPG transition project between 2007 and 2015 was driven by the Vice President. The current project in Nigeria, which is growing very quickly now is being pushed by the LPG Expansion Plan out of the Vice President's Office (New African Magazine, n.d.).

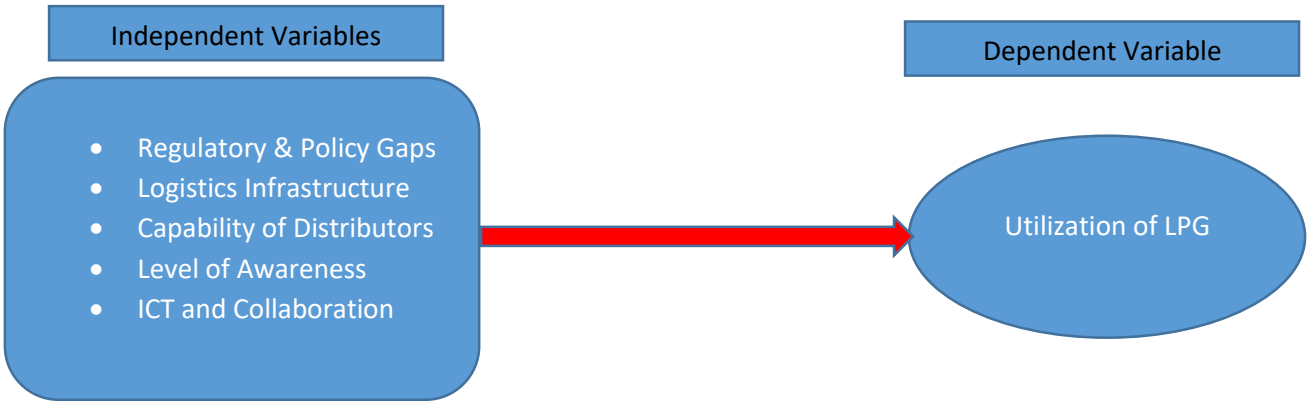
According to Addis Fortune (2018), LPG and electricity are alternative fuels and EEU (Ethiopian Electric Utility) announced new electricity tariffs for residential customers. The tariff increase will be implemented in four different phases to ease the burden on customers and the phases will be rolled out over four years. This will be increasing the demand of LPG. In Ethiopia LPG is competing against electricity in developed cities and towns and against firewood and charcoal in less developed areas. Hence, price affordability at grass root level should be achieved. This could easily be achieved if the private sector and the government work together to address the various factors contributing to the high cost which are product cost, long hauling cost, initial cost of having LPG burners and cylinders. The target should be to bring down below cost of electricity at the least

Not much has been done by the government and regulators to drive growth in a sustainable LPG market. The need for energy in Ethiopia is growing. Electric power capacity in the country is inadequate, there is always power cut and the tariff is increasing. Also, as it has been discussed throughout the paper regarding the environmental and health related harms due to use of traditional fuels, now it is time to scale up utilization of LPG in Ethiopia.

2.5. Conceptual Framework

A conceptual framework is a visual or written product, one that "explains, either graphically or in narrative form, the main things to be studied, the key factors, concepts, or variables, and the presumed relationships among them" (Miles and Huberman, 1994).

The researcher has developed a conceptual framework from the topics discussed so far, shown below in figure 2.2. The factors which are identified to be the major causes which have impacted utilization of LPG are the independent variables as shown in the figure below.



Source: Researcher's construct, 2021

Figure 2.2 - Conceptual Framework

Chapter Three: Research Methodology

The methodology adopted in this research is mixed type. Both qualitative methods of data collection and analysis as well as quantitative analysis using questionnaire are used.

3.1. Research Design

The intention of this research is to examine the factors which affect utilization of LPG in Ethiopia. Hence the study uses descriptive and analytical research design to achieve its aim.

According to Meyer (2010), descriptive studies are more formalized and typically structured with clearly stated evaluative questions. It serves to attain a variety of research objectives such as description of phenomenon or characteristics associated with a subject population, estimates of proportions of population that have these characteristics and discovery of associations among different variables. The design enabled the study to combine both qualitative and quantitative research approaches.

According to Creswell (2011), the mixed research approach uses separate quantitative and qualitative methods as a means to offset the weaknesses inherent within one method with the strengths of the other method. Quantitative approach strives for precision by focusing on items that can be counted into predetermined categories and subjected to statistical analysis (Taylor, 2013). Whereas, qualitative approaches enable collection of data in the form of words rather than numbers. It provides verbal descriptions rather than numerical (Kothari, 2011). Mugenda and Mugenda (2003) states that qualitative methods can be used to gain more in-depth information that may be difficult to convey quantitatively. The use of these two approaches reinforces each other (Zhu et al, 2013).

This approach is used by the research as the data collected using the main questionnaire was quantitative and was analyzed using statistics while the data collected using interview is analyzed and described qualitatively.

3.2. Data Sources and Collection techniques

3.2.1. Target Population, Sampling methods and Sample size

The target population for the survey questionnaire in this study are supervisors/managers of all retail stations and distributors of companies distributing LPG in Addis Ababa. Target population for the interview were Sales, Marketing, Operations and Logistics managers of the LPG distributing companies and a government official. Verbal data through interview was gathered from these managers about the extent to which the regulatory and policy gaps affect the supply and affordability of LPG, how infrastructure and Supply Chain affect the level of utilization of LPG, to examine the influence of the capacity of distributors on supply of LPG, to describe the impact of level of awareness in relation to the health & environmental benefits and safety issues on usage of LPG, and to identify the influence of ICT and collaboration on LPG supply. To confirm the findings of the qualitative research, close ended questionnaires were used. The study employed a questionnaire with 5-point Likert-type scale that ranged from strongly disagree to strongly agree. It was pretested to see its simplicity and understandable before it is sent to participants.

To determine the size of the participants, general rule of thumb not less than 50 participants for correlation or regression is used (Morgan, 2007). In this regard, the total numbers of target population which are supervisors of all retail stations and distributors of companies distributing LPG in Addis Ababa have been considered. Therefore, due to the small number, all 90 distributor and retail station managers are used for the survey which is the total number of the target population. In addition, purposive sampling technique was employed in order to make interview with selected key managers.

Table 3.1 - Population and sampling

	Company	Population	Sample
1	Ghion Gas (through retailers and OiLibya Service Stations)	26	26
2	NOC Service Stations	29	29
3	Total Ethiopia Service Stations	20	20
5	Others	15	15
	Total	90	90

Source: Own Survey, 2021

3.2.2. Method of Data Gathering

The study is carried out by gathering primary and secondary data. A thorough review of the existing practice together with review of relevant literature on the subject constitutes information collection from secondary source. Primary data was collected using questionnaires and interviews. Both data types are obtained from the main actors in the LPG distribution sector of the country. Self-administered, close ended questionnaires were used to collect primary data for analysis. Open ended interviews were also conducted for qualitative analysis. The questionnaires were designed in such a way that they can give a comprehensive overview of the factors which affect utilization of LPG in Ethiopia.

3.3. Method of Data Analysis

The method to be used for data analysis is mainly descriptive and analytical. Frequency tables, mean and percentage are used to explain some of the factors. The results are summarized and presented using tables and graphs. Qualitative interpretation is employed to utilize information gathered through the interview and meetings. Consistency and completeness of the gathered information is checked before analysis is carried out. Cronbach's alpha is used to test the reliability of the items used in the study. All analysis is done using the SPSS version 25.

