Wharton WIVP International Volunteer Program

GLPGP – Greater Accra LPG Demand Assessment

FINAL PRESENTATION

MAY 24, 2014

WIVP Project setting

The Wharton International Volunteer Program (WIVP) is a student-run organization that sends Wharton MBA students on consulting-like projects at resource-limited social impact organizations in developing countries.

There is absolutely no cost to recipient organizations, except time invested by staff. In return, WIVP asks that organizations allow students to focus on projects with high-level strategic importance and that key stakeholders be available for meetings during the project.

Projects most often focus on fundraising, marketing, strategic and financial planning, business development, performance evaluation, market sizing and other areas specific to the MBA skill set.

While project costs are partially subsidized by WIVP, the majority of costs for airfare, lodging and visa are covered by students.

In this specific project, we had significant support from the Global LPG Partnership, and multiple public and private participants from Ghana's LPG value chain. Additionally, all statistical analysis related to conjoint analysis was processed using Sawtooth Software. We were given an academic grant by Sawtooth Software to use their software package in this project.

SOURCE OF PICTURES IN THE PRESENTATION: CANSTOCK.COM, INTERGAS.TRADEINDIA.COM, KRAFTINDIA.IN, MADE-IN-CHINA.COM, ALIEXPRESS.COM, STOVESER.COM, CLKER.COM, 123RF.COM

Agenda

Greater Accra LPG demand assessment

Appendix

1. **LPG value chain structure**
2. **Conjoint methodology**
3. **Detailed interview results**

Agenda

Greater Accra LPG demand assessment

Appendix

1. LPG value chain structure
2. Conjoint methodology
3. Detailed interview results

Executive summary (1/3): Approach

- Throughout this project our **objective** was to **characterize demand for LPG in Greater Accra**, and **identify barriers and solutions to the adoption of LPG**
- To accomplish this we **studied consumers in Greater Accra** (from all income levels) by conducting: 1) **84 conjoint surveys** to understand how consumers trade-off their preferences; 2) **in-depth consumer interviews** to understand the underlying reasons for consumers' preferences; and 3) **a community workshop** with a local Chief in Jamestown to identify potential barriers and test key hypothesis for solutions
- In parallel we conducted **seven meetings** with major **players along the LPG value chain** to **understand the LPG value chain structure** in Ghana; and to **identify and test key insights** on potential **barriers and solutions to adoption** for LPG

Executive summary (2/3): Segments

- Based on this research, **in Greater Accra we identified two consumer segments in LPG consumption at home (consumption for automotive not considered)**

  —The Access Seekers (83% of respondents)

  - These consumers have **income below ~1000GHS/month** and a **lower share of LPG adoption** (~57%) compared to the second segment
  - They **wish to adopt LPG** and tie a significant importance to: 1) **proximity to cylinder decanting station** (ideally ≤5 minutes walking distance); and 2) **low upfront adoption price** for cylinder + cook stove kit

  —The Convinced Users (17% of respondents)

  - These consumers have **income above ~800GHS/month** and the **majority use LPG as** their **primary cooking fuel**
  - They **wish to maintain their current access to LPG,** use **cook stoves**, and **distrust service providers and intermediaries** with refilling and maintaining their cylinders. Because of this, they distrust the exchange model

Executive summary (3/3): Segment strategies

- To **maximize adoption**, each segment should be targeted with a different **strategy**
  - For **Access Seekers**, we recommend to **increase adoption** by 1) **increasing the availability of LPG** in their communities through **alternative distribution models** (at **5 minutes walking** distance); 2) **decreasing upfront costs of adoption** through microfinance; and 3) **educating consumers** on the **health benefits** and **safety** of LPG
  - For **Convinced Users**, we recommend to seek widespread acceptance of the **future exchange model** by 1) providing **education** on the **reliability of the cylinder exchange model**; and 2) **ensuring** that substitute cylinders **include a trusted safety guarantee** (e.g., certificate, seal)

