LPG Supply Survey in Northern Ghana

Prices, Peers, and Perception (P3) Project Report

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Background

In Northern Ghana, the majority of households continue to use biomass (wood or charcoal) to meet their cooking needs. This practice has well-documented impacts on health outcomes and environmental quality, and a national and global push is underway to enable transitions toward cleaner cooking options. Liquefied petroleum gas (LPG) is widely advocated as one of the cleanest options from a human health perspective. At the national level, Ghana has adopted a goal of expanding LPG access to 50% of the country's population; the target date for reaching this goal was originally 2015, but progress has been slower than hoped, and the target date was revised to 2020 [1] (see Figure 1). National efforts are underway to expand LPG access and use, most notably through the Rural LPG Promotion Program (RLP) [2]. However, progress has been particularly slow in the Northern areas of the country. A 2012 report by the Ghana Energy Commission mapped LPG retail filling stations across Ghana (Figure 2), clearly showing the relative scarcity of LPG supply in the Northern regions of Ghana compared to the south.

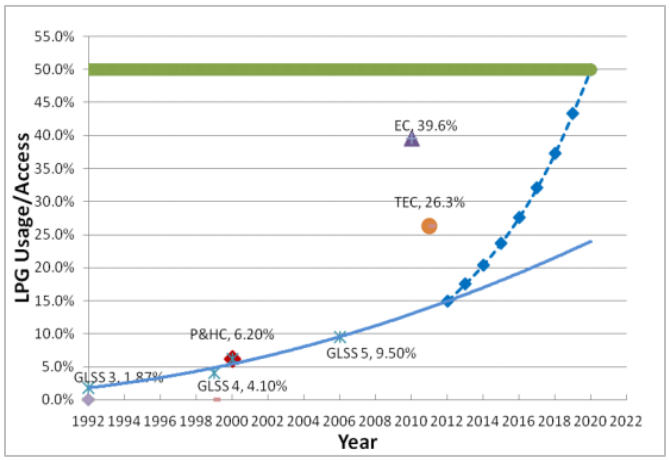

Figure 1: Measurements and projections of LPG access in Ghana [1]

Exemplifying Ghana's LPG access challenges, the Kassena-Nankana (K-N) Districts are located in Ghana's Upper East region along the country's northern border. According to 2011-2013 data from a demographic surveillance survey conducted periodically by the Navrongo Health Research Center [3], only 7% of households in these districts use LPG as their main cooking fuel, while 74% rely primarily on fuelwood or crop residue and 18% use charcoal as their main fuel. Use of LPG is concentrated in the central urban areas around Navrongo town, but even in these areas access is not universal: about 1/3 of the urban population uses LPG as their main cooking fuel, while 60% primarily use

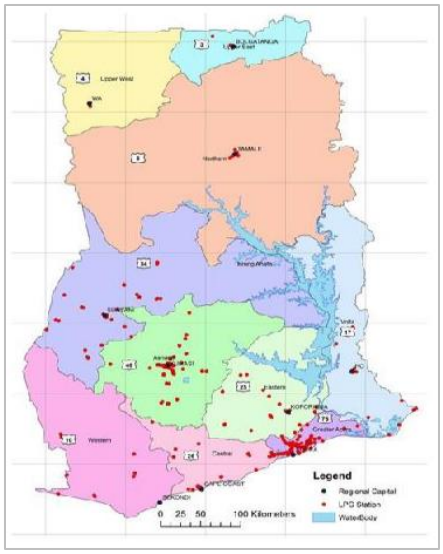

Figure 2: Locations of LPG retail stations across Ghana [1]. Upper East region shown in light blue in northeast corner of the country.

charcoal. Outside of the central area, only 3% of the population uses LPG as their main fuel.

The Prices, Peers, and Perceptions (P3) project aims to investigate how adoption of LPG stoves and fuel could be scaled up in Northern Ghana through an in-depth assessment of both supply- and demand-side barriers and opportunities. This report summarizes results from a survey conducted with LPG suppliers in this region.

Methods

The P3 LPG Supply Survey was conducted between June 20 and July 22, 2016. We identified all retail centers in the K-N Districts selling LPG stoves or cylinders, as well as retail LPG filling stations throughout the larger Upper East region. We developed the survey using a review of the literature on LPG, as well as input from international experts in the household energy sector (e.g., Global LPG Partnership). Surveys were conducted in person (using Android tablets and the ODK survey software platform) at the respondents' places of business by an experienced interviewer. Surveys were conducted in either English or Kasem (a local language). This report presents descriptive statistics and summaries of text responses. The full survey instrument is included as an Appendix.

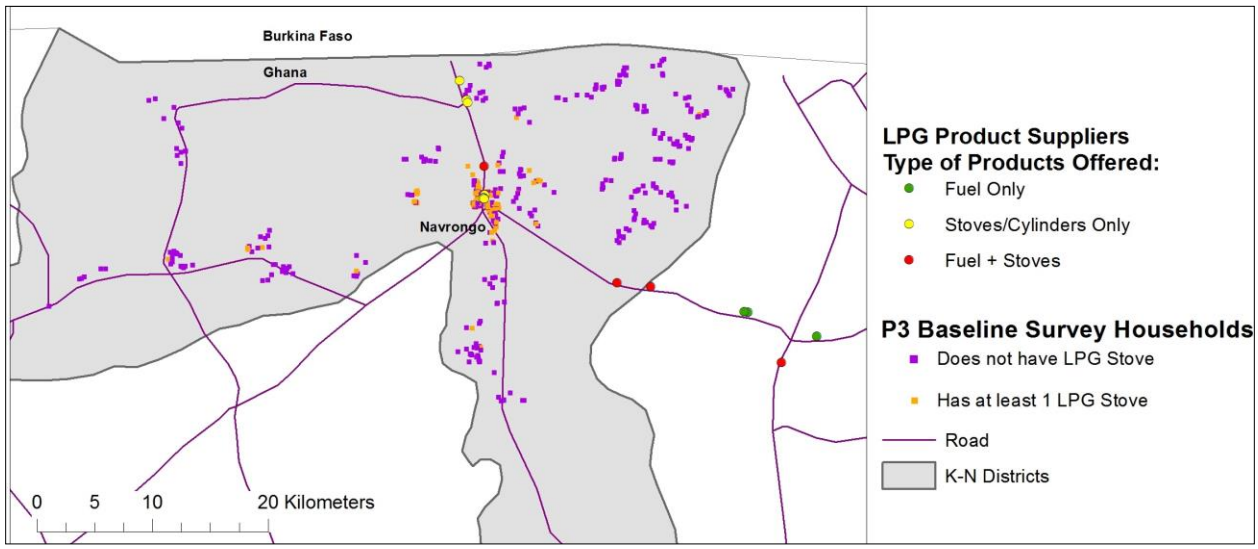

Figure 3: Map of LPG Suppliers (by types of products sold) and P3 Households (by LPG ownership)

Results

Part I: Business Information

In total, sixteen stores throughout the K-N districts that sold any combination of LPG stoves and cylinders as well as all LPG refilling stations in the Upper East region were interviewed. Seven (43.75%) of these stores were located in the town of Navrongo (in the K-N), six (37.5%) in Bolgatanga (outside the K-N), and three (18.75%) in Paga (also in the K-N). Each respondent was asked whether their business refilled LPG cylinders, sold LPG stoves, and sold LPG cylinders. Of the sixteen businesses, 7 (43.75%) served as LPG refilling stations, 12 (75%) sold LPG stoves, and 13 (81.25%) sold LPG cylinders. Locations of these businesses are shown in Figure 3 (circles), color coded by the types of products offered. This figure also shows the locations of households interviewed for the P3 project's baseline household survey, color coded

by ownership of LPG stoves at baseline. Officially, only one LPG filling station is located in the K-N District, though two others – officially in the town of Bolgatanga and outside of the K-N boundary – show up within the K-N boundary on the map.