3.4. Ethical Considerations

The names and any other private information which describe about the respondents of questionnaires and interviews will never be disclosed. Also, the data obtained from the respondents shall be kept confidential.

All respondents were told, prior to data collection, that the response they provided will be confidential and be used only for the study purpose. The data is collected after assuring the consent of the respondents. The obtained data had only been used for this academic purpose.

Chapter Four: Data Analysis, Results, and Discussion

4.1. Questionnaire Response Rate

As shown in table 4.1 below, 90 questionnaires were distributed and 86 were appropriately filled and retuned. The response rate for this study is 95.5%.

Table 4. 1. Questionnaire response rate

Questionnaires Distributed	Questionnaires Returned	Percent
90	86	95.5%

Source: Own survey, 2021

4.2. Background Information of Respondents

This section presents the background information of the respondents that includes, gender, Age, work experience and level of education.

Table 4.2. Respondent Profile

	Frequency	Percent
	Gender	
Male	63	73.3
Female	23	26.7
Total	86	100.0
	Age group	
18-24 years	2	2.3
25-30 years	7	8.1
31-40 years	33	38.4
41-50 years	28	32.6
Above 50 years	16	18.6
Total	86	100.0
	Work experience	
Below 2 Years	4	4.7
2-5 Years	9	10.5
6-10 Years	35	40.7
11-15 Years	29	33.7
Above 15 Years	9	10.5

Total	86	100.0
	Level of education	
Grade 12 + certificate/diploma	51	59.3
Bachelor's Degree	27	31.4
Master's Degree	8	9.3
Total	86	100.0

Source: Own survey, 2021

As shown in Table 4.2 above, in terms of gender distribution 63 (73.3%) of the respondents were male, 23 (26.7%) of the respondents were female. The survey showed that there are more male as compared to females.

In terms of the age group of respondents 2 (2.3%) of the respondents were between 18-24 years, 7 (8.1%) of the respondents were between 25-30 years, 33 (38.4%) of the respondents were between 31-40 years, 28 (32.6%) of the respondents were between 41-50 years and, 16 (18.6%) of the respondents were above 50 years. It can be seen that majority of the respondents were aged between 31 – 50 years, which indicates that the respondents are well informed about the trends of LPG supply history in the country.

In terms of experience in the field, 4 (4.7%) of the respondents had less than 2-year work experience, 9 (10.5%) of the respondents had 2-5-year work experience, 35 (40.7%) of the respondents had 6-10-year work experience, 29 (33.7%) of the respondents had 11-15-year work experience and 9 (10.5%) of the respondents had above 15 years work experience. This distribution indicates that the respondents have good exposure and awareness of the problems to provide valid information required for the study.

The educational distribution of the respondents showed that 51 (59.3%) of the respondents were grade 12 + certificate or diploma holders, 27 (31.4%) of the respondents were bachelor's degree holders, and 8 (9.3%) of the respondents were master's degree holders. This implies that most respondents have the capacity to reliably provide accurate information for the research.

4.3. Reliability and validity

4.3.1. Reliability test

As shown in the table below, in this study, in order to check the reliability of the questionnaire a Cronbach's Alpha was used and a Cronbach's Alpha value greater than 0.7 was considered as reliable. Therefore, in this case the results indicate that the reliability test as a group of variables and each variable independently is greater than 0.7 and proved the questionnaire is reliable instrument.

Table 4.3. Group reliability test

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.829	.834	6

Source: SPSS Descriptive Analysis result based on questionnaire survey, 2021

Table 4.4. Variables reliability test

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Capability of distributors	.808	7
Influence of Infrastructure	.811	6
Regulatory and policy gap	.790	7
Awareness	.798	6
Information technology	.826	5
Utilization of LPG	.775	5

Source: SPSS Descriptive Analysis result based on questionnaire survey, 2021

4.3.2. Validity

The validity of the study was checked to ensure the quality of the research design, the content as well as constructs. The contents of questionnaire and interview questions were verified by the advisor, who has looked into the appropriateness of questions and the scales of measurements.

Peer discussion, another way of checking the appropriateness of questions on each variable was used. In addition, the pilot test that was conducted prior to the actual data collection has helped to get valuable comments.

4.4. Descriptive on the Perceived Levels of the Variables of Interests

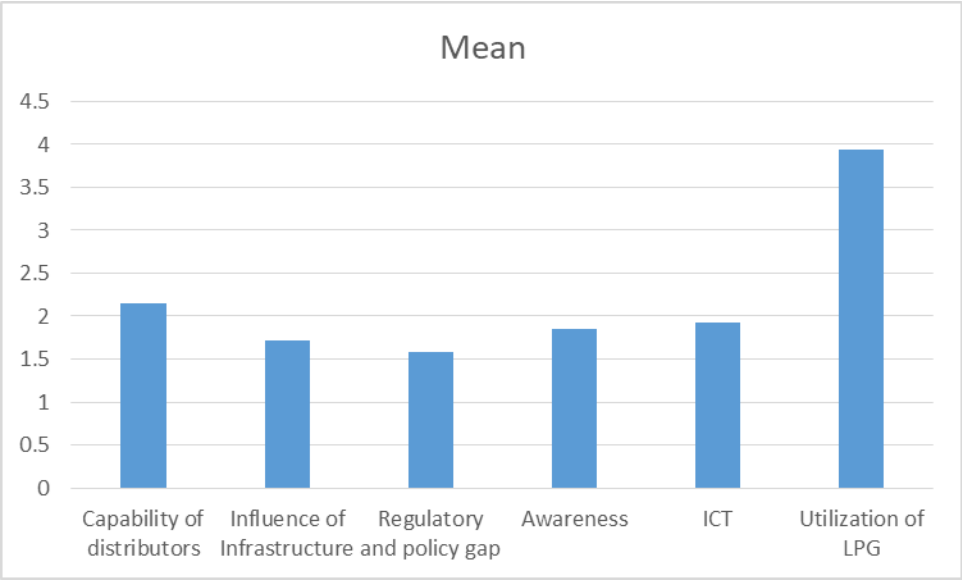
By calculating a composite average, a mean was used to estimate the perceived level of utilization of LPG in the country. As depicted in table 4.5 below, out of a 5-point likert scale, 3.9372 (0.66008) is the perceived level of agreement that the independent variables affect the level of utilization of LPG in Ethiopia. The utilization level is believed to be attributed to several factors and some of those factors are accounted for in this study. Hence, such factors as capability of distributors, influence of infrastructure, regulatory & policy gaps, awareness and ICT were measured with different proxy items each. The average perceived level of the variables is displayed by means of a table (Table 4.5) and a chart (Figure 4.1) below.

Table 4.5. The average overall perception of respondents

Variables	N	Mean	Std. Deviation
Capability of distributors	86	2.1553	.80431
Influence of Infrastructure	86	1.7174	.73369
Regulatory and Policy gaps	86	1.5767	.79258
Awareness	86	1.8581	.86020
ICT	86	1.9209	.67057
Utilization of LPG	86	3.9372	.66008

Source: Own survey, 2021

The below figure displays the distribution of the respondent's perception about both the dependent and independent variables. Accordingly, the highest of all average perceived performances of the factors that are believed to influence the utilization of LPG in Ethiopia is that of capability of distributors followed by ICT. The least is Regulatory & Policy gaps, implying that this factor is the most susceptible factor for utilization of LPG.