Objective: characterize demand for LPG in neighborhoods and small towns in the outskirts of Accra and identify solutions to LPG adoption

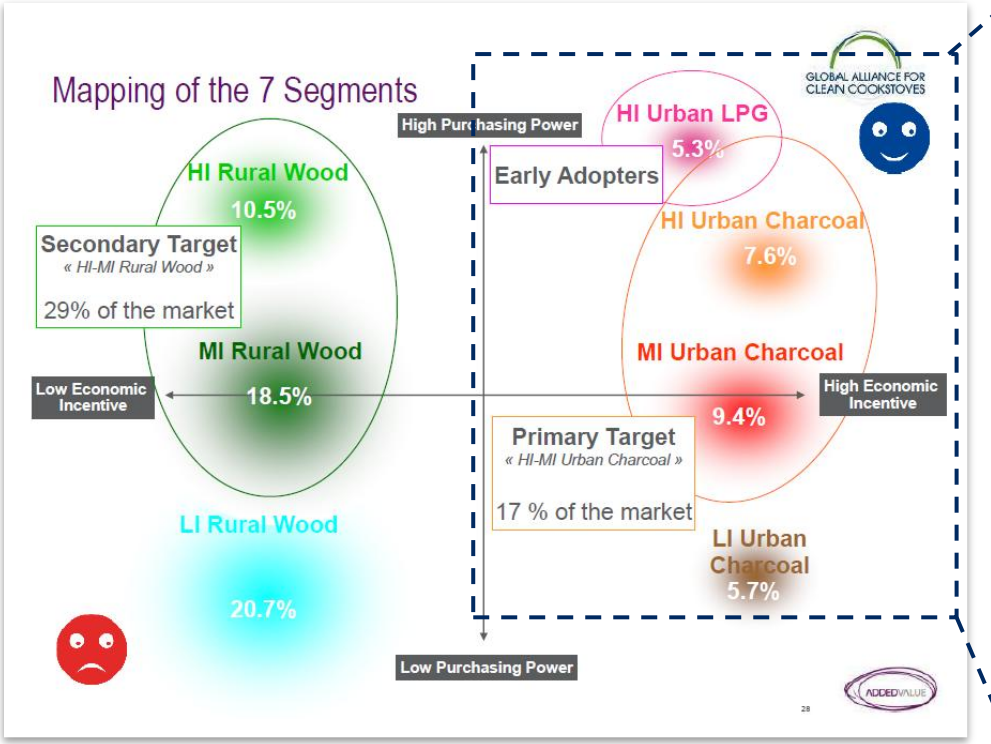
Initial project objectives

TOR Goals	Description
2.5 Characterize the customer profile for the typical LPG-using household	▪ Understand **consumer behavior** when buying and using cooking fuel ▪ Evaluate **perception of key product attributes** of LPG usage ▪ Estimate **demand curve for LPG** and value of different fuel configurations (based on consumer trade-offs)
2.8 Identification and prioritization of primary barriers limiting the adoption and use of LPG by households	▪ Identify **potential barriers to adoption** from the consumer-end ▪ **Initial hypothesis of solutions** to address these barriers

Demand characterization focused on previously identified segments with a focus on the region of Greater Accra

Methodological description

Market segmentation based on "Ghana Consumer Segmentation Study"[1]



Focus on high economic incentive segments

Given Greater Accra's higher income, project aimed at covering **all income segments in Greater Accra** (due to their high economic incentive to adoption):

- **Early adopters**: High income urban consumer segment with already high LPG adoption rate
- **Primary target**: Middle and high income segment in urban areas, with charcoal as primary fuel
- **Low income charcoal users:** low income segment in Accra with higher viability of adoption of LPG than the equivalent segment in other regions

1) SOURCE: THE GLOBAL ALLIANCE FOR CLEAN COOKSTOVES - GHANA CONSUMER SEGMENTATION STUDY (APRIL 2014)