Of the sixteen LPG supply survey respondents, six (37.5%) were the business owner while the remainders were employees. Of these respondents, only 5 (31.25%) were female, but all five of these females were the business owners. The respondents ranged in age from 22 to 59 years, with a median age of 27.5 years old. Eight (50%) of respondents have completed at least tertiary school, six (37.5%) have completed secondary school, and two (12.5%) finished primary school. These respondents have been working in this business for a range of 1 to 27 years with a median of 8 years.

Table 1: Statistics on P3 LPG Supply Survey respondents and businesses

Respondent's role in business	Owner: 6 (37.5%) Employee: 10 (62.5%)
Respondent's gender	Male: 11 (68.75%) Female: 5 (31.25%)
Respondent's age	Min: 22 Median: 27.5 Max: 59 Mean: 32.0625
Respondent's highest level of education completed	Never attended school: 0 (0%) Primary: 2 (12.5%) Secondary: 6 (37.5%) Tertiary/higher: 8 (50%)
Number of years respondent has been in this business	Min: 1 Median: 8 Max: 27 Mean: 8.66
Number of years this business has been in operation	Min: 1 Median: 6 Max: 25 Mean: 7.5
Number of full time employees (35 hours or more per week)	Min: 0 Median: 1.5 Max: 5 Mean: 2.06
Number of part time employees (less than 35 hours)	0: 2: 1 4: 1
Own or rent business property	Own: 10 (62.5%) Rent: 6 (37.5%)
Monthly rental payment	30, 30, 50, 125 cedi
Products provided by business	LPG refills: 43.75% LPG stoves: 75% LPG cylinders: 81.25%

These businesses have been in operation for between 1 and 25 years with a median of 6 years, and currently have between 0 and 5 full time employees (median = 1.5). Only two businesses have part-time employees (<35 work hours a week), and these businesses have 2 and 4 part-time employees. Of the sixteen businesses, 10 (62.5%) own the property their business is located on and 6 (37.5%) rent the property. Two businesses reported renting for 30 cedi[1] a month and two other businesses reported paying 50 and 125 cedi. Additional information about the survey respondents and businesses can be seen in Table 1.

Part II: Product Information

LPG Filling Station Questions

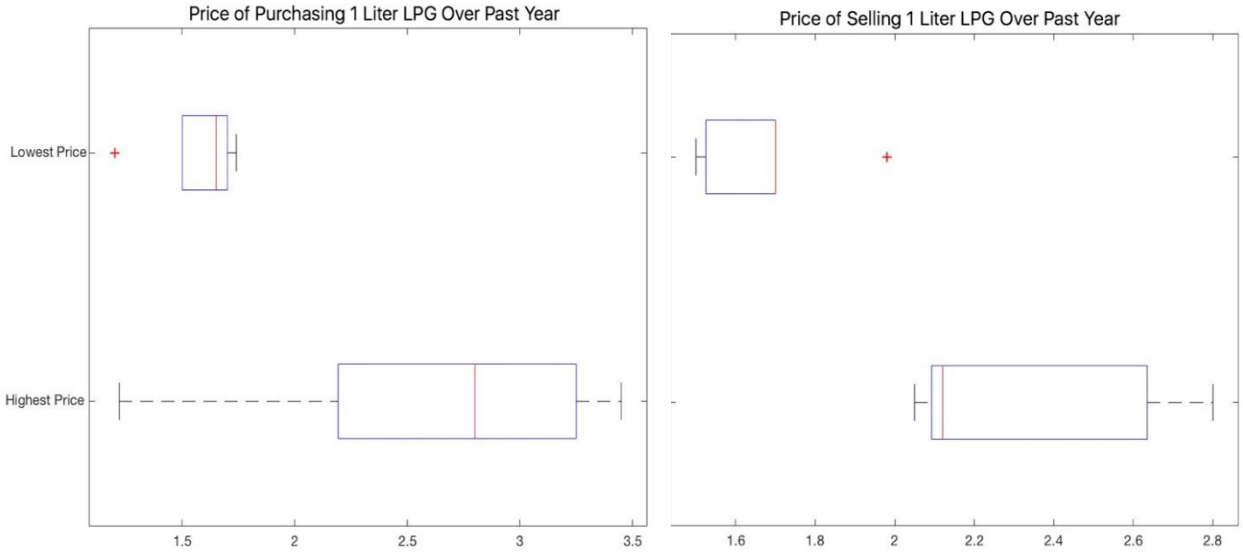

Figure 4: Highest and lowest price in cedi that business bought (left panel) and sold (right panel) LPG for in past year.

The seven businesses self-reported as LPG refilling stations were interviewed more in-depth about LPG refilling specifics. When asked what percentage of the business's income comes from selling LPG, respondents reported between 50 and 100% of their income with a median of 99% of their income coming from selling LPG. Respondents gave current LPG prices per liter ranging from 2.05 to 2.14 cedi/L with a median of 2.1 cedi/L. Respondents were asked to share the lowest and highest price they have sold LPG for in the past year. Additionally, respondents shared the highest and lowest price they have purchased LPG for in the past year. These results can be seen in Figure 4. It is clear that both the highest price sold and highest price purchased had much larger ranges in cedi than the lowest prices. All seven respondents of LPG refilling stations believe that the price of LPG changes frequently. Reasons respondents think prices change frequently include: the "deregulation of petroleum products", the "deregulation and world market price", that "fuel prices changes every week", use of an "automatic adjustment formula", and that "it depends on the dollar, when the dollar goes up the price will increase and the other way around. The high taxes also affect the frequent change". One respondent said there is no specific time when prices change, three (42.9%) said

[1] 1 Ghana Cedi = Approx. US$4

prices change whenever world prices change, two (28.6%) think prices fluctuate every month, and the remaining respondent said that prices are low at the beginning of the year and high at the end.