Source: Own Survey, 2021

Figure 4.1 - Measures of central tendency

4.5. Inferential Statistics

4.5.1. Correlation Analysis

The relationship between two quantitative variables can be investigated by correlation technique. Correlation measures the strength of the linear association between two variables. In this study, Pearson‘s correlation coefficient (r) is used to identify the presence as well as the strength of relationship between the variables. According to Samuel and Lawrence (2015), correlation provides the platform for regression to predict the values of the dependent variable based on the known relationship that exist between the independent variable and the dependent variable. Hence, with the help of the response obtained from the questionnaire, the relationship between the dependent and independent variables is formulated by means of correlation analysis. According to Hair, Money, Samuel, & Page (2007), the Pearson correlation coefficient values can be grouped as ±0.91 to ±1.00 (Very strong), ±0.71 to ±0.90 (High), ±0.41 to ±0.70 (Moderate), ±0.21 to ±0.40 (Small but definite relationship), and ±0.00 to ±0.20 (Slight, almost negligible).

Table 4.6. Correlation between Dependent and Independent Variable

Correlations							
		LPG	II	RPG	ICT	Awareness	CD
LPG	Pearson Correlation	1					
	Sig. (2-tailed)						
	N	86					
II	Pearson Correlation	-.546**	1				
	Sig. (2-tailed)	.000					
	N	86	86				
RPG	Pearson Correlation	-.637**	.582**	1			
	Sig. (2-tailed)	.000	.000				
	N	86	86	86			
ICT	Pearson Correlation	-.493**	.419	-.469*	1		
	Sig. (2-tailed)	.001	.003	.012			
	N	86	86	86	86		
Awareness	Pearson Correlation	-.564**	.453**	.509**	.551**	1	
	Sig. (2-tailed)	.000	.002	.000	.000		
	N	86	86	86	86	86	
CD	Pearson Correlation	-.473**	.481**	.416**	.443**	.418**	1
	Sig. (2-tailed)	.002	.000	.002	.001	.000	
	N	86	86	86	86	86	86
**. Correlation is significant at the 0.01 level (2-tailed).							
*. Correlation is significant at the 0.05 level (2-tailed).							

Source: SPSS Descriptive Analysis result based on questionnaire survey, 2021

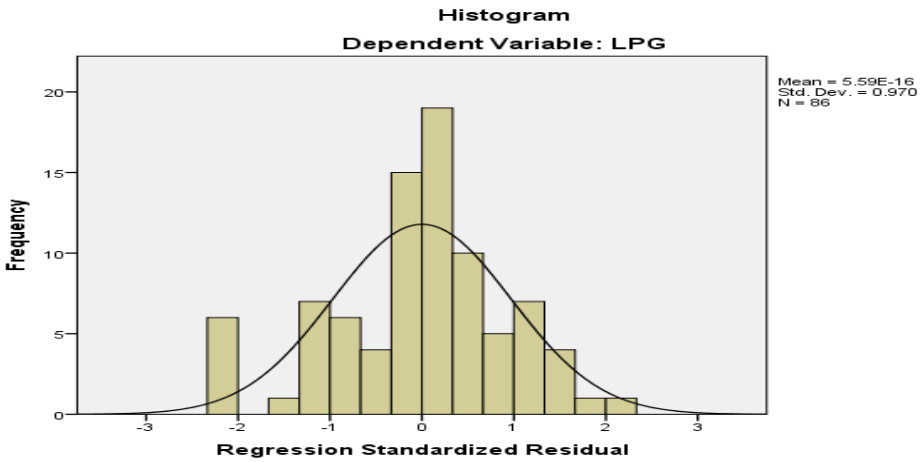
The result of the correlation analysis in the above table (Table 4.6) indicates that all of the dimensions of the LPG sector performances such as infrastructure, regulatory & policy gaps, ICT, Awareness and capacity of distributors (r=-0.546, -.637, -.493, -.564, -.473) have moderate association with utilization of LPG in Ethiopia. All the independent variables also have a coefficient correlation that is moderate. This indicates the absence of multi co linearity among these variables.

4.5.2. Testing Assumptions of Linear Regression

In order to estimate the parameters in multiple linear regression models and minimize the sum of squared error or the difference between observed value and predicted value ordinary least square method (OLS) method were employed for this study. While using OLS method in order to have correct estimator value the five key underlying assumptions should be satisfied. When the assumptions are violated OLS estimators produce biased, inconsistent and in efficient result. Therefore, tests of hypothesis are no longer valid, since the standard errors are wrong. Therefore, in order to protect against the chance of getting and interpreting wrong regression results the researcher conducted a diagnostic test. To make sure that the model is unbiased, consistent, efficient and valid the following tests are conducted.

4.5.2.1. Multivariate normality

Figure 4.2. Normality test



Source: SPSS Descriptive Analysis result based on questionnaire survey, 2021

The result in figure 4.2 illustrates that the mean of the residual is zero and approximately its variance is 1, which implies that the distribution of the error is normally distributed.

4.5.2.2. Absence of Multicollinearity

In order to test the multi-collinearity problem, the study applied variance inflation factor (VIF) and correlation coefficient of explanatory variables. If the VIF of the variables exceed 10%, multi-collinearity can be a potential problem (Hair et al., 2013). As illustrated in table 4.13 the value of variance inflation factor for all explanatory variables is less than 10%. Therefore, it implies that there is no multi-collinearity between explanatory variables.

Table 4.7: Multicollinearity test

Coefficients[a]			
Model		Collinearity Statistics	
		Tolerance (1/VIF)	VIF (%)
1	Capability of distributors	0.951	1.051
	Influence of Infrastructure	0.854	1.171
	Regulatory and policy gap	0.895	1.118
	Awareness	0.823	1.116
	Information Technology	0.926	1.182
a. Dependent Variable: Utilization			

Source: SPSS Descriptive Analysis result based on questionnaire survey, 2021

4.5.2.3. Absence of auto-correlation

This study applied Durbin Watson test. Durbin Watson test is the most commonly used technique of detecting autocorrelation. Hence, if the value of DW test is between 1.5 and 2.5, there is no evidence for the presence serial correlation among error terms (Hassen et al, 2017).

As illustrated in table 4.8 the DW test result 1.960 falls in the acceptable range, which implies absence of serial correlation among errors.