Insights generated by collecting data using four key sources

Sources	Data collection	Insights
Consumers **Conjoint surveys**	**Structured interview** on product preferences with **84 consumers** in Greater Accra region (~25min each)	• **Consumer preferences** for different product attribute combinations • Insights on **usage behavior and potential LPG adoption rate**
Consumers **In-depth customer interviews**	In-depth qualitative interview on **LPG usage behavior with 4 current consumers** (~60min each)	• Comprehensive information on current **LPG usage practices** • Insights **on perceptions and challenges** of LPG in contrast to other fuels
Consumers **Community workshop**	**Round-table discussion with 30 fish fryers** in urban Accra neighborhood (Jamestown) for approx. 60 minutes	• Insights on **barriers to adoption** of LPG under current market conditions • Potential solutions for **education and distribution** in urban communities
Suppliers **Supplier meetings**	7 small group meetings (lasting more than 12 hours) with **representatives of players** in LPG value chain (e.g. cylinder manufacturer, retailers)	• Understanding of **current LPG value chain** in Ghanaian market • Insights on **key challenges in LPG market** from different points of view

Focus on next slides

Field research focused on conjoint analysis on customer preferences

Conjoint analysis methodology

- Field research mainly focused on analysis of customer preferences based on **conjoint analysis**
- In conjoint analysis, **customers reveal "*true*" preferences** by selecting preferred choices among a set of alternative combinations of product attributes
- Conjoint provides insights in **relative importance** of product design dimensions and **preferred product attributes**
- Differences in preferences allow **segmentation** among customer base

Conduct

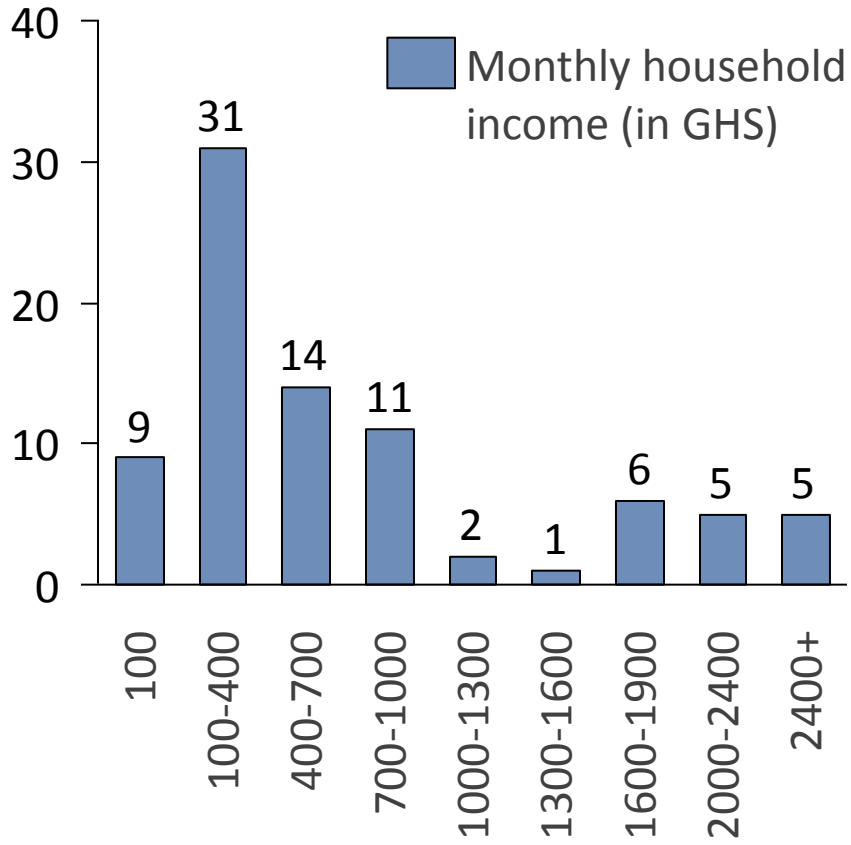
- Survey taken with a randomized sample on May 19 & 20, 2014 in Accra (e.g. Korle-bu, Jamestown, Russia) and Tema (e.g. community 5, 7)[1]
- Each Wharton researcher complemented with local market research specialist
- Interview duration approx. 25 mins