There is a lot of diversity in where the LPG is purchased. Of the seven LPG refilling stations, respondents gave 5 different LPG suppliers such as GASU Petroleum Company, Morgan Petroleum Company, Virgin Petroleum, Trinity Oil, and Tema Oil Refinery. These suppliers also deliver LPG at very different intervals. Two respondents receive LPG deliveries every week, one respondent gets deliveries twice a month, two receive LPG every three weeks, one gets LPG once a month, and the last respondent receives LPG deliveries only once every two months.

LPG filling stations have a wide range of capacities, being able to hold 15,000 to 64,000 liters of LPG with a median of 29,000 liters. These capacities can reportedly last refilling stations between 14 and 60 days, with a median of 31 days. When asked to recall the amount paid for the last LPG delivery, responses ranged from paying 45,000 to 102,000 cedi with a median of 78,800 cedi. These amounts paid correspond to a quantity received ranging from 16,000 to 30,100 liters with a median of 26,500 liters of LPG. When asked if their store had to pay upfront for deliveries or if buying on credit was an option, five (71.4%) respondents have to pay upfront while the remaining two can sometimes pay on credit. These two locations that may sometimes pay on credit have 7 and 14 days to make their payments.

When considering their LPG stock, only two (28.6%) of respondents would like to increase their gas stock. One of these respondents gave a reason for not increasing their stock, as they did not have enough funds to do so. When asked if they have ever experienced any shortages in LPG provision to their businesses, five (71.4%) of respondents have experienced shortages. Of these five, two respondents explained that there is no specific time when shortages happen, but whenever there is a shortage in the country it affects them. Another respondent gave a supplier problem by Tema Oil Refinery as the reason for their shortage, and another said the shortage was due to “deregulation of the product due to an upcoming increment”.

Respondents were then asked about the amount of LPG they sell per day. Responses ranged from 200 to 3,000 liters/day with a median of 1375 liters/day. On a ‘high’ day respondents reported selling between 300 and 5,000 liters with a median of 2,250 liters, whereas on a ‘low’ day reported values were between 200 and 2,500 liters with a median of 475 liters. All businesses report selling these liters of LPG to a roughly equal number of men and women.

When asked if they ever receive complaints from customers about either the filling station or LPG provided, six (85.7%) respondents reported complaints. Customers have been unhappy with the LPG shortages, not getting the right amount of gas in the cylinder, the frequent increase of prices, cylinder leakages, and have advised the businesses to upgrade their services on two occasions.

Retail Stoves Business Questions

Next, business respondents who indicated their stores sold LPG stoves were asked for additional information about the stoves they sell. Respondents were asked what percentage of

their business's income comes from selling LPG stoves. Responses received ranged between 0 and 40% with a median of 5% of the business's income coming from the sale of LPG stoves. Of these twelve stores selling LPG stoves, seven (58.3%) of them consider selling LPG stoves to be a good business. Respondents reporting selling LPG stoves to be a good business gave the following explanations:

- "It's better in a way that when you buy the burner, they have to buy other things like tubes head and cylinders, so it's ok"
- "I do get some profit from the sales"
- "Selling of the stoves move faster than the other goods"
- "People prefer burners these days and for that matter we make profit from the demand"
- "Economically and health wise it's better getting this than the charcoal"
- "Sometimes the market is good"
- "People buy"

Respondents who reported that selling LPG stoves is not a good business gave explanations of:

- "People want them but they don't have money"
- "It doesn't move well"
- "The main shop for these stove's are in our stove shop in town"
- "There is no market"

LPG stove types include 1, 2, 3, and 4 burner stoves. Of the twelve businesses selling LPG stoves, three (25%) sell single burner stoves, ten (83.3%) sell 2-burner stoves, eight (66.6%) sell 3-burner stoves, and six (50%) sell 4-burner LPG stoves. This distribution can be seen in Figure 5. Respondents report selling 21 different types of LPG stoves. Some examples include brands such as Elbee, Becko and Mitsui. Businesses can receive a discount by buying in bulk with only four (16%) of the stove types.

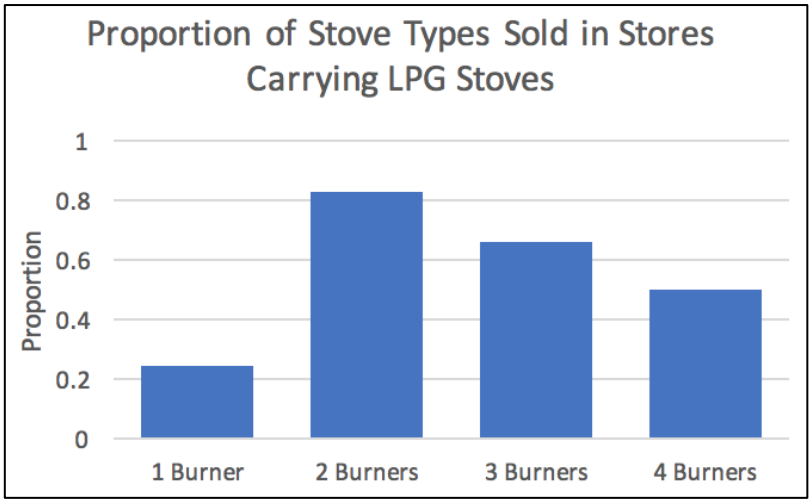

Figure 5: Proportion of stove types sold in businesses carrying LPG stoves.

Of the businesses selling single-burner LPG stoves, more information was gathered from two of the businesses. These single burner stoves are being sold for 40 and 15 cedi, the businesses have 2 and 33 stoves in stock, have bought 2 and 20 stoves from suppliers in the last month, and have sold 0 and 8 stoves in the past month respectively. Both businesses report selling less than usual of this stove compared to the past six months.

Eight businesses provided more information on 2-burner LPG stoves. Prices the 2-burner

stoves are sold for range from 58 to 100 cedi with a median of 82.25 cedi. Stores currently had between 1 and 6 of these stoves in stock with a median of 3 stoves in stock. When asked how many 2-burner stoves they have sold in the last month, responses ranged from 1 to 40 stoves with a median of 2 stoves sold. The number of 2-burner stoves purchased from suppliers in the past month ranged from 2 to 100 with a median of 5 stoves purchased. Seven (87.5%) of respondents said they've sold about the same number of these stoves as in the past six months, while the remaining respondent reported selling a lower amount than the last six months.

Further information was received for five 3-burner stoves with selling prices being between 69.5 and 110 cedi with a median of 100 cedi. Businesses have purchased between 0 and 100 (median = 10) of these stoves in the past month and sold between 1 and 70 (median = 3) of these stoves. Currently in stock, these businesses have between 1 and 12 3-burner stoves with a median of 5 stoves. Respondents shared how their sales in the past month compare to the previous six months with four (80%) saying purchases of the 3-burner stoves have stayed about the same and one (20%) reporting a higher number of sales in the past month.

