



## **ADOPTION OF LIQUEFIED PETROLEUM GAS FOR COOKING IN OLD SENGA SUBURB IN GWERU, ZIMBABWE**

By

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### **Abstract**

*This study intended to establish the adoption of liquefied petroleum gas as a cooking energy in Old Senga Suburb in Gweru. This was motivated by the fact that the adoption of LPG was in its infancy yet in other countries use was quite advanced. The study was pragmatic and utilized both quantitative and qualitative research techniques. These included questionnaires, interviews and observations. The study established that although there was an upsurge in the use of LPG, it remained an alternative source that was used in cases of emergency, like when there was power outage or load shedding. Most users had small gas tanks, which was an indicator they consumed small quantities of LPG. Age and gender were not determinants in the adoption of LPG, whilst ducation had a positive influence. Affordabilty had an impact on the adoption. The study recommends that education and awareness campaigns on safe use by households will positively influence the adoption of LPG. Users in Old Senga in Gweru, should acquire government approved LPG stoves and gas tanks. LPG should always be made available and users should migrate to modern LPG stoves as this will encouge uptake of LPG.*

**Key words:** biomass, energy poverty, liquefied petroleum gas, Old Senga,

### **Background to the study**

Globally, about three billion people are exposed to energy poverty as they lack access to clean cooking energy (Gould and Urpelainen, 2020; Ritchie and Roser, 2019; The World Bank, 2019; Van Leeuwen, Evans & Hyseni, 2017). They depend on energy derived from biomass to cook their meals. According to IEA (2017) 1.65 billion people (43% of the population) in Asia depend on biomass for cooking, while about 80% of the population in sub Saharan Africa (SSA) still cooks with solid biomass, which means that it is the region with the least progress on clean cooking. Biomass energy consists of wood, agricultural residues and animal dung. There is continued use of the polluting biomass fuels particularly in SSA because of their

availability and low cost as well as the ability to gather the fuels for free from the local forests (Bailis, 2015; Shupler et al., 2021).

The use of biomass as a source of energy is, however, associated with a number of challenges. Women and girls travel long distances and spend several hours in search of fuelwood (Kethoilwe & Kanene, 2018). Furthermore, women and children face the risk of being harassed and assaulted while searching for fuelwood particularly in rural and peri-urban areas (Food and Agriculture Organization, 2018). Lack of cooking energy exposes women and children to a number of health challenges. These include injuries of the neck and back from carrying heavy loads of fuelwood (Thompson, 2015). Thompson (2015) also observes that women and children are also exposed to effects of smoke inhalation of unburned hydrocarbons as they spend many hours close to the cooking fire in the kitchen. It is estimated that four million people die annually in low- and middle-income countries from household indoor air pollution emanating from the use of inefficient solid fuels for cooking (Stanistreet, Hyseni, Puzzolo, Higgerson & Ronzi, 2019). The use of dirty biomass is associated with the development of eye problems that include cataracts. Studies conducted over the years suggest there is a close association between the incidence and prevalence of cataracts with the practice of using solid biomass fuel (Roanova, Heilig & Godnic-Cvar, 2009; Fullerton, Bruce & Gordon, 2008).

The continued dependence on firewood is also causing serious deforestation and ecological damage on the urban fringe. According to Dube, Musara, and Chitamba, (2014) increased firewood use might be a threat to the extinction of certain tree species in the peri-urban area in Bulawayo in Zimbabwe. It is also realised that the demand for firewood encourages firewood commercialisation, which results in the depletion of preferred firewood tree species (Kethoilwe & Kanene, 2018). Furthermore, there is a serious concern on global warming and climate change, which could be triggered by excessive use of woodfuel. According to Practical Action (2010) burning biomass fuels in open and traditional stoves results in the emission of greenhouse gases (GHG) which cause global warming and climate change.