Survey design

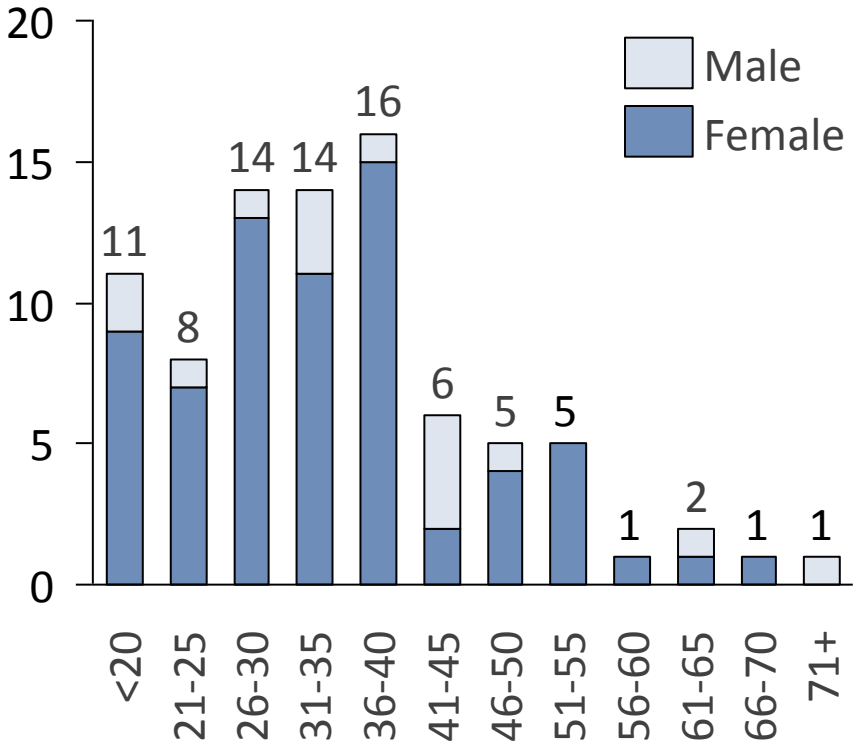
- 1. Conjoint choices between four options based on 3 attributes out of 6 dimensions, such as
  - Stove type (e.g. 2 burner tabletop vs. 4 burners)
  - Cylinder size (e.g. 14.5kg vs. 6.0 kg cylinders)
  - Initial purchase price of starter-kit
- 2. Perception and usage of LPG gas in comparison to other fuels
- 3. Demographic information

Randomized sample consists of 84 respondents across different income levels, genders and age groups