Finally, four businesses shared information about the 4-burner LPG stoves they sell. These 4-burner stoves sell for between 450 and 700 cedi with a median of 600 cedi. Purchasing and selling of 4-burner stoves was much less than the other stove types with between 0 and 3 (median = 0) 4-burner stoves being sold in the past month and between 0 and 5 (median = 0) 4-burner stoves being purchased from suppliers. Stores currently have a range of 1 to 2 (median = 1.5) 4-burner stoves in stock. Three (75%) respondents reported selling the same amount of 4-burner stoves in the last month as compared to the previous six, while the remaining respondent reported lower sales than during the past six months.

Respondents were then asked how they determine which stove types to sell. Of eleven responses received, six (54.5%) make stove type decisions based on the quality of the stove, three (27.3%) purchase their stoves based on high demand, one respondent purchases a stove type because people like that type, and the last respondent makes stove decisions 'based on the market movement of the stove and what my supplier has in stock'.

Retail Cylinder Business Questions

The thirteen businesses selling LPG cylinders responded to additional questions on this aspect of their business. Twelve respondents shared whether they think selling LPG cylinders is a good business with results showing six (50%) respondents considering it a good business. When asked to explain this opinion, these six respondents gave responses such as:

- They do make a profit (2 responses)
- People as of lately like using gas (2 responses)
- People buy the cylinders

The six respondents who did not consider selling LPG cylinders to be a good business explained:

- People do not buy the cylinders (2 responses)
- People cannot afford the cylinders
- There is no market
- People prefer to purchase the cylinders in town

Two respondents (15.4%) reported currently selling zero types of cylinders, three respondents (23.1%) sell one type, six (46.2%) sell two types, and two (15.4%) sell three types of LPG cylinders. Currently, respondents have between 0 and 33 (mean = 2) cylinders in stock and bought between 0 and 100 (median = 10) cylinders in the past month. Respondents report that cylinder sizes sold range from 3 to 52kg with a median of 14.25kg. Cylinder questions were analyzed in categories by cylinder size with categories being 3kg, 5-8kg, 12-15kg, and 52kg.

The smallest cylinder size sold at these locations is 3kg. Respondents were asked what they charge for this size cylinder when empty and full. Empty 3kg cylinders sell for between 90 and 100 cedi (median = 95 cedi) and respondents did not report full prices. When purchasing from a supplier, the two responding participants report paying 85 and 70 cedi for the 3kg cylinder and do not receive a discount for purchasing in bulk. All respondents had sold zero of this size cylinder in the past month. Two (66.6%) of respondents report these sales are lower relative to the past six months and the remaining respondent reports no change in sales.

For cylinders sized 5 to 8kg, respondents report selling these cylinders empty for between 95 and 125 cedi with a median empty price of 110 cedi. Only two respondents reported the price these cylinders sell for when full with responses being 117 and 130 cedi (both for a 6kg cylinder). Only three respondents reported the price they pay to suppliers for this sized cylinder with responses of 90, 115 and 950 cedi. Likely, the respondent reporting 950 cedi was reporting a price paid for a full order of cylinders, so it is difficult to extract a price from this response. Three of five reporting respondents (60%) say they can receive a discount for these cylinders when buying in bulk. Stores have sold between 0 and 30 cylinders (median = 6 cylinders) of this size in the past month. Responses comparing these sales to the past six months are split, with two (40%) reporting lower sales this month, two (40%) the same amount of sales, and one (20%) reporting higher sales this month.

Cylinders sized 12-15kg reportedly sell empty for between 120 and 155 cedi with a median of 140 cedi. These same cylinders sell full for from 142 to 202 cedi (median = 190 cedi). Respondents report purchasing these cylinders from suppliers for between 95 and 1440 cedi (median = 140 cedi). Again, some of these respondents may have misunderstood the question and reported price per total order. 36.4% of respondents receive a discount when purchasing these sized cylinders from their supplier in bulk. Sales of cylinders sized 12-15kg range from 0 to 50 (median = 4) cylinders in the past month. Changes in sales are reported as 18.2% seeing a decrease in sales this month as compared to the past six months, 45.5% seeing the same amount of sales, and 36.4% reporting more sales this month than the last six months.

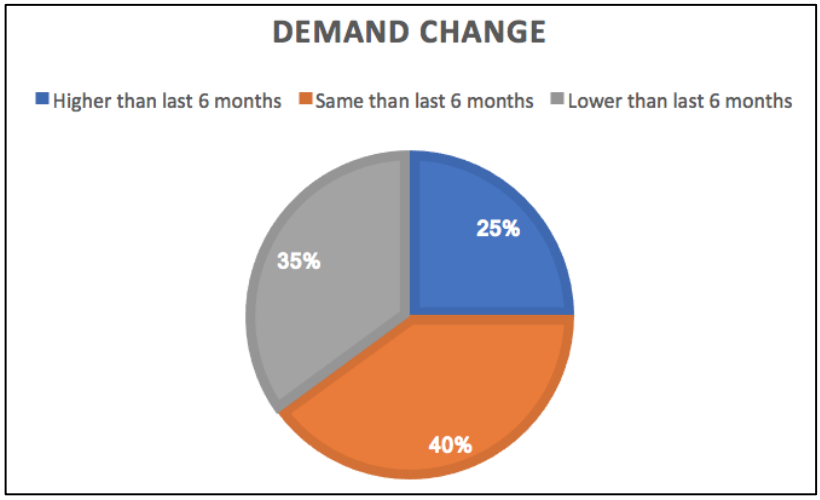

Figure 6: Demand change in selling LPG cylinders compared to the last six months.

The final category for cylinder size was a much larger LPG cylinder of 52kg, of which there was only one respondent reporting a cylinder this large. This cylinder sells for 350 cedi empty, is purchased for 250 cedi from the supplier, and no bulk discount is offered. The respondent selling this cylinder reported zero sold in the past month, which they categorize as lower than the past six months.

Demand change for all cylinders combined can be seen in Figure 6. 40% of respondents saw the same sales during the month of this survey as they did during the past six months, while 35% saw a decrease in demand then the past six months. The remaining 25% reported more sales during the survey month.

Stove and Cylinder Suppliers

Respondents were then asked more details about the suppliers they receive LPG stoves and cylinders from. Nine respondents shared how many suppliers they purchase stoves from with five (55.6%) buying stoves from one supplier, three (33.3%) from two suppliers, and one (11.1%) from three suppliers. Of these fourteen suppliers, one (7.1%) is in Accra, 1 (7.1%) is in Bolgatanga, eight (57.1%) are in Kumasi, and four (28.6%) are in Tamale. Two suppliers from Tamale and one from Kumasi deliver the stoves to the respondent's business, while the remaining eleven suppliers require pick-up by the respondent's business. If driving, from city-center to city-center these businesses must travel 817 kilometers to Accra, 30 kilometers to Bolgatanga, 577 kilometers to Kumasi, and 189 kilometers to Tamale to pick up their stoves. Respondents reported that eleven (78.6%) of these suppliers consistently have the products they need in stock, and the respondents are generally satisfied with all fourteen suppliers.