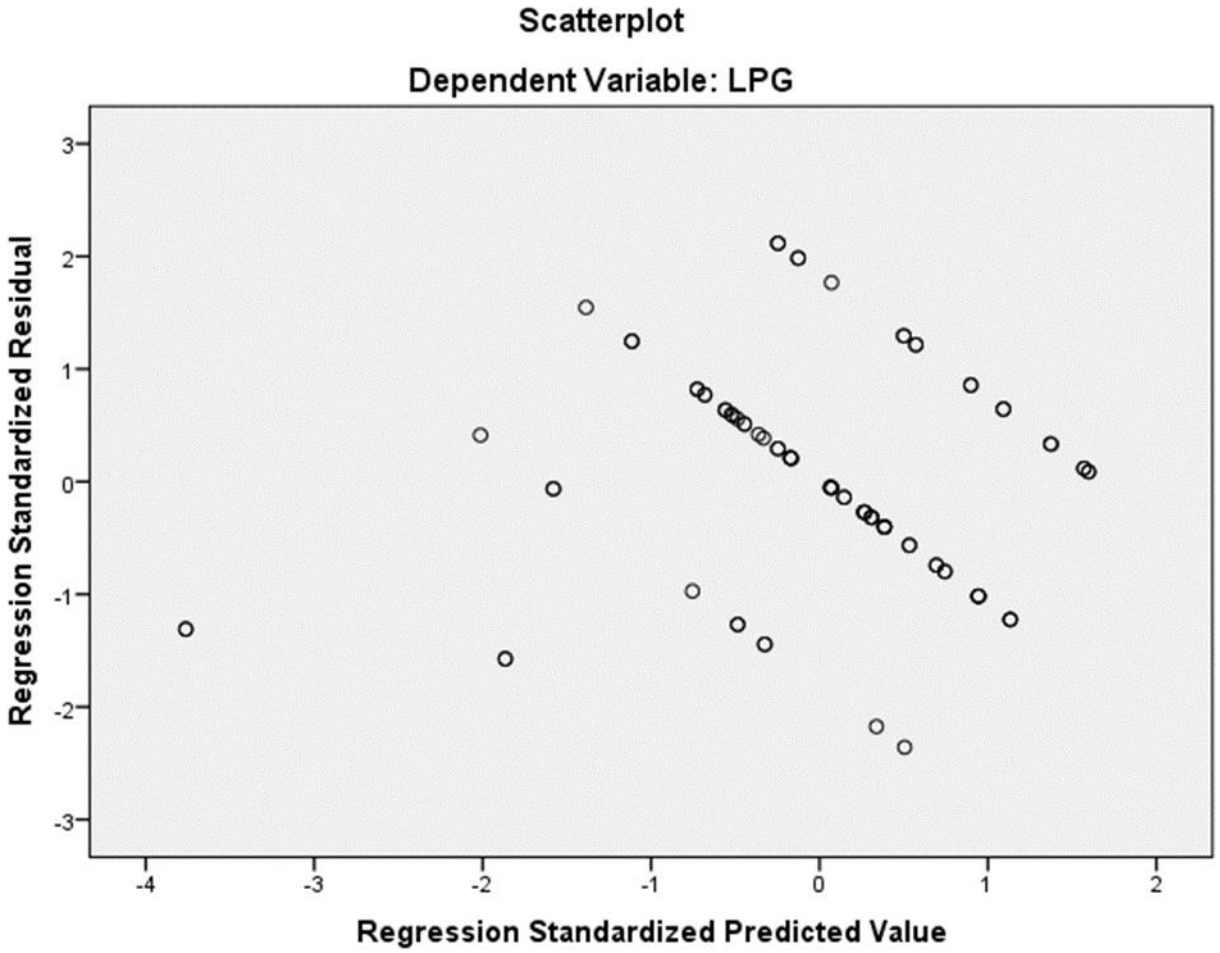
Table 4.8: Autocorrelation test

Model	Durbin-Watson
1	1.960
a. Predictors: (Constant), ICT, II, CD, Awareness, RPG	
b. Dependent Variable: LPG	

Source: Own survey, 2021

4.5.2.4. Homoscedasticity

Figure 4.3. Homoscedasticity test



Source: SPSS Descriptive Analysis result based on questionnaire survey, 2021

In order to check the assumption of homoscedasticity, the study used scatter plot technique. The result plots the standardized residual, against standardized predicted value. If the plots have a pattern it implies the presence of hetroscedasticity. Conversely if the plots don't depict a pattern there is no evidence for the presence of hetroscedasticity. As illustrated in the figure, 4.3 above, the graph looks like a random array dots or the plots have no pattern. So, homoscedasticity assumption is not violated.

4.5.2.5. Linearity test

Based on the linearity test output, it can be concluded that there is a linear relationship between dependent variable (utilization of LPG) and independent variables (Capability of distributors, Influence of Infrastructure, Regulatory and policy gap, Awareness and Information technology).

4.5.3. Analysis of Variance (ANOVA)

As shown in the table 4.15 below, the analysis of variance was employed to establish the overall significance of the model. ANOVA also tells whether the overall effect of the five independent variables on utilization of LPG is significant. As depicted in table 4.15, at 95% confidence interval, significant P-value of .000 and F-value of 12.368 was recorded. This implies the regression model is a suitable prediction for explaining the challenges towards utilization of Liquefied Petroleum Gas (LPG) in Ethiopia.

Table 4.9: Analysis of variance

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	30.935	5	6.187	12.368	.000[b]
	Residual	24.054	80	.301		
	Total	54.988	85			
a. Dependent Variable: LPG						
b. Predictors: (Constant), ICT, CD, RPG, II, Aware						

Source: SPSS Descriptive Analysis result based on questionnaire survey, 2021

4.5.4. Model summary

Tests of determination were indicted with the coefficient of determination as indicated in table 4.10 below. As shown in the table, R-square, which is statistical measure that tells the proportion of the percent variation in the dependent variable that can be explained by the variation in the independent variables of the model is determined. The value of R-square in this study was found to be 0.563 or 56.3%. This indicates that, 56.3 % of the time, level of utilization of LPG is

explained by the five selected independent factors that are mentioned in the model, i.e., policy & regulatory gaps, infrastructure, capability of distributors, ICT and awareness.

Table 4.10. Model summary

Model Summary[b]										
				Std. Error of the Estimate	Change Statistics					
Model	R	R Square	Adjusted R Square		R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.750[a]	.563	.535	.54834	.417	12.368	5	80	.000	1.967
a. Predictors: (Constant), ICT, CD, RPG, II, Awareness										
b. Dependent Variable: LPG										

Source: SPSS Descriptive Analysis result based on questionnaire survey, 2021

4.5.5. Results of multiple Regression Analysis

In agreement with classical linear regression model, the model used has satisfied the diagnostic tests. Based on this, multiple regression analysis was determined in order to reveal the value of the coefficient included in the model. Accordingly, the table below depicts the result of regression model that explain the challenges towards utilization of Liquefied Petroleum Gas (LPG) in Ethiopia. Thus, utilization of Liquefied Petroleum Gas is the explained variable. Capability of distributors, influence of infrastructure, regulatory and policy gap, awareness and ICT are explanatory variables. Hence, the model applied in this study was ordinary least square method.

Table 4.11. Coefficients of multiple regression analysis

Coefficients[a]					
Model		Unstandardized Coefficients		T	Sig.
		β	Std. Error		
1	(Constant)	2.342	.226	12.415	.000
	Influence of Infrastructure	-.554	.039	2.139	.002
	Regulatory and Policy Gap	-.621	.098	-1.885	.000
	ICT	-.471	.085	-2.079	.013
	Awareness	-.505	.022	3.188	.004
	Capability of Distributors	-.443	.027	-2.026	.012
a. Dependent Variable: LPG					

Source: SPSS Descriptive Analysis result based on questionnaire survey, 2021

In multiple regression output, the unstandardized coefficients of determination were used to replace the unknown β value of the regression model. Beta (β) indicates the level of influence of each predictor variable on dependent variable: as well it indicates the direction of relationship. Positive beta coefficient indicates the variable has positive effect on dependent variable whereas for negative beta coefficient, the variable has negative effect on dependent variable and it tells us on average when mean score value of independent variable increase by one unit, the mean score value of dependent variable increase or decrease by beta amount if the variable is statistically significant. The significance value (p-value) implies the statistical significance of the relationship. The constant term of the model indicates the value of utilization of LPG if all explanatory variables held constant.