Income levels



Gender and age groups

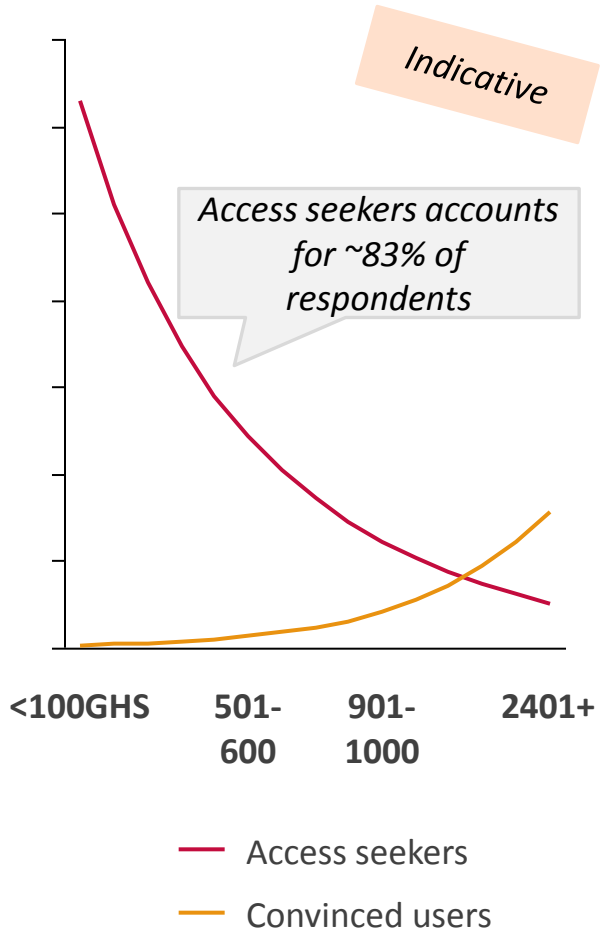


Research identified two segments: one focused on convenience and upfront cost, and another on their cooking experience

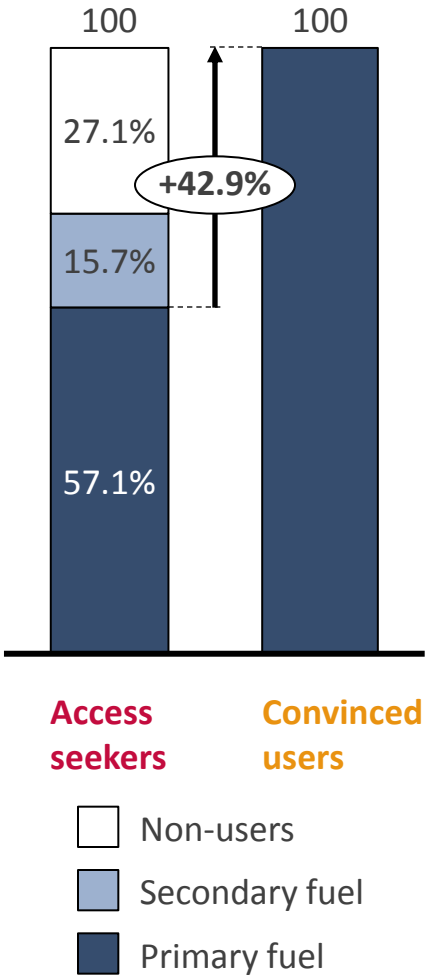
	Segment 1 **Access seekers** **(low-income, 83% of respondents)**	Segment 2 **Convinced users** **(high-income, 17% of respondents)**
1 **Demo-graphics**	• Household **income below ~1,000 GHS/mo.** • Currently **lower share (57%) of LPG adoption**	• Household **income above ~ 800 GHS/mo.** • Majority uses **LPG for daily cooking**
2 **Customer preferences**	• Strong preference **for proximity to sales points** and large cylinder size • **Initial investment** in stove and cylinder is main barrier of adoption due to lack of financial resources	• Primarily focused on **optimizing LPG usage and cooking experience** (i.e. stove types with at least 4 burners and low decanting costs) • **Limited trust in LPG service providers and intermediaries** forces them to take care of cylinder maintenance and decanting
3 **Segment strategy**	• Provide customers with **convenient access** to cylinder exchange at **5 minutes walking distance** through exchange truck system • **Decrease upfront cost** of adoption **through microcredit** solutions • **Educate consumers** on the health benefits and convenience of LPG	• Provide **door-to-door cylinder exchange** for a fee • **Educate consumers** on the importance and reliability of the cylinder exchange model