In order to avert the above named challenges, there is a global push towards a transition to cleaner energy forms for cooking. Liquefied petroleum gas (LPG) is viewed as one of the cleanest options that could be adopted to realise both health and climate change mitigation goals (Rosenthal et al., 2018). LPG is a clean burning efficient, versatile and portable fuel which is produced as a by-product of natural gas extraction and crude oil refining. ENERGIA (2014) sees the increased use of LPG by households as one of the several pathways to meet the objective of universal access to clean cooking and heating solutions by 2030. According to the

Asian Development Bank (2015) one of the targets of the United Nations Sustainable Energy for All (SE4All) initiatives was universal access to modern energy services. This could be achieved by adopting LPG as a cooking and heating energy form. Although the value of LPG is easily recognized in the context of SDG 7, that is focusing on affordable and clean energy, it could contribute towards the realisation of all SDGs either directly or indirectly in a range of ways (World LPG Association, 2019).

LPG could be utilised to solve problems associated with cooking energy issues. However, before this could be done a number of hurdles need to be cleared. Affordability and availability of LPG remain as some of the greatest challenges affecting the migration of households from biomass energy to LPG in the developing countries. Rao, Dahal, Hadingham and Kumar (2020) argue that LPG and electricity are not affordable and as a result they tend to be used by higher income groups. Lower income groups tend to use fuelwood and other biomass forms of energy. The same sentiments were expressed by Stanistreet et al (2019) who contend that affordability of gas technology was one of the main barriers to LPG adoption and sustained use, particularly for households that did not have a stable income. It is also observed that unreliable supply of LPG constricts the use of the fuel (Shupler et al., 2021). Households end up resorting to the polluting biomass fuels which they believe are relatively easy to acquire.

Phobia for LPG is a major deterrent in the adoption of the energy system. A study conducted by Williams, Kephart, Fandiño-Del-Rio, Condori, Koehler, Moultona, Checkley and Harvey (2020) showed that women exhibited fear in using LPG stoves as they were not well acquainted with them. In another study by Rao, Dahal, Hadingham and Kumar (2020) it emerged that the adoption of LPG in rural India was initially affected by the fear of exploding LPG cylinders. However, with continuous campaigns organized by LPG agencies over the years, more and more people are adopting LPG as a cooking energy form. Failure to cook certain traditional dishes with LPG stoves was also a hindrance in the adoption of LPG. According to Williams et al. (2020) a number of women in Peru revealed that they could not migrate to the use of LPG as they could not use it to prepare traditional dishes such as chapati. In Haryana India, households preferred chapati made with traditional stoves as they felt chapati made with LPG did not taste the same (Mukhopadhyay, 2012). Chapati, is unleavened flat bread made from whole wheat flour and is part of the Indian traditional staple food (Shaikh, Ghodke & Ananthanarayan, 2008).

It is important to note that social factors may also affect the adoption of and use of LPG technology in developing countries. It is apparent that some women enjoy cooking on an open fire as they take this as part of their cultural obligation. A study by Hollada et al. (2017)

conducted in Peru showed that women regarded the time they spent cooking as a normal part of their daily routine; hence they enjoyed the activity. In Guatemala women enjoy the social time presented by biomass fuel collection (Thompson, Hengstermann, Weinstein, & Diaz-Artiga, 2018). This is also consistent with observations made by Mangizvo (2014) in a study in Chiwundura, a rural area in Zimbabwe, where women utilised fuelwood collection time as pass time to engage in social discussions as well as initiate each other in social issues concerning them.

Government intervention plays a critical role in the adoption of LPG by local communities. In Ecuador, the central government took a deliberate effort to subsidise LPG in the 1970s and by 2018, 90% of Ecuadorian households cooked primarily with LPG (Gould, 2018). Cameroon, in Central Africa, has made some concerted effort to increase the number of households using LPG from 20% in 2016, to 58% by 2035 (Bruce et al., 2018). This decision was propelled by the desire to protect forests, improve health as well as to develop energy and the economy in line with the Central African regional policy (CEEAC, 2014). The decision made by government resulted in 18 million more Cameroonians gaining access to LPG (GLPGP, 2016). However, the situation is different in Zimbabwe, where the use of LPG is in its infancy (Nsingo, 2019). This study therefore made a deliberate attempt to find out why the adoption of LPG as a domestic energy source was lethargic in Old Senga, a high density suburb in Gweru in Zimbabwe.