The result of multiple regression as presented in table 4.11 above revealed that, policy and regulatory gaps has the most significant effect on utilization of LPG with a beta value of -0.621 and p-value of 0.000 which is less than 0.05. This indicates that when there is an increase of one unit in regulatory & policy gap, it will result in a 0.621 unit decrease in the level of utilization of LPG in Ethiopia. Moreover, the regression result indicates that infrastructure (beta value = -0.554), Awareness (beta value = -0.505), ICT (beta value = -0.471) and capability of distributors (beta value = -0.443) all have significant negative influences at 5% significance level on the level of utilization of LPG in Ethiopia.

Chapter Five: Summary, Conclusion, and Recommendations

This chapter briefly summarizes the findings of the research. Conclusion would be drawn on the findings with regards to the objectives of the study that examines the challenges towards utilization of Liquefied Petroleum Gas (LPG) in Ethiopia. Then, recommendation will be forwarded based on the analysis made in the previous chapter.

5.1. Summary

The findings of the study revealed that one of the main challenges which result in low utilization of LPG in Ethiopia is Regulatory and Policy gaps. There is no clear policy and no regulatory body in guiding LPG supply & distribution, operations, prices, monitoring malpractices, etc. The government hasn't given adequate attention towards LPG business. The government is also not considering LPG to help in the deforestation program as there is no transition plan to switch from traditional fuels (which cause deforestation and poor health) to LPG.

The study showed that capability of distributors is not to the level expected by respondents because it is very limited to adequately meet the current demand. LPG is most of the time in short supply due to the fact that distributors cannot ensure smooth supply. LPG storage, cylinder filling and logistics capacity of distributors is found to be low. The distributors with better capability are the ones with better performance in the business.

The study also indicated that the storage and transportation infrastructure isn't sufficient enough to meet the current demand, let alone help transition from traditional fuels to LPG. Low storage capacity at ports, inadequate and inefficient loading operations at ports, poor transportation infrastructure from the ports to distributors' depots coupled with the long hauling distance contributes to the high selling price of LPG.

Awareness of the society and government bodies is another factor which plays a role in the low utilization of LPG in Ethiopia. Most people are not aware of the health and environmental benefits of LPG. Those who have some information fear that it is not safe to use LPG. In addition, the study showed that ICT is not integrated throughout LPG supply chain as there is no real-time stock

monitoring and vehicle tracking system. The collaboration among the players in LPG business is also found to be unsatisfactory.

All the issues outlined above have contributed to the low utilization of LPG in Ethiopia.

5.2. Conclusion

The following conclusions are drawn based on the objectives of the study and analysis of raw data:

Analyzing the influence that policy and regulatory issues have on LPG business portrays that there is huge policy and regulatory gap. The country lacks a policy with regard to Guidelines to address the various issues related with the LPG industry such as LPG importation, transportation, LPG licensing, HSE standards, pricing, LPG applications, monitoring malpractices, etc. There is no regulatory body responsible to handle issues related with LPG. Hence, there is no one to solve the supply and affordability issues or to take an initiative and strategically plan the growth of LPG industry. Lack of responsible authority has made the business uncontrolled, resulting in unfair pricing, shortage of supply, and lack of proper investment. The country is not reaping the benefits of the LPG industry as there is neither a policy nor a responsible regulatory body.

The assessment of the effect of capability of bulk distributers on supply of LPG reveals that the distributor's capability is inadequate to meet current demand. Capacity has a direct effect on distribution of LPG in Ethiopia. Greater capacity means greater performance, efficiency and profitability. There is a need to enhance and improve the capacity to meet demand and achieve the best of returns. The capacity of LPG storage in the depots of the distributors, the loading capacity and efficiency for bulk supply and the cylinder filling capacity and efficiency have noticeable impact on the distribution of the product.

With regard to the objective to describe the effect of logistics infrastructure on supply and affordability of LPG, it is imperative to conclude that infrastructure plays a great role in the distribution of LPG in the country. Being land locked and having no developed petroleum or gas reserves, Ethiopia solely depends on importation and also has to use neighboring countries' ports. Also, despite there being other means of efficient distribution of fuel elsewhere in the world, Ethiopia is solely dependent on road transport for the entire transportation of LPG. Storage at Djibouti is too small and not fully functional. Storage at Port Sudan has better capacity but shared

between Sudan and Ethiopia with priority always given to Sudan. The hauling distance from Sudan is also very long. The condition of the roads is poor. Hence, there is need to improve the overall infrastructure in order to achieve better supply and affordability.

The attempt to identify the effect of awareness level of consumers to switch from traditional fuels to LPG, in relation to health benefits and safety helped to conclude that lack of awareness has a negative effect on utilization of LPG. The majority of the society are unaware of the environmental and health benefits of LPG and are reluctant to use it. Fear of explosion is also a factor in refraining from its use, even though the modern safety features of LPG accessories make it much safer than the imaginary fear. Lack of awareness has prohibited people from considering LPG as an alternative energy source.

As far as ICT and Collaboration among distributors are concerned, it can evidently be concluded that LPG distributing companies are neither equipped with modern technologies & ICT (for instance, absence of real-time stock monitoring and vehicle tracking system) nor do they have the collaboration with each other.

5.3. Recommendations

Based on the objective of identifying and suggesting ways to increase the utilization of LPG in Ethiopia, the findings from qualitative & quantitative analysis and subsequent conclusions, the following recommendations are forwarded by the researcher.

- It is recommended that the Government should work on developing clear Policies and regulations on LPG business and operations. Hence, a regulatory body responsible for all LPG matters should be appointed to work on policy making, developing HSE and operational standards, regulating, controlling and development of the sector.
- Subsidizing LPG should be seriously considered by the government. The huge health benefits to the population suffering from health issues which results from the use of traditional fuels & kerosene, coupled with LPG's contribution in significantly reducing deforestation, air pollution & soil erosion can be adequate reasons to subsidize the product.

- The government should encourage more investment on LPG business by setting clear policies & regulations, availing the required foreign currency, tax exemption on importation of LPG gadgets and accessories such as stove, cylinder, regulator, hose, etc. This will have a big impact in improving supply & affordability. Involving NGOs and UN organs to support the rural public could also be considered.

- Strategy on scaling up (Large scale transition) to switch from traditional fuels to LPG within a certain period (for example: Goal 2030) should be planned. Such an initiative by the government will have a strong impact in realizing the issues addressed in this paper. Best Practices from other countries can be learned. It is advised to consider LPG as a savior of the deforestation problem and as a contributor to reducing emission levels as well as significantly reduce adverse health problems on the society due to traditional fuels. Relating the subsidy recommended earlier to the global environmental goals and trying to secure funding can also be considered. Scaling up requires maximum attention by the government and even though the subsidy and tax cut can be challenging, the government will ultimately benefit from the resulting economic growth of the industry.

- Improving the overall infrastructure (upgrading storage capacity at ports, maintenance of main roads from Djibouti & Sudan) need to be given utmost attention by the government in order to achieve better supply and affordability of the LPG sector. Feasibility study for installation of pipelines should also be considered as this is an available alternative to transport the product to the required locations.

- LPG distributing companies should consider using latest ICT and other technologies in their depots and filling plants for better safety and efficiency.