Seven survey respondents reported the number of suppliers they purchase their cylinders from, all purchasing from only one store with names such as Buniah and Solomon Enterprises. These businesses are located in Bolgatanga (14.3%), Kumasi (57.1%), and Tamale (28.2%). Only one business in Kumasi will deliver cylinders to the businesses, but this respondent also reported picking up cylinders from this location at times. The rest of the suppliers all expect the respondent's business to pick up the cylinders they purchase, again from the approximate distance away listed above. Of the seven suppliers, six (85.7%) consistently have the needed cylinders in stock. All respondents are generally satisfied with the seven suppliers of LPG cylinders and have had no other problems or issues with their supplier.

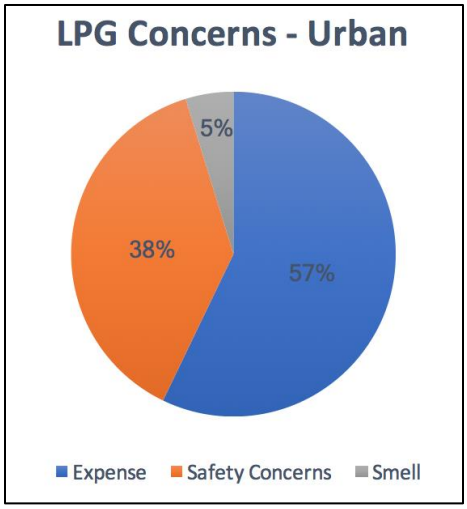

Figure 7: Reasons why households in urban areas near Navrongo may not use LPG.

Part III: Expanding LPG Demand and Supply

LPG is not as commonly used for cooking in the K-N districts as it is in other areas of Ghana. A portion of this survey was dedicated to discovering why this may be the case and what measures could be taken to increase LPG use in these districts. Respondents were asked their opinion on the main reasons why households in urban areas near Navrongo and rural areas not far from

Navrongo do not use LPG. These responses were categorized and responses for reasons urban and peri-urban households near Navrongo do not use LPG are seen in Figure 7 and Figure 8. For urban households, respondents saw the main concerns of using LPG to be that it is expensive (57%), that there are safety concerns for using LPG (38%), and the smell of LPG is unpleasant (5%). Respondents saw the main concerns for peri-urban households very differently than urban. They saw issues for these households being mainly the expense of using LPG (67%) and that many peri-urban households are uninformed about LPG stoves and how to use them (19%). Additionally, there are issues of peri-urban households being far away from LPG refilling stations (9%) and that other fuel is already available nearby their homes (5%).

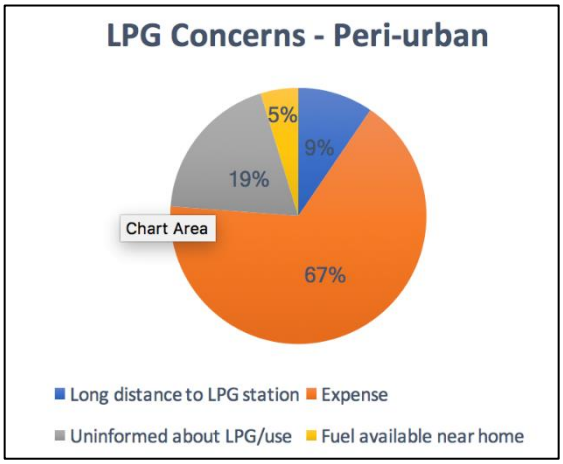

Figure 8: Reasons why households in peri-urban areas may not use LPG.

Since LPG use in the K-N districts is less than desired, it is important to determine ways in which LPG use could be encouraged. Respondents were given a list of potential policy options and asked how effective they thought each policy would be for the purpose of expanding the use of LPG stoves among households in the K-N districts. Policy options included:

- Subsidizing an LPG start-up package (e.g. government vouchers for LPG stoves, cylinders, gas and equipment)
- Subsidizing the cylinder and gas, but not the stove
- Subsidizing the LPG fuel (e.g. government vouchers covering part or all of the cost of refueling)
- Offering "refer-a-friend" discounts – providing cash or fuel subsidies for households that get another customer to buy a stove
- Offering home delivery services for LPG fuel to households in the central urban areas
- Offering home delivery services for LPG fuel to rural households near urban areas
- Offering home delivery services for LPG fuel to rural households located far from urban areas

Respondents ranked each policy by choosing 'Not at all effective (would not increase LPG use)', 'Slightly effective (would increase LPG use a little)', 'Moderately effective', 'Pretty effective (would increase LPG use quite a bit)', or 'Very effective (would increase LPG use a lot)'. These responses were scored 0-4 and totals were then standardized to a maximum score. This gave an idea of the perceived effectiveness of each policy, which can be seen in Figure 9.

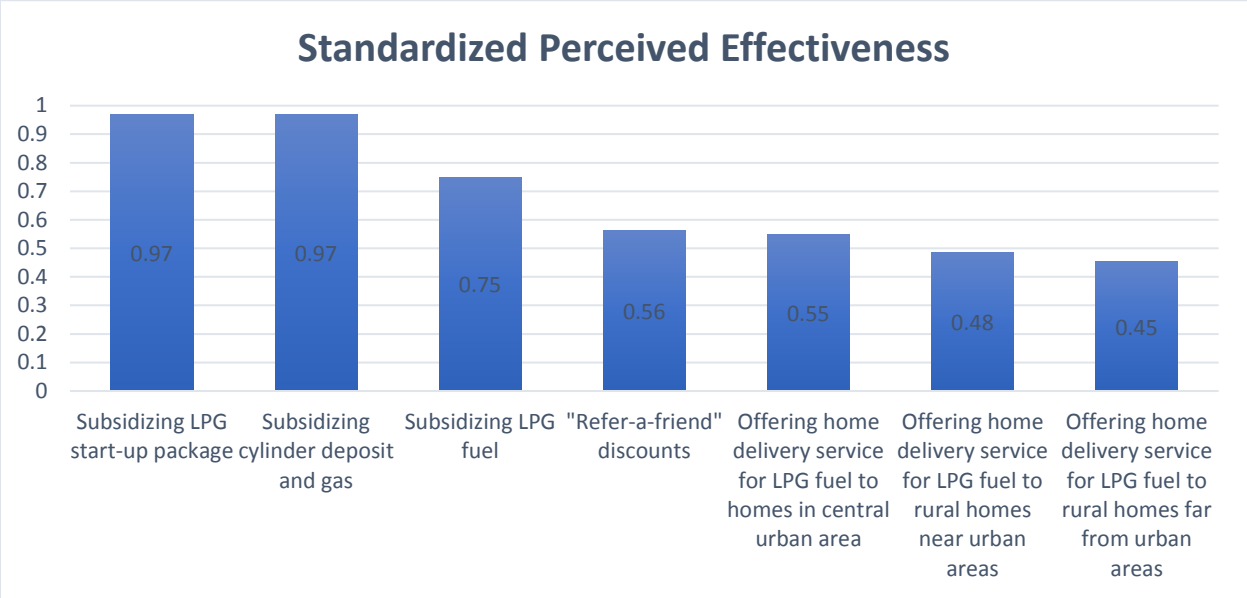

Figure9: Standardized perceived effectiveness of different policy options in encouraging LPG use in the K-N districts.