### **Theoretical framework**

This study was premised on the concept of the 'Fuel Stacking' or 'Multiple Fuel'. According to this concept, with increasing income, households do not switch fully to a new and different fuel type, because their incomes have increased. Instead they would rather use an energy mix. The households would in that case, depend on multiple fuels which include superior fuels combined with inferior fuels such as biomass for their domestic energy-use (Kroon, Brouwer & Van Beukering, 2013; Mekonnen, Gebreegziabher, Kassie, & Köln, 2009). It is important to observe that not only income is responsible for the fuel-switching behaviour of a number of households. Instead, a number of factors which include price changes, preferences, taste, availability of technology, reliability of supply, education, cooking and consumption habits, household composition and further cultural or habitual factors, play a significant role in why households tend to adopt the 'multiple fuel' model (Mekonnen et al. 2009). It is against this background why this theory was adopted for use in this study as it is relevant in the adoption and use of LPG in Old Senga Suburb in Gweru City. As will be observed, LPG was used as

one of the fuels in the study area, which included biomass, electricity and to some extent plastics.

### **Statement of the problem**

It is apparent that residents in Old Senga only use LPG as an alternative backup source of cooking energy. This is usually in the absence of grid electricity. Otherwise they continue to depend on other sources of energy such as biomass, especially fuelwood, which is associated with a number of negative challenges, and electricity, that was not always available to load shedding.

### **Research objectives**

This study was therefore guided by the following objectives:

- to establish the reasons why the uptake of LPG was at low levels despite efforts by government to encourage households to switch to the energy source.
- to find out whether the households in Old Senga had adequate information on the use of LPG as a form of cooking energy.
- to recommend what could be done to encourage residents to migrate to LPG for cooking.

### **Research methodology**

The study adopted a mixed research approach, that is, triangulating quantitative and qualitative methods. This was done as a way of obtaining a complete understanding of the challenges stalling the adoption of LPG in Old Senga Suburb. According to Cresswell (2014) the use of the mixed approach, that is mixing quantitative and qualitative methods, provides a complete understanding of the research problem than using only one type of methods. The two methods have complementary strengths when they are mixed, which means that using the strengths of one research method to enhance or support the other one. On the one hand, the qualitative techniques were useful as they enabled the study to reflect on the local social understanding on the issues surrounding the adoption of LPG. On the other hand, the quantitative approach provided the quantitative precise results which could be later generalized in other contexts. The collection of data was divided into three parts. The first part was basically composed of observations on the residents who visited the kiosks to buy gas. The second part involved interviewing residents who visited the kiosks. Lastly, the third part was based on administering questionnaires to selected residents as they came to procure gas.

This study utilized the exploratory sequential design. The researcher started by observing the people who came to buy LPG from the kiosks in Old Senga. The study was interested in their characteristics, such as gender and age. The study also observed the nature of gas tanks used by the residents. The study also observed circumstances associated with buying of the gas among many other things as shall be discussed later. The researcher spent time at the kiosks where he interviewed residents who visited to buy gas. Convenience sampling was used to select participants for the interviews for this study. Anyone who visited the kiosks when the researcher was there was interviewed. Once the saturation stage was reached, interviews were stopped. The qualitative findings were used as the basis for the other part of the study which is the quantitative phase. The questionnaire guide to elicit information from respondents was crafted based on findings from the observations made and interviews conducted. Respondents for the questionnaire were selected using systematic sampling. The study administered questionnaires to every third person who visited the kiosks. On average six questionnaire guides were given in a day. A total of 100 people responded to questionnaires. According to information obtained from the municipality, Old Senga has 383 houses with an approximate population of 5000 people. The study utilized basic statistics to analyse quantitative data. It also used thematic frames to analyse qualitative data.