- LPG distributing companies should work together, collaborate on LPG related issues, and share relevant information. By collaboration and even forming a union, they can be a strong body to influence the government to provide support and more focus to the industry.

- The government, in collaboration with LPG distributing companies should give awareness programs for the public on the health and environmental benefits, on how to use LPG cylinders safely, and educate the society on safety related wrong beliefs. People have fear in using LPG. This fear is imaginary and lack of awareness. One means is by giving training

to retailers and wholesalers, or by making short clips about LPG usage and broadcasting on media.

- LPG market promotion programs should focus on raising awareness (health and environmental benefits must be discussed). Promotions target only the market – price, fraud, etc.
- The government is putting on a large scale effort on reforestation by planting trees but didn't put clear alternative source of energy for the public. LPG can play a big role in this reforestation effort of the nation. Hence, the government can use this opportunity to promote and develop the use of LPG.

5.4. Implications for Further Research

The regression analysis from the research finding showed that the model could explain variability of the dependent variable, utilization of LPG by only 56.3%. The implication is that there is more room for further research by introducing more variables that could affect the dependent variable considered in this study. Expanding the current study to a larger sample size or geographical area may also turn the study to reflect better result.

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Appendices

Annex I: Questionnaire

Addis Ababa University

College of Business and Economics

Executive MBA Program

Dear Sir/Madam,

You are kindly requested to participate in a study entitled "Examining the challenges towards utilization of Liquefied Petroleum Gas (LPG) in Ethiopia". The purpose of the research is to examine the factors which influence the utilization of LPG and will try to propose possible solutions. Hence, your participation in the survey will greatly help in this effort.

Please note that your participation in this study is voluntary and you are free to withdraw from participating in this study at any time. The researcher will not identify you by name in any report using information obtained from your questionnaire. Your genuine response is highly required and appreciated as it is solely used for academic purpose and will be strictly confidential.

The survey will take approximately 30 minutes to complete. If you have any questions regarding the survey or this research project in general, please call +251 (0) 911-346898. Thank you for taking the time and effort in completing this survey questionnaire.

Sincerely,

Alexander Teka

Part I – Respondent's Profile

1. Gender: Female ☐ Male ☐

2. Age Group:

   18-24 ☐ 25-30 ☐ 31-40 ☐ 41-50 ☐ Above 50 ☐

3. Work Experience in the LPG Sector:

   Less than 2 years ☐ 2-5 years ☐ 6-10 years ☐

   11-15 years ☐ Above 15 years ☐

4. Level of education:

   Below Grade 10 ☐ Grade 10 to Grade 12 ☐

   12 + certificate/Diploma ☐ Bachelor's degree ☐

   Master's degree ☐ PhD ☐

Part II – Basic Research questions related to the objective of the study, which is to examine the factors that make utilization of LPG in Ethiopia a challenge, identify the gaps and recommend solutions.

Please put a tick mark **(√)** to indicate the extent to which you agree or disagree to the statements given below. This is to assess the scale from strongly disagree to strongly agree for the different questions presented in relation to each independent and dependent variables. The score levels are described as: 1=Strongly Disagree, 2=Disagree, 3 Neutral (Neither agree nor disagree), 4=Agree and 5=Strongly Agree.

No.	**Description**	**Scales**				
1.	**Capability of distributors**	**1**	**2**	**3**	**4**	**5**
1.1	The storage capacity of LPG depots in the country is adequate enough to meet demand.					
1.2.	The cylinder filling capacity of LPG depots in the country is adequate enough to meet demand.					

1.3.	Retailers distributing LPG have a good financial capacity.					
1.4.	Retailers distributing LPG use appropriate forecasting models to estimate the demand for the product.					
1.5.	The financial capacity of LPG distributing companies has a significant impact on the distribution of LPG.					
1.6.	The logistics capacity of LPG distributing companies has noticeable influence on the efficiency of LPG distribution.					
1.7.	The reputation of LPG distributing companies has noticeable influence on the efficiency of LPG distribution.					
2.	**Influence of Infrastructure**	**1**	**2**	**3**	**4**	**5**
2.1.	The conditions of roads from port to different destinations in the country are suitable to ensure timely delivery of LPG.					
2.2.	There are adequate options/alternatives to transport LPG in the country.					
2.3.	The level of integration between the various infrastructural provisions are well performing.					
2.4.	The storage capacity at Djibouti and Sudan ports is adequate enough to meet demand.					
2.5.	The loading capacity at Djibouti and Sudan ports is adequate enough to meet demand.					
2.6.	There are adequate trucks for transportation of LPG on time from ports to the country.					
3.	**Regulatory and Policy Gaps**	**1**	**2**	**3**	**4**	**5**
3.1.	There are adequate number of institutions to settle matters related to LPG supply.					
3.2.	The accessibility of the available institutions for the settlement of LPG related matters is adequate.					

3.3.	There are clear policies on every matter related to LPG supply activities and SHE.					
3.4.	There are no noticeable gaps between the policies and practices of LPG supply in the country.					
3.5.	The regulations cover all the important matters (such as safety, quality and distribution) around LPG supply operations.					
3.6.	Adequate attention for the supply of LPG is given by the government.					
3.7.	Adequate attention for the affordability of LPG is given by the government.					
4.	**Awareness**	**1**	**2**	**3**	**4**	**5**
4.1.	Your customers have full and up to date information and understanding about the product.					
4.2.	The public has adequate information on the health and sanitation benefits of LPG compared to traditional fuels.					
4.3.	The public has adequate information on the environmental benefits of LPG compared to traditional fuels.					
4.4.	The public has adequate information on the energy efficiency benefits of LPG compared to traditional fuels.					
4.5.	The public is willing to use LPG as an alternative to electricity if the price is affordable and supply is adequate.					
4.6.	The public don’t fear about safety related issues of LPG.					
5.	**Information Communication Technology and Collaboration**	**1**	**2**	**3**	**4**	**5**
5.1.	There is a good culture of sharing information among the parties on LPG supply in the country.					

5.2.	The information received on the status of the sector's performance are helpful for the subsequent decision by LPG distributing companies.					
5.3.	Information is fairly distributed for all companies without bias.					
5.4.	LPG distributing Companies and transporters use up-to-date communication technology to monitor drivers' behavior and arrival time.					
5.5.	Your organization has transparent information sharing platform that serves to know about each other's inventory status with your suppliers.					
6.	**Utilization of LPG**	**1**	**2**	**3**	**4**	**5**
6.1.	Capability of distributors affects the level of utilization of LPG.					
6.2.	Infrastructure affects the level of utilization of LPG.					
6.3.	Regulatory and policy gaps affect the level of utilization of LPG.					
6.4.	Awareness affects the level of utilization of LPG.					
6.5.	ICT and Collaboration affect the level of utilization of LPG.					