Subsidizing an LPG start-up package including vouchers for LPG stoves, cylinders, gas and equipment, as well as subsidizing only the cylinder and gas, were viewed as the best policies to encourage LPG use in the K-N districts. All home delivery options for LPG fuel were seen as the least effective way to encourage LPG use, with delivery to far away rural homes being viewed as the least effective. Overall, all policy options involving subsidizing all or part of the items needed for LPG use were viewed as best. Respondents were also asked what other strategies they could think of for encouraging LPG use in the K-N districts. Responses included:

- Reducing the price of LPG (8 responses)
- Providing education on how to use LPG and the benefits of use (5 responses)
- Discounting (or giving free) cylinders (4 responses)
- Supplying LPG frequently (2 responses)
- Door-to-door delivery (1 response)
- Enacting laws on cutting down trees (1 response)
- Advertising LPG (1 response)

Responses mimicking the policy options already given ('discounting/free cylinders' and 'door-to-door delivery') could indicate either respondent not understanding the initial policy or respondent repeating their favorite policy when asked this question.

Respondents were next asked why they think there is a lack of refilling stations in the K-N districts. Responses to this question varied and included:

- There is no money to establish those businesses (6 responses)
- There is low patronage for cost and use reasons, so those with money do not want to invest (6 responses)
- There is not enough land (1 response)
- Expenditure outweighs the demand (1 response)
- There are not many using LPG, so if more refilling stations are established it will lead to a problem of price losses (1 response)

- There are already LPG stations around (1 response)

In the current distribution model for LPG throughout most of Ghana, customers purchase LPG cylinders and then bring them to filling stations to purchase fuel as needed. This distribution model creates challenges for rapid scale-up of supply, since infrastructure costs for building new filling stations are relatively high. An alternative model that could enable more rapid supply expansion would be a cylinder recirculation scheme in which customers pay a deposit for cylinders and exchange empty ones for full ones at more dispersed distribution locations [1]. Recirculation has the additional advantage of being safer, since households do not have an incentive to continue to use older cylinders. This model has been piloted in the Accra area and is now being promoted at the national level (newspaper cite?). To our knowledge, LPG recirculation has not been implemented in Northern Ghana, though it will be employed for the P3 LPG intervention.

In the last portion of the survey, the LPG cylinder exchange / recirculation model was explained to respondents and opinions about this system were elicited. Of the sixteen respondents, five (31.25%) had never heard of this model before, eleven (68.75%) had heard of this model, and zero respondents knew of any store that used this model. When asked if they thought the LPG cylinder exchange model should be adopted in the K-N districts, the results were split with half of respondents thinking it should be adopted. Of those who had previously heard of the LPG cylinder exchange model, fewer respondents were in favor of adopting the model (45.5%), whereas those who had not previously heard of the model were more supportive (60% supporting). These results can be seen visually in Figure 10.

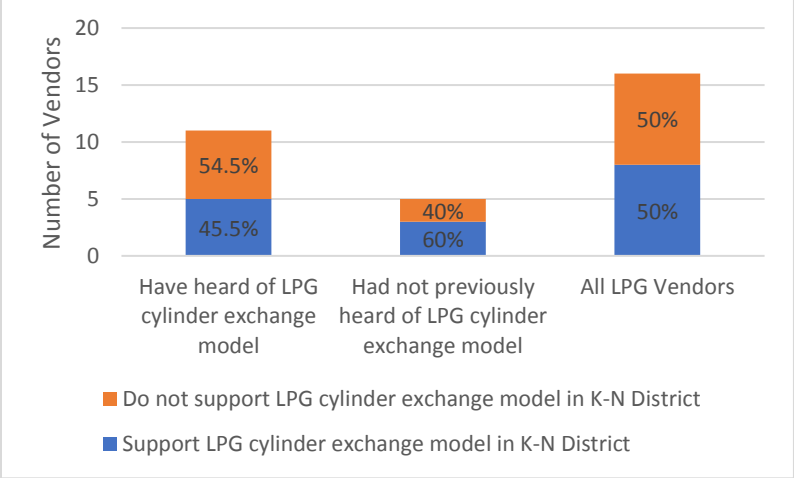

Figure 10: Support of LPG cylinder exchange model in the K-N districts based on previous knowledge of model.

When asked what they thought it would take to set up the LPG cylinder exchange model in the K-N districts, two respondents did not have an idea (12.5%), five (31.25%) think the government would need to provide free LPG cylinders, four (25%) think the public needs to be educated on why to use LPG and that 'bad cylinders' would not be a problem, two (12.5%) think there needs to be a perception change for LPG, and one (6.25%) respondent each thinks there needs to be collaboration with the LPG companies, support from the government and NGOs, and quality cylinders must be used. Finally, reasons respondents think the LPG cylinder exchange model is not more widely used in Ghana include:

- Concern of exchanging a new or 'good' cylinder for an old or 'bad' one (11 responses)
- 'Because some Ghanaians are not trustworthy. We were doing it before and people were running away with our cylinders' (1 response)

- Concerns with education and the cost involved (1 response)
- There is no trust in Ghana (1 response)
- There are not resources to do the LPG cylinder exchange model (1 response)
- 'Because we are many' (1 response)

Conclusions

With a national and global push for cleaner cooking options and a national goal of expanding LPG access to 50% of the country's population, there are, however, a few challenges that could hinder LPG access in the KN districts. Paramount among these is affordability of LPG start up (cylinders and stoves), the frequent shortage of LPG, concerns about safety and LPG price.

There is a growing interest in the use of LPG for cooking in the KN District, with businesses recording somewhat good sales of LPG stoves. Further policy interventions such as subsidizing LPG start up packages and fuel have the support of product suppliers, and have the potential to increase access to and use of LPG. Further analysis of the causes of LPG shortages is also warranted.

Finally, knowledge of and support for cylinder recirculation were mixed among the suppliers we interviewed in June and July of 2016. About a year following this survey, in May of 2017, the Ghana Ministry of Energy announced a national push toward recirculation, and efforts to enact this policy were initiated. However, there was substantial pushback from key stakeholders, particularly gas tanker drivers who objected to a plan to make one supplier (Puma Energy) the sole supplier of gas and cylinders nationwide. In response, the Ministry of Energy suspended the recirculation policy in August of 2017. Given that recirculation is viewed in the international community as the safest way to distribute LPG, and given that this model could reduce the upfront cost burden on customers, further efforts are warranted to develop sound strategies for implementing this policy in a way that benefits customers and businesses along the supply chain. In 2017-2018, the P3 project will be piloting a recirculation model in partnership with the refilling station located in the K-N District. This experience may help to inform the scale-up of this policy in the K-N and beyond.