### **Study area**

Old Senga is one of the oldest suburbs in Gweru having been established in 1946. Initially it was intended to accommodate black domestic labourers who worked in the white low density suburbs of Gweru East, Windsor, and Kopje. At independence in 1980, this suburb gradually transformed to become a residential area for various classes of people. The suburb is no longer occupied by domestic workers as some people from different backgrounds bought houses in the suburb from the municipality. However, an observation made showed that the suburb had a significant number of retirees. Several houses in the suburbs were renovated and very few houses still maintain the colonial structure. At the time of the study the suburb had 343 houses, with approximately 5000 residents. The suburb is connected to grid electricity and generally this is the form of power used by most households in the area. It was also realized that fuelwood was commonly used by a number of households. The smoke from the fire was associated with a thick blanket of smog that covered the suburb in the evenings, especially in winter.

### **Findings and discussions**

The study established that there was an upsurge in the use of LPG in Old Senga at the time the study was conducted compared to the previous years. The study observed that there was a steady flow of residents visiting the LPG kiosks to fill their gas tanks. According to kiosk

attendants, more households compared to periods in the past were using gas as they recorded on average a total of twenty-five people coming to buy gas on a daily basis. Information obtained from questionnaires established that although there was this increase, very few households were using LPG as their main source of energy for cooking. Only 10% of the respondents used LPG as their main source of energy for cooking. The majority (75%) of households preferred using grid electricity for cooking, followed by 13% of the respondents who used fuelwood or firewood as their main source of energy for cooking. A paltry 2% of the respondents used paraffin (kerosene) for cooking.

During interviews it emerged that LPG was used mainly as an alternative form of energy especially when there was power outage due to electrical fault, or when there was load shedding. Observations made showed that whenever there was no electricity in Old Senga for several hours the traffic of people visiting the kiosks increased. The same observations were made by the kiosk attendants who mentioned that they registered brisk business whenever there was no electricity supply in the suburb. The same scenario was observed by Mohlakoana and Annecke (2009) who noticed that there was a gradual shift to the use of LPG by poor households when load shedding was introduced in the Western Cape in South Africa. Unlike the situation in the study area, several households in the Western Cape continued to utilise LPG for cooking after the easing of load shedding, because it was clean, fast and convenient.

The study observed that most residents visiting the kiosks in the study area had small gas tanks ranging between 2 kilograms and 5 kilograms. The interviews conducted with the participants revealed that they did not see the need to acquire large gas tanks as these were only used as a contingency measure. They went on to say that they usually bought on average one or two kilograms of gas. This was confirmed by the kiosk attendants who revealed that most of their customers who came when there was an electricity outage bought between one and two kilograms. Those who came even when electricity was available are the households that bought anything above five kilograms. This showed that LPG had not been adopted as the main energy source for cooking but was only a back up to electricity. A close analysis reveals that this was some form of energy stacking taking place, as the residents continued to depend mainly on electricity, but only resorted to LPG in the event of load shedding or power outage. It was used as a backup together with other forms of energy such as biomass.

The study wanted to find out whether the age of household head was a determinant in the adoption of LPG. Information obtained from questionnaires showed that the adoption of LPG as a form of cooking energy according to age group was unevenly distributed. The 31-40 age group dominated the usage as they constituted 33% of the respondents. This was followed by

the 25-30-year age group who constituted 23%. The 41-50-year age group made up 20% of the respondents. Those above 50 years of age comprised 14% of the respondents, whilst those below 25 years of age were 8% of the respondents. It is apparent from the statistics that age was not a determinant in the adoption of LPG as an alternative cooking energy in Old Senga Suburb. From the interviews conducted with elderly participants it emerged that they still had phobia of LPG, but they were embracing it as a form of cooking energy. They revealed that they used it occasionally, when there was no electricity supply to the suburb. They also mentioned that they were cautious whenever they used LPG and made sure vigilance was adhered to when operating LPG stoves. The adoption of LPG by those above 50 years of age seems to be in contradiction with views by Pope et al. (2018) who observe that it was less likely for household heads of an older age (46+ years) to report using any LPG. This was probably users in the study area were made aware of the dangers associated with reckless use of LPG. They had been empowered and were able to operate LPG stoves.