If you have any additional comments in relation to LPG business challenges in Ethiopia and/or comments relevant to the study, please use the space provided below:

Annex II – መጠይቅ

መጠይቅ

አዲስ አበባ ዩኒቨርሲቲ

የቢዝነስ እና ኢኮኖሚክስ ትምህርት ክፍል

ኤክሲኪዩቲቭ ኤምቢኤ ፕሮግራም

ክቡራን፣

“ወደ ፈሳሽነት የተቀየረ የፔትሮሊዬም ጋዝ (ኤልፒጂ) አጠቃቀም ላይ በኢትዮጵያ ያጋጠሙ ተግዳሮቶች” በሚል ርእስ በተዘጋጀው ጥናት እንዲሳተፉ በትህትና ተጠይቀዋል፡፡ የጥናቱ አላማ በኤልፒጂ አጠቃቀም ላይ ተጽእኖ የሚያደርሱ ሁኔታዎችን መመርመር እና ሊኖሩ የሚችሉ መፍትሔዎችን መጠቆም ነው፡፡ ስለዚህ በጥናቱ ላይ የሚኖሮዎት ተሳትፎ በዚህ ጥረት ላይ ትልቅ እገዛ ያደርጋል፡፡

እባክዎት በዚህ ጥናት መሳተፍ በፈቃደኝነት ላይ የተመሠረተ መሆኑን እና በማናቸውም ጊዜ በዚህ ጥናት ያለዎትን ተሳትፎ በማንኛውም ሰአት መቆም የሚችሉ መሆኑን ልብ ይበሉ፡፡ አጥኝው በማናቸውም ሪፖርት ላይ እርስዎ በመጠይቁ ላይ የሰጡትን መረጃ በመጠቀም በስም ለይቶ አያቀርብዎትም፡፡ ጥናቱ ጥቅም ላይ የሚውለው ለትምህርታዊ አላማ ብቻ ሲሆን ሚስጥራዊነቱም በጥብቅ የተጠበቀ ሰለሆነ ምለሽዎን በትክክል እንዲሰጡ በከፍተኛ ደረጃ የሚፈለግ እና ይበረታታል፡፡

ጥናቱን ለማጠናቀቅ ወደ 30 ደቂቃዎችን ይወስዳል፡፡ ጥናቱን ወይም ይህንን ጥናታዊ ፕሮጀክት በተመለከተ ማናቸውም ጥያቄ በተመለከተ ማናቸውም ጥያቄዎች ካሎዎት እባክዎትን በ +251 (0) 911-346898 ይደውሉ፡፡ ይህንን ጥናታዊ መጠይቅ ለመሙላት ላጠፉት ጊዜ እና ላደረጉት ጥረት አመሰግናለሁ፡፡

ከሰላምታ ጋር

አሌክሳንደር ተካ

ክፍል I — የመላሽ ማህደር

1. ጾታ:- ሴት ☐ ወንድ ☐

2. Age Group:

   18-24 ☐ 25-30 ☐ 31-40 ☐ 41-50 ☐ ከ50 በላይ ☐

3. በኤልፒጂ ዘርፍ ያሎዎት የሥራ ልምድ፡-

   ከ 2 አመት ያነሰ ☐ ከ2-5 አመታት ☐ ከ6-10 አመታት ☐

   ከ11-15 አመታት ☐ ከ 15 አመታት በላይ ☐

4. የትምህርት ደረጃ:-

   ከ10ኛ ክፍል በታች ☐ ከ10ኛ ክፍል እስከ 12ኛ ክፍል ☐

   12+ ሰርትፊኬት/ዲፕሎማ ☐ የመጀመሪያ ዲግሪ ☐

   ሁለተኛ ዲግሪ/ማስተርስ ☐ ፒኤችዲ ☐

ክፍል II — በኢትዮጵያ በኤልፒጂ አጠቃቀም ላይ የሚያጋጥሙ ተግዳሮቶችን መለየት፣ ክፍተቶችን መለየት እና መፍትሔዎችን መጠቆም ጠቆም ከሆነው የጥናቱ አላማ ጋር ተያያዥነት ያላቸው መሠረታዊ የጥናታዊ ጽሑፍ ጥያቄዎች፡፡

እባክዎትን ከዚህ በታች በቀረቡት አረፍተ ነገሮች ላይ የሚስማሙበትን ወይም የማይስማሙበትን ደረጃ ለማመለከት የ (√) ምልክት ያደርጉ፡፡ ይህ ራሳቸውን በቻሉና ጥገኛ በሆኑ ተለዋዋጭ ሁኔታዎች ጋር በተያያዘ ለቀረቡት ለተለያዩ ጥያቄዎች ላይ በጣም ከማይስማሙባቸው በጣም እስከሚስማሙባቸው ድረስ ያለውን ስኬል ለመገምገም ነው፡፡ የነጥብ አሠጣጥ ደረጃዎች፡- 1=በጣም አልስማማም፣ 2=አልስማማም 3 ገለልተኛ (እስማማለሁም አልስማማምም)፣ 4=እስማማለሁ እና 5=በጣም እስማማለሁ

ተ.ቁ	ዝርዝር	ስኬሎች				
1.	**የአከፋፋዮች አቅም**	1	2	3	4	5
1.1	በአገራቱ ያለው የኤልፒጂ ማከማቻ አቅም ያለውን ፍላጎት ለማሟላት በቂ ነው።					
1.2.	በአገራቱ የለው የነዳጅ ማከማቻ የሲሊንደር ሙሌት ያለውን ፍላጎት ለማሟላት በቂ ነው።					
1.3.	ኤልፒጂ የሚያከፋፍሉ ቸርቻሪዎች በቂ የገንዘብ አቅም አላቸው።					
1.4.	የምርቱን ፍላጎት ለመገመት ኤልፒጂ የሚያከፋፍሉ ቸርቻሪዎች አግባብነት ያላቸውን የትንበያ ሞዴሎች ይጠቀማሉ።					
1.5.	የኤልፒጂ አከፋፋይ ድርጅቶች የገንዘብ አቅም በኤልፒጂ ማከፋፈል ላይ የጎላ ተጽእኖ አላቸው።					
1.6.	የኤልፒጂ አከፋፋይ ድርጅቶች የሎጅስቲክስ አቅም በኤልፒጂ ማከፋፈል ላይ ጉልህ ተጽእኖ አላቸው።					
1.7.	የኤልፒጂ አከፋፋይ ድርጅቶች ታዋቂነት በኤልፒጂ ማከፋፈል ላይ ጉልህ ተጽእኖ አላቸው።					
2.	**የመሠረተ ልማት ተጽእኖ**	1	2	3	4	5
2.1.	ከወደብ ጀምሮ በአገራቱ እስከሚገኙት የተለያዩ መዳረሻዎች ድረስ ያሉት የመንገድ ሁኔታዎች ኤልፒጂ በሰአቱ መድረሱን ለማረጋገጥ አመቺ ናቸው።					
2.2.	ኤልፒኢን በአገራቱ ለማንገዝ በቂ ምርጫዎች/አማራጮች አሉ።					