1 Demographics: two segments coincident with household income

Preference segment distribution by income levels



LPG usage by segment



Description

Access seekers mainly defined by household income of below ~1,000 GHS/month

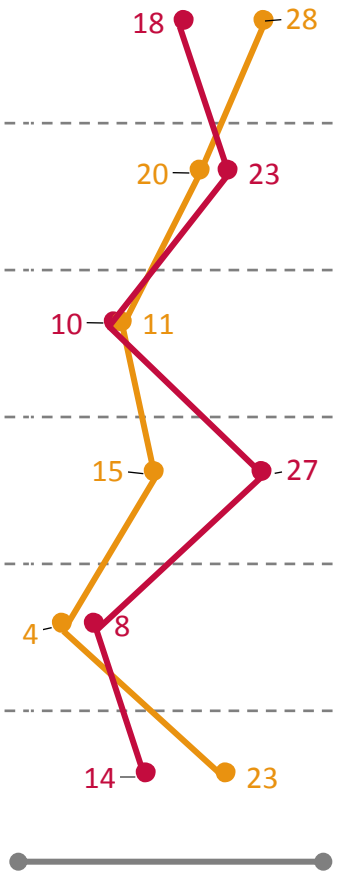
- Majority of people completed Senior or Junior High School
- Working in low skilled professions (e.g. trader, vendor)

Convinced users customers primarily in higher income segment of above ~800 GHS/month

- Mostly obtained higher education (university, polytech)
- Mostly white collar professions (e.g. engineer, manager)

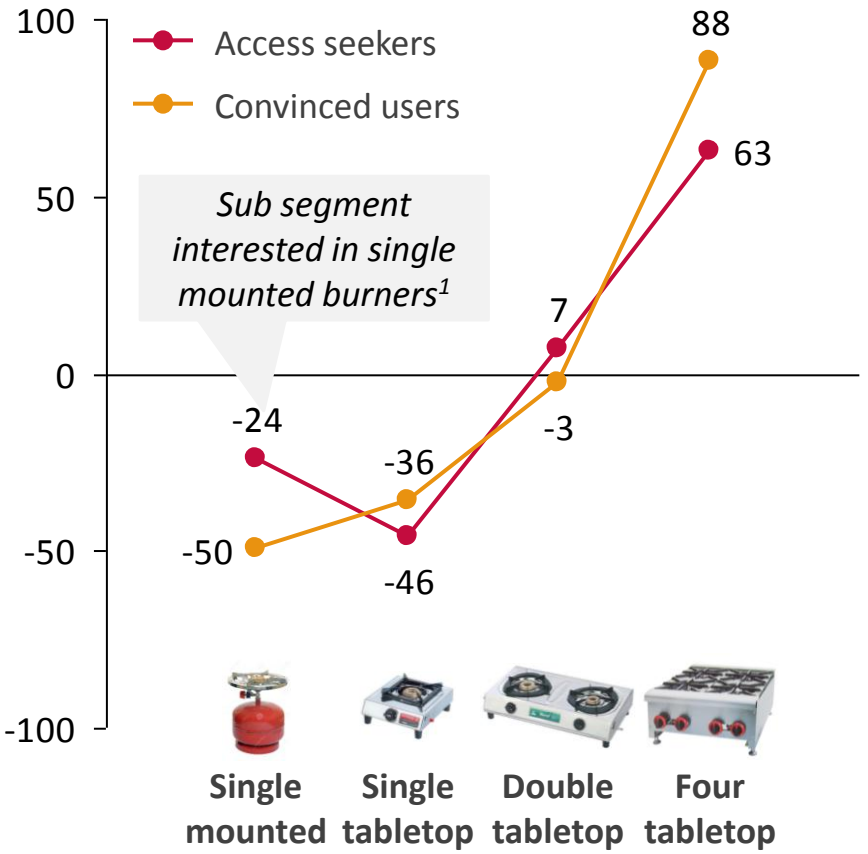
Differences in age, gender and household size not significant between two segments