The study also wanted to establish whether the gender of the respondents had anything to do with the adoption of LPG as a cooking energy. Fifty-three percent of the respondents were males while 47% were females. There was no significant difference on the numbers between males and females. It therefore appeared that the adoption of LPG as a cooking energy form was not really dependent on the gender of the household head. It emerged that most respondents were busy people who spend the day engaged in various activities to raise money for the survival of their families. They felt that in the absence of electricity they resorted to LPG since it was efficient, fast and clean. It was therefore appropriate as a backup to electricity.

The study was concerned with finding out whether affordability was a major determinant in the use of LPG in Old Senga. It was realized that the cost of LPG stoves, that is, tank and plate as well as refilling the tanks, were a major factor in the regular use of LPG in Old Senga Suburb. During interviews the participants revealed that the cost of gas stoves was exorbitant, whilst the cost of refilling the tanks was volatile and on the upward trend. A study conducted by Perros and Shupler (2022) in Nigeria, Rwanda, Brazil, Vietnam and Kenya revealed a similar situation as observed in Old Senga. Households that had migrated to LPG reverted to cooking with wood and charcoal because of costs. According to Ndunguru (2021) high upfront costs to purchase cylinders and stoves as well as high cylinder refilling price, were some of the challenges affecting residents who intended to use LPG in Kinondoni, in Dar es Salaam, in Tanzania. In the end they resorted to the use of charcoal and biomass energy. Similar sentiments were raised by Kar, Pachauri, Bailis and Zerriffi (2019) who content that some households are able to raise the initial amount of full LPG cylinder, they could not raise money



for LPG refills due to insecure incomes as well as precarious financial situations. This resulted in unsustainable usage of LPG as a primary cooking fuel.

The situation in Zimbabwe was made worse because at the time of the study, the country's economy was being affected by inflation. This meant that the price of gas in the local currency, that is the Zimbabwe currency (RTGS) continued to rise from the time the study commenced, up to the time the study was concluded. At the initial stages of the study, the cost of gas ranged between RTGS\$125 (US\$1.25) and RTGS\$170 (US\$1.70). This was beyond the means of the majority of the residents whose income was pegged in RTGS dollars (Zimbabwean currency) at the time the study was conducted. At the tail end of the study the kiosks in Old Senga and those in the city centre had resorted to the selling gas in United States dollars only, and it was pegged at USD 2 (RTGS 800) a kilogram. They argued that their suppliers only accepted United States dollars; hence it was logical for them to sell their gas using the same currency in order for them to remain viable. This volatility in prices was not good for the adoption of LPG in Old Senga in particular, and the country in general.

It emerged during interviews that most of the participants could not access the United States dollars on the parallel market where it was more available than the official market. The exchange rate was exorbitant. At face value it actually turned out that using electricity was far cheaper than using LPG. Those who could not afford LPG during blackouts used fuelwood. This was considered cheaper because those using fuelwood simply collected it from the outskirts of the Gweru City. Some actually bought the fuelwood from vendors who acquired it from places such as Northgate and Hertfordshire, which were new suburbs where residential stands were being cleared to enable the construction of houses.

The study established that 74% of the respondents were using the old models of LPG stoves. These required the use of match sticks. Only 26% of the respondents had migrated to using the modern automatic gas cookers, which did not require the use of match sticks. These were deemed safer than the old models. Those using the old models revealed that they acquired these long back before the advent of the automatic cookers. They felt it was unnecessary to acquire the automatic cookers since they used LPG for cooking occasionally. Furthermore, their financial resources were strained and could not afford the luxury of buying the automatic cookers when they at least had something to use. They argued that the prices of gas stoves and tanks were generally exorbitant and well beyond their means. Observations made during the time of the study showed that on average 5kg tanks cost USD35. Some revealed that they had never heard of the automatic cookers, while others were skeptical of the new model that did not use match sticks. They doubted their safety. In a study conducted by Dalaba et al. (2018)

in Kassena Nankana Districts (KND) of Ghana, affordability featured as one of the main reasons for low usage of LPG.