2.3.	በልዩ ልዩ የመሠረተ ልማት አቅርቦቶች መካከል ያለው የቅንጅት ደረጃ በደንብ እየሠራ ይገኛል፡፡					
2.4.	በጅቡቲ እና በሱዳን ወደቦች ያለው የክምችት አቅመም ያለውን ፍላጎት ለመመላት በቂ ነው፡፡					
2.5.	በጅቡቲ እና በሱዳን ወደቦች ያለው የመጫን አቅም ያለውን ፍላጎት ለማሟላት በቂ ነው፡፡					
2.6.	ኤልፒጂን ከወደቦች ወደ አገሪቱ ለማጓጓዝ በቂ የጭነት መኪኖች አሉ፡፡					
3.	**የቁጥጥር እና የፖሊሲ ክፍተቶች**	1	2	3	4	5
3.1.	ከኤልፒጂ አቅርቦት ጋር ተያያዥነት ያላቸውን ጉዳዮች መፍታት የሚችሉ በቂ ቁጥር ያላቸው ተቋሞች አሉ፡፡					
3.2.	ከኤልፒጂ ጋር ተያያዥነት ያላቸውን ጉዳዮች ለመፍታት ዝግጁ የሆኑ ተቋሞች ተደራሽነት በቂ ነው፡፡					
3.3.	ከኤልፒጂ የአቅርቦት ተግባራት እና ከኤስኤችኢ (የስራ ደህንነት) ጋር በተያያዘ ባለው እያንዳንዱ ጉዳይ ግልጽ ፖሊሲዎች አሉ፡፡					
3.4.	በአገሪቱ ባለው የኤልፒጂ አቅርቦት በተመለከተ በፖሊሲዎች እና በተሞክሮዎች መካከል ክፍተቶች አሉ፡፡					
3.5.	ደንቦች በኤልፒጂ አቅርቦት ሥራዎች ጋ በተያያዘ ሁሉንም አስፈላጊ ጉዳዮችን (ለምሳሌ ደኅንነት፣ ጥራት እና ስርጭት/ማከፋፈል) ይሸፍናሉ፡፡					
3.6.	ለኤልፒጂ አቅርቦት በመንግስት በቂ ትኩረት ተሰጥቶታል፡፡					
3.7.	የኤልፒጂ የመሸጫ ዋጋ አቅምን ያገናዘበ እንዲሆን በቂ ትኩረት ተሰጥቷል፡፡					

4.	**ግንዛቤ ማስጨበጫ**	1	2	3	4	5
4.1.	ደንበኞችህ ስለምርቱ የተሟላ እና የቅርብ ጊዜ መረጃ እና ግንዛቤ አላቸው፡፡					
4.2.	ከባሕላዊ ነዳጆች (ማገዶ) ጋር ሲነፃፀር ህዝቡ በኤልፒጂ ጤና እና ንጽህና አጠባበቅ ጥቅሞች ላይ በቂ መረጃ አላቸው፡፡					
4.3.	ከባሕላዊ ነዳጆች (ማገዶ) ጋር ሲነፃፀር ህዝቡ በኤልፒጂ የአካባቢያዊ ጥቅሞች ላይ በቂ መረጃ አላቸው፡፡					
4.4.	ከባሕላዊ ነዳጆች (ማገዶ) ጋር ሲነፃፀር ህዝቡ በኤልፒጂ ኃይል ቆጣቢነት ጥቅሞች ላይ በቂ መረጃ አላቸው፡፡					
4.5.	ዋጋው ተመጣጣኝ ከሆነ እና አቅርበቱ በቂ ከሆነ ሕዝቡ ኤልፒጂን እንደ ኤሌክትሪክ አማራጭነት ለመጠቀም ፈቃደኛ ናቸው፡፡					
4.6.	ሕዝቡ ከኤልፒጂ ደኅንነት ጋር ተያያዥነት ያላቸውን ጉዳዮችን አይፈሩም፡፡					
5.	**የመረጃ ግንኙነት ቴክኖሎጂ እና ትብብር**	1	2	3	4	5
5.1.	በአገሪቱ ባለው የኤልፒጂ አቅርቦት ላይ በባለድርሻ አካላት መካከል መረጃ የመለዋወጥ ጥሩ ባሕል አለ፡፡					
5.2.	በዘርፉ የሥራ አፈጻጸም ሁኔታ ላይ የምንቀበለው መረጃ በቀጣይ በኤልፒጂ አከፋፋይ ድርጅቶች ለሚሰጠው ውሳኔ ይረዳል፡፡					
5.3.	መረጃ ያለምንም አድልኦ በሁሉም ድርጅቶች መካከል በፍትሐዊነትተሠራጭቷል፡፡					

5.4.	የኤልፒጂ አከፋፋይ ድርጅቶች እና አንገቦች የአሽከርካሪዎችን ባሕሪይ እና የመድረሻ ጊዜ ለመቆጣጠር የቅርብ ጊዜ የመረጃ ቴክኖሎጂ ይጠቀማሉ፡፡					
5.5.	ድርጅትዎ የአቅራቢዎችዎን እርስ በራሳቸው ያላቸውን የኤልፒጂ መጠን ለማወቅ የሚረዳ ግልጽ የመረጃ መስጫ መድረክ አለው፡፡					
6.	**የአልፒጂ አጠቃቀም**	1	2	3	4	5
6.1.	የአከፋፋዮች አቅም በኤልፒጂ አጠቃቀም ደረጃ ላይ ተጽእኖ ያደርጋሉ፡፡					
6.2.	መሠረተልማት በኤልፒጂ አጠቃቀም ላይ ተጽእኖ ያደርሳል፡፡					
6.3.	የቁጥጥር እና የፖሊሲ ክፍተቶች በኤልፒጂ አጠቃቀም ደረጃ ላይ ተጽእኖ ያደርሳሉ፡					
6.4.	ግንዛቤ በኤልፒጂ አጠቃቀም ደረጃ ላይ ተጽእኖ ያደርሳል፡፡					
6.5.	አይሲቲ (የመረጃ ግንኙነት ቴክኖሎጂ) እና ትብብር በኤልፒጂ አጠቃቀም ላይ ተጽእኖ ያደርሳሉ፡፡					

በኢትዮጵያ ከኤልፒጂ የሥራ ተግዳሮቶች ጋር በተያያዘ ማናቸውም ተጨማሪ መረጃ እና/ ከጥናቱ ጋር ተያያዥነት ያለው አስተያየት ካሎዎት እባክዎን ከዚህ በታች የተሰጠውን ቦታ ይጠቀሙ፡-

Annex III – Interview Questions

1. What is your thought on the utilization of LPG in Ethiopia? Do you believe that it is being adequately supplied? Please discuss.
2. What are the challenges related to LPG business in Ethiopia? Please explain in detail.
3. How do you describe the storage and loading capacities at ports in terms of the effect in improving the supply and affordability of LPG?
4. How is the status (in terms of quality & quantity) of the roads against the current LPG demand of the nation? What alternative means of fuel transportation do we have at hand or should we consider for the future?
5. How do you evaluate the storage, loading and cylinder filling capacities of LPG distributors against the current demand in the country?
6. How do capabilities influence the Distributors' efficiency in meeting their commitments and attaining competitive advantage?
7. Are there clear policies and regulations as well as accessible and adequate number of institutions to address all issues related to LPG business operations? What about the practicality of the policies and regulations? Please describe.
8. What is your view on the level of attention by the government on LPG business considering its benefits on public health, the environment, portability and energy efficiency?
9. Please assess the level of awareness of the public regarding LPG's safety management, health and environmental benefits compared with traditional fuels?
10. To what extent have LPG distributing companies and the government acted to raise the awareness level of the public? If not much, what should be done to change the status?
11. How do you describe the challenges in terms of market penetration of LPG as an alternative for electricity?
12. What do you think should be done to encourage more investment on LPG business?
13. Would you please discuss the culture and fairness of sharing information among the players in the LPG business sector?
14. Do the LPG industry stakeholders apply latest technologies and devices in monitoring and controlling the supply efficiency and malpractices in the sector?
15. What do you think should be done to make large scale transition from traditional fuels to LPG?