2 Preferences: Segments differ in importance of product attributes

	Relative importance	Access seekers (low income)	Convinced users (high income)
Stove		**Preference for multiple burners**, but stove type is not first priority	Stove is **most important** attribute and most people opt for **four burners**
Cylinder size		Strong preference for **large cylinders**, as this reduces exchange/decanting frequency	Preference for **large cylinders** due to longer lifetime
Purchase price		**High sensitivity to initial retail price of stove and cylinder** due to financial constraints	Preference for lower prices, but **willingness to pay for appealing stove/cylinder** combinations
Distance to point of sale		Proximity single most important factor due to **lack of time and financial resources** for transportation	Relatively unimportant as people have **access to car** or sufficient financial resources for taxi ride
Cylinder management		Preference for **exchange model** with safety certified cylinders	**Prefer current decanting model and** taking care of cylinder maintenance themselves
Decanting / exchange price		Willingness to **pay more for cylinder exchange/decanting** in exchange for additional services and lower upfront costs	Strong preference for **lower decanting/exchange costs due to pay-off of long-term savings** of LPG investment

Consumers prefer multiple burners for multi-tasking

Cook stove attribute preferences by segment



Burners – "the more, the better"

Overall, in both segments clear preference for stove types with more than one burner

Access seekers prefers multiple burners for dual applications, but also sees benefit of single mounted type

- Multiple burners would substitute current usage of multiple charcoal stoves for dual cooking
- Single burners mounted on cylinder seen as viable portable solution for a few customers
- *Quote: "I like two burners because I can cook two dishes at the same time"*

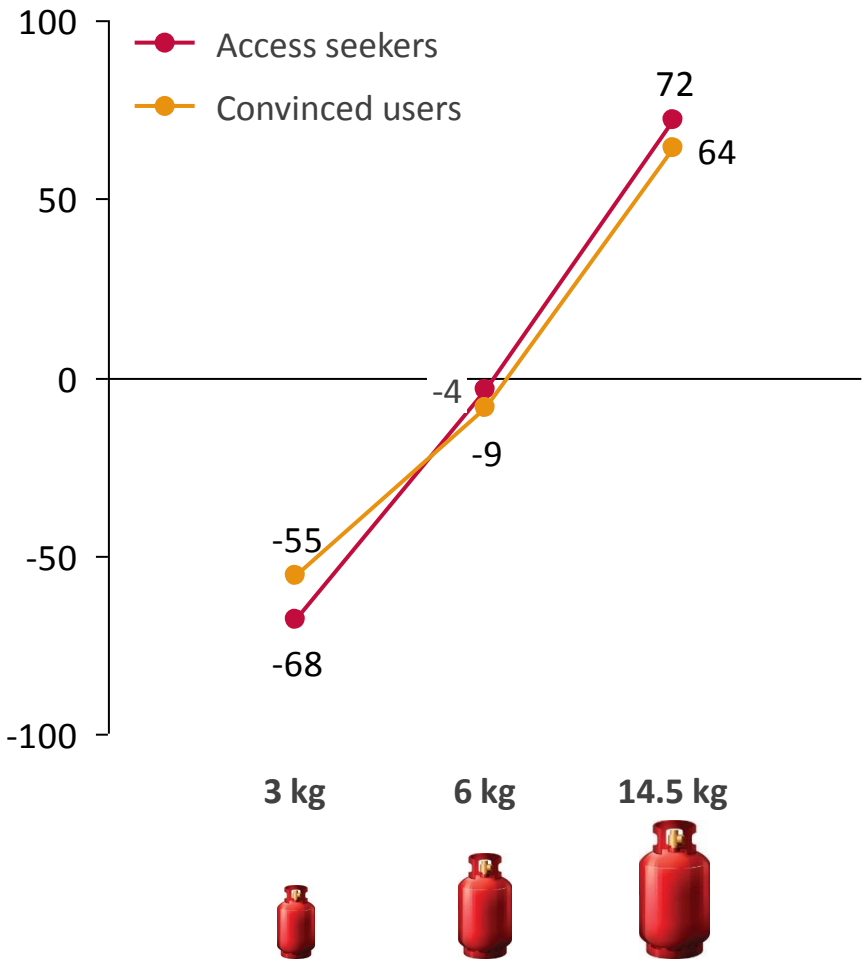
Convinced users not willing to accept any stove types with less than four burners