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Appendix: LPG Supply Survey

name	label
start	
end	
today	
deviceid	
intro	Hello, my name is _____ and I am working with the Navrongo Health Research Center and the University of Colorado. We are doing research on households' cooking practices in the Kassena-Nankana Districts, including adoption of liquefied petroleum gas (LPG) and other stoves that may be cleaner than traditional cooking methods. As part of this study, we are interested in learning about the LPG supply business and the opportunities and challenges faced by suppliers. We will be talking with all of the LPG suppliers in this area, and would appreciate your time and the information you can provide about your business. Any information you share with us will be kept confidential, and we will not share any specific details, including cost and sales information, with any of your competitors. If you have any questions or concerns about this study, please contact (name and contact for NHRC).
consent	Do you agree to participate in the survey? Yes No
partI	**I. Business Information**
store_name	I.1 Business Name
interviewee	I.2 Name of the person being interviewed
resp_role	I.3 Respondent's role in the business Owner Employee
resp_gender	I.4 Respondent's gender Male Female
resp_age	I.5 Respondent's age
resp_educ	I.6 What is the highest level of education you have completed? Never attended school Less than primary Primary Jr High Secondary Tertiary/higher
resp_exper	I.7 How many years have you been in this business?
bus_age	I.8 How long has this business been in operation?
ft_emp	I.9 How many full time employees (35 hours or more per week) work at this business?

pt_emp	I.10 How many part time employees (less than 35 hours) work at this business?
own_rent	I.11 Do you own or rent the property where this business operates? Own Rent
rent	I.12 What is your monthly rental payment?
partII	**II. Product Information**
filling_station	II.1 Is this an LPG filling station? Yes No
stove_store	II.2 Does this business sell LPG stoves? Yes No
cylinder_store	II.3 Does this business sell LPG cylinders? Yes No
filling_block	LPG Filling Station Questions
filling_questions	**LPG Filling Station Questions**
lpg_price	F.1 Record the current LPG price per liter
highest_price_sell	F.2 What is the highest price (per liter) you have sold LPG for in the past year?
lowest_price_sell	F.3 What is the lowest price (per liter) you have sold LPG for in the past year?
highest_price_buy	F.4 What is the highest price (per liter) you have paid for wholesale LPG delivered to your business over the past year?
lowest_price_buy	F.5 What is the lowest price (per liter) you have paid for wholesale LPG delivered to your business over the past year?
price_ch	F.6 Do you think the price of LPG changes frequently? Yes No Don't know
price_ch_exp	Please explain:
price_ch_when	F.7 Is there a specific time of year when your prices are higher or lower?
lpg_suppliers	F.8 Who do you purchase LPG from (or who delivers LPG to you)?
lpg_supply_freq	F.9 How frequently do you receive LPG deliveries?
lpg_capacity	F.10 What is the filling station storage capacity (in liters)?
lpg_price_buy	F.11 What was the TOTAL amount you paid for LPG on the last delivery?
lpg_quantity_buy	F.12 What quantity of LPG (in liters) did you receive at the last delivery?
lpg_stocklast	F.13 How many days does your gas stock last?
lpg_credit_or_not	F.14 Do you have to pay upfront for the gas delivery, or are you able to buy on credit? Have to pay upfront Can pay on credit

	Depends (can pay on credit sometimes or with some suppliers)
lpg_credit_days	F.14.1 When you pay on credit, how many days do you have to make your payment?
increase_stock	F.15 Would you like to increase your gas stock?
increase_stock_whynot	F.15.1 Why haven't you increased your gas stock?
	F.16 Have you experienced any shortages in the LPG provision to your business?
	Yes
lpg_shortages	No
lpg_shortages_explain	F.16.1 Please provide details (when / how often do shortages occur):
lpg_shortages_why	F.16.2 Do you know what has caused the shortages?
lpg_kgperday	F.17 How many liters of LPG do you sell a day (roughly)?
lpg_kg_lowday	F.18 How many liters do you sell in a 'high' day?
lpg_kg_highday	F.19 How many liters do you sell in a 'low' day?
lpg_pct_income	F.20 What % of your business's income is coming from selling LPG?
	F.21 Would you be willing to share sales figures for your LPG business over the past few months?
	Yes
lpg_share_sales	No
lpg_share_note	Enter sales information for up to the last 6 months. Leave any information the respondent cannot or does not wish to provide blank.
monthly_sales	Monthly sales info
	Enter month:
	May 2016
	April 2016
	March 2016
	February 2016
	January 2016
month	December 2015
monthly_amt	Enter quantity of LPG sold (liters):
	Enter monthly revenue from sales of LPG
	May 2016
	April 2016
	March 2016
	February 2016
	January 2016
monthly_revenue	December 2015
	Enter monthly profit from sales of LPG
	May 2016
	April 2016
	March 2016
	February 2016
	January 2016
monthly_profit	December 2015
monthly_goodorbad	How do this month's sales compare to your usual sales?

	Much better than usual A little better than usual About the same as usual A little worse than usual Much worse than usual
	F.22 Is it mainly women or men who come to buy a gas refill? Mostly men Mostly women
lpg_men_women	Roughly equal number of men and women
	F.23 Do you ever receive complaints from customers about the filling station or the LPG they buy here? Yes
lpg_complaints	No
lpg_complaints_details	Please explain:

stove_block	Retail Stove Business Questions
stove_questions	**Retail Stove Business Questions** S.1 What types of LPG stoves are sold at this store? 1 burner stoves 2 burner stoves 3 burner stoves 4 burner stoves
stove_types	Other
stove_types_other	Specify other: S.2 How many different types of stoves are sold at this store? 1 burner stoves 2 burner stoves 3 burner stoves 4 burner stoves Other
num_stoves	
lpg_stoves	Enter information for each type of stove sold
stove_barcode	Scan stove barcode (if available)
stove_pic	Take picture of stove
stove_name	Stove brand name / model name and/or number
stove_price	Stove price
stove_num	How many of this type of stove do you currently have in stock?
stove_amtsold	How many of these stoves have you sold in the past month? How has this changed compared to the past six months? More than usual for past 6 months About the same as usual for past 6 months
stove_amtsold_highlow	Less than usual for past 6 months