The study also intended to find out whether education influenced the use of LPG in Old Senga. It was apparent education had a positive influence on the adoption of LPG as a form of cooking energy. The respondents with tertiary education, had the highest number of people using LPG (31%), followed by those with Ordinary level and Advanced level who constituted 29% and 24% respectively of the respondents. Those with primary education made up 12% whilst those with no form of education constituted 4% of the respondents. Education empowers individuals with information on correct use of LPG stoves. One is able to read instructions on proper use and is therefore able to avert possible dangers that are associated with improper use of the gadgets. Education helps individuals to dispel myths associated with the use of LPG. In a study conducted in Lagos in Nigeria by Ozoh et al. (2018), it was established that LPG users were significantly more educated than users of other lower forms of energy. Similar observations were made by Kizilcec, Perros, Bisaga and Parikh (2022) who are of the opinion that there was a more likelihood for families with educated members to use LPG compared to families with less educated members. Educated consumers had increased awareness about benefits of using clean fuels. There were also collinearities between higher levels of education and increased income (Kizilcec et al., 2022).

The study established that source of income for the household head did not have a close association with the use of LPG for cooking. Only 31% of the respondents were formally employed, while 69% were either self-employed or were in informal employment. It was therefore clear that those adopting LPG were pushed more by convenience rather income levels. As already discussed earlier on, the trend was that most consumers of LPG bought the gas in small quantities. This could be a reflection of their employment status. One participant had this to say:

*I am not employed on a full time basis and I depend on casual employment for survival. I therefore buy enough quantities to use during times when there is load shedding and during the rainy season when power cuts are frequent due to storms. Otherwise I normally use electricity and since it is prepaid I can control my consumption.*

Pope et al. (2018) concur with the above notion, as they say a higher household income associated with a regular salary were all positively associated with reported use of LPG.

The study observed that the availability of the gas at the kiosks was also a major determinant in the adoption of the energy technology. The attendants revealed that there were times they could not procure LPG and this tended to be a deterrent to those people intending to migrate to the use of LPG. Users develop some attachment to a commodity that is easily available. Once they fail to get the commodity, they either revert to their old ways, or even look for alternatives such as charcoal, which was gradually gaining popularity due to its affordability and availability. One participants shared these views:

*There are times when kiosks in Old Senga may go for days without gas. This is not good because if I fail to get the gas when I need it most I end up resorting to other sources of energy. Charcoal is becoming popular in Old Senga despite not being a clean source of energy. It is critical for suppliers to always ensure the availability of LPG because consumers might switch to available alternatives.*

According to Alem, Ruhinduka, and Berck (2017) households in Dares Salam in Tanzania, find it easier to continue using charcoal because charcoal vendors are located in areas that can be easily reached, compared to gas dealers.

## **Conclusions**

There was evidence on the ground indicating that the use of LPG in Old Senga Suburb was increasing. However, the study established that the use was sparing. It remained as a backup source of energy that was used only in the absence of electricity. It was apparent there were very few households if any in the study area, that used LPG as their main energy source for cooking. The study realized that kiosks in the study area were busy when there was load shedding or blackout resulting from faults. The kiosks also experienced brisk business during the rainy season when the use of biomass was difficult.

LPG remains very expensive and households in Old Senga who used LPG bought small quantities ranging between one kilogram and three kilograms that were used as a contingency energy source.

The adoption of LPG in the study area was negatively affected by the volatility in prices spurred by the superiority of the United States dollar over the local currency.

Households in the study area continued to depend on the old fashioned gas stoves that required the use of matches to ignite them. These were not safe and could instill some phobia on the use of LPG stoves in certain individuals.

## **Recommendations**

There is need for the general public to be educated on the safe ways of using LPG. This will dispel fears and phobia that they might have concerning the use of LPG.

Households in the study area should always take precautionary measures when using LPG in their homes.

It is incumbent upon the government through its regulatory board, that is ZERA, to ensure that approved LPG cook stoves are sold through registered dealers. Only properly licensed kiosks in the study area should be allowed to sell gas. These are ways of ensuring that quality products are on the market and the safety of users is guaranteed.

The government should ensure that LPG is readily available to guard against the unwarranted price increases. Easy access and affordability will allow households to migrate to the use of LPG as one of the energy sources amongst the other forms stacked by households.

Households in the study area should migrate to the use of safe LPG stoves such as automatic gas cooker which do not require the use of match sticks to light them.

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