stove_amtbuy	How many of these stoves did you buy (from suppliers) last month?
stove_buy_price	What do you pay for this stove when you purchase it from your supplier(s)?
stove_discount	Do you receive a discount if you buy them in bulk?
stove_likes	What do customers like about this stove?
stove_dislikes	What do customers dislike about this stove?
stoves_decide	S.3 How do you decide which types of stoves to sell?
suppliers_note	S.4 Now I'd like to know about the different suppliers that you buy stoves from to sell in this business.
num_stv_suppliers	S.5 How many suppliers do you buy stoves from?
stv_suppliers_info	Please enter the following information for each supplier.
stv_supplier_name	Name of supplier (business and/or individual name)
stv_supplier_loc	Supplier's business location (Town, Region, Country)
stv_supplier_stoves	Which stoves do you get from this supplier?
stv_supplier_how	How do you get these stoves from the supplier? Delivered to your business Pick them up from supplier Other
stv_supplier_how_oth	Please explain:
stv_supplier_instock	Does this supplier consistently have the products you need in stock?
stv_supplier_stock_prod	Which products are not always available?
stv_supplier_quality	Are you generally satisfied with the quality of products you get from this supplier? Yes No
stv_supplier_qual_prob	Please explain any problems you have had with this supplier's products' quality.
stv_supplier_probs	Have you had any other problems or issues with this supplier? Yes No
stv_supplier_probs_explain	Please explain.
stoves_pct_income	S.6 What percentage of this business's income is coming from the sale of LPG stoves?
stove_good_business	S.7 Do you consider selling LPG stoves to be a good business? Yes No
stove_goodbus_exp	Please explain.

cylinder_block	Retail Cylinder Business Questions
cyl_questions	**Retail Cylinder Business Questions**
num_cylinders	C.1 How many different types of cylinders are sold in this store?
cylinders_repeat	Please enter the following information for each type of cylinder sold in this

	store
cyl_barcode	Scan barcode of cylinder (if available)
cyl_pic	Take picture of cylinder
cyl_make	Cylinder manufacturer
cyl_color	Cylinder color
cyl_size	Cylinder size (kg)
cyl_price_empty	Cylinder price (empty)
cyl_price_full	Cylinder price (full)
cyl_numinstock	How many of this cylinder do you currently have in stock?
cyl_amtsold	How many of this cylinder have you sold in the past month?
cyl_amtsold_highlow	How has this changed compared to the past six months? More than usual for past 6 months About the same as usual for past 6 months Less than usual for past 6 months
cyl_amtbuy	How many of these cylinders did you buy (from suppliers) last month?
cyl_buy_price	What do you pay for this cylinder when you purchase it from your supplier(s)?
cyl_discount	Do you receive a discount if you buy them in bulk? Yes No
num_cyl_suppliers	C.2 How many suppliers do you buy cylinders from?
cyl_suppliers_info	Please enter the following information for each supplier.
cyl_supplier_name	Name of supplier (business and/or individual name)
cyl_supplier_loc	Supplier's business location (Town, Region, Country)
cyl_supplier_stoves	Which types of cylinders do you get from this supplier?
cyl_supplier_how	How do you get these cylinders from the supplier? Delivered to your business Pick them up from supplier Other
cyl_supplier_how_oth	Please explain:
cyl_supplier_instock	Does this supplier consistently have the products you need in stock?
cyl_supplier_stock_prod	Which products are not always available?
cyl_supplier_quality	Are you generally satisfied with the quality of products you get from this supplier? Yes No
cyl_supplier_qual_prob	Please explain any problems you have had with this supplier's products' quality.
cyl_supplier_probs	Have you had any other problems or issues with this supplier? Yes No
cyl_supplier_probs_explain	Please explain.

	C.3 Do you consider selling LPG cylinders to be a good business? Yes No
cyl_good_business	Don't know
cyl_goodbus_exp	Please explain.

partIII	**III. Expanding LPG Demand and Supply**
why_urban	III.1 In your experience, what are some of the main reasons why many households in the urban areas near Navrongo do not use LPG?
why_peri	III.2 What are some of the main reasons why households in peri-urban areas (rural areas not far from Navrongo) do not use LPG?
policies_note	III.3 For each of the following policy options, please tell me how effective you think the policy would be for expanding use of LPG stoves among households in the K-N Districts.
pol_startup	III.3.1 Subsidizing LPG start-up package (e.g., government vouchers for LPG stoves, cylinders, gas and equipment)
pol_cyl_sub	III.3.2Subsidizing the cylinder deposit and gas, but not the stove Not at all effective (would not increase LPG use) Slightly effective (would increase LPG use a little) Moderately effective Pretty effective (would increase LPG use quite a bit) Very effective (would increase LPG use a lot)
pol_fuel_sub	III.3.3 Subsidizing LPG fuel (e.g., government vouchers covering part or all of the cost of refueling) Not at all effective (would not increase LPG use) Slightly effective (would increase LPG use a little) Moderately effective Pretty effective (would increase LPG use quite a bit) Very effective (would increase LPG use a lot)
pol_friend	III.3.4 Offering "refer-a-friend" discounts – providing cash or fuel subsidies for households that get another customer to buy a stove Not at all effective (would not increase LPG use) Slightly effective (would increase LPG use a little) Moderately effective Pretty effective (would increase LPG use quite a bit) Very effective (would increase LPG use a lot)
pol_deliver_urb	III.3.5 Offering home delivery services for LPG fuel to households in the central urban areas Not at all effective (would not increase LPG use) Slightly effective (would increase LPG use a little) Moderately effective

	Pretty effective (would increase LPG use quite a bit) Very effective (would increase LPG use a lot)
	III.3.6 Offering home delivery services for LPG fuel to rural households near urban areas Not at all effective (would not increase LPG use) Slightly effective (would increase LPG use a little) Moderately effective Pretty effective (would increase LPG use quite a bit) Very effective (would increase LPG use a lot)
pol_deliver_peri	
	III.3.7 Offering home delivery services for LPG fuel to rural households located far from urban areas Not at all effective (would not increase LPG use) Slightly effective (would increase LPG use a little) Moderately effective Pretty effective (would increase LPG use quite a bit) Very effective (would increase LPG use a lot)
pol_deliver_rur	
pol_other	III.4 What other strategies do you think would increase LPG use among households in this area?
why_nostations	III.5 Why do you think there are not more refilling stations in the K-N Districts?
	III.6 Do you have any experience with LPG cylinder exchange (i.e. users swap their empty cylinder with a filled one)? No Heard of it Know of places that use this model
recirc_exper	Other
recirc_exper_other	Please explain:
recirc_support	III.7 Do you think LPG cylinder exchange model should be adopted in the K-N Districts? Yes No Don't know
why_recirc	III.8 Why do you think LPG cylinder exchange model is not more widely used in Ghana?
pol_recirc	III.9 What do you think it would take to set up LPG cylinder exchange model in the K-N District?
partIV	**IV. Photos and Location**
bus_pics	Take pictures of the business
bus_pic_resp	Take a picture of business exterior showing business sign
bus_pic_sign	Take picture of business sign with respondent (if willing)
bus_pic_pump	Take picture of filling pumps (for filling station)
bus_pic_other1	Take any other picture of business exterior or interior

bus_pic_other2	Take any other picture of business exterior or interior
store_gps	Collect the GPS coordinates of this store
thanks	Thank respondent and end survey