- Most customers already use LPG stoves with at least four burners and a stove
- No willingness to switch to smaller burner
- *Quote: "I am used to my four burners, I can heat tea and cook at the same time"*

1) SIZE OF SUB SEGMENT TO BE ESTIMATED BY FUTURE RESEARCH

14.5kg cylinder sizes favored by both segments

Cylinder size preferences by segment



14.5kg cylinder top favorite in the market

Both segments favor 14.5kg cylinder, while smaller cylinders not consider viable options (especially 3kg)

Access seekers' choice for cylinder size driven by reduction of refill frequency and increased carrying comfort

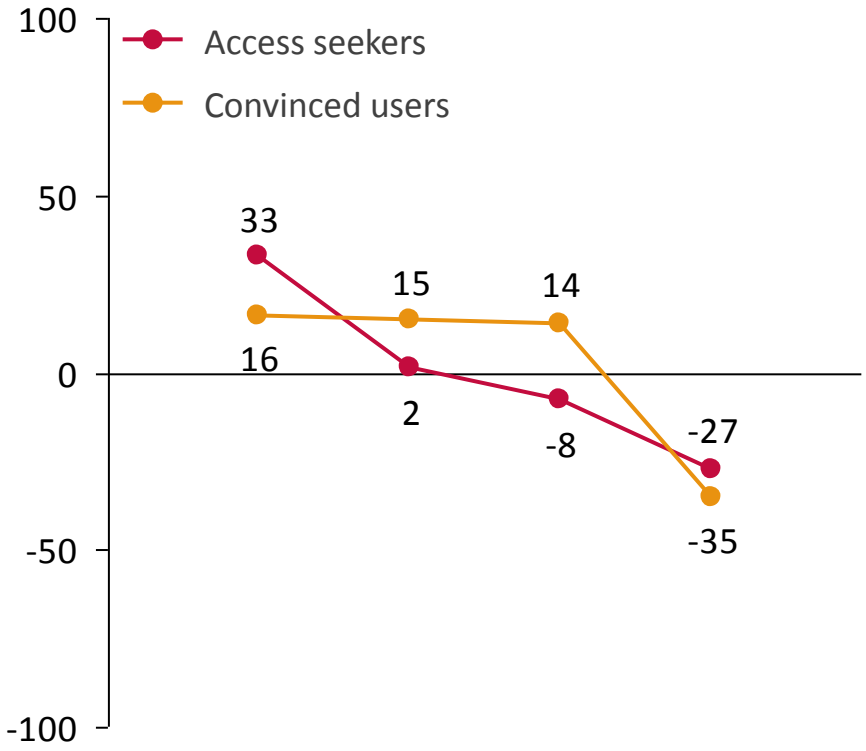
- On average, customers refill their 14.5kg cylinder every 4-6 weeks
- Customers hate going to decanting stations because they are far away (walking/taxi required) and availability is uncertain
- *Quote: "I have a large family and sometimes cook commercially. Anything smaller than 14.5kg would have me going back and forth to the refill station"*

Convinced users prefer 14.5kg cylinders size as it optimizes convenience and refill frequency

- Customers often with 14.5kg spare cylinders at home to build reserves for potential shortages
- Refills considered less painful because customers have car or sufficient financial resources to afford a taxi ride
- *Quote: "You never know when LPG is not available. That's why I have three 14.5kg cylinders."*

Initial purchase price as a barrier of adoption for access seekers

Willingness to payfor stove and cylinder by segment



	Low	Medium	High	Very high
e.g. retail price double tabletop 14.5 kg cylinder[1]	*100*	*120*	*140*	*160*

Starting kit purchase price – "the lower, the better"

While economic pricing rules apply for both, purchase price seem to be show-stopper for access seekers

Income constraints make access seekers very sensitive to upfront retail price of stove and cylinder starting kit

- Anything else than low price combinations seem as a potential barrier to adoption for access seekers
- Lack of savings and larger cash amounts make initial starting-kit purchase impossible
- *Quote: "I don't have money for the cylinder or the cooker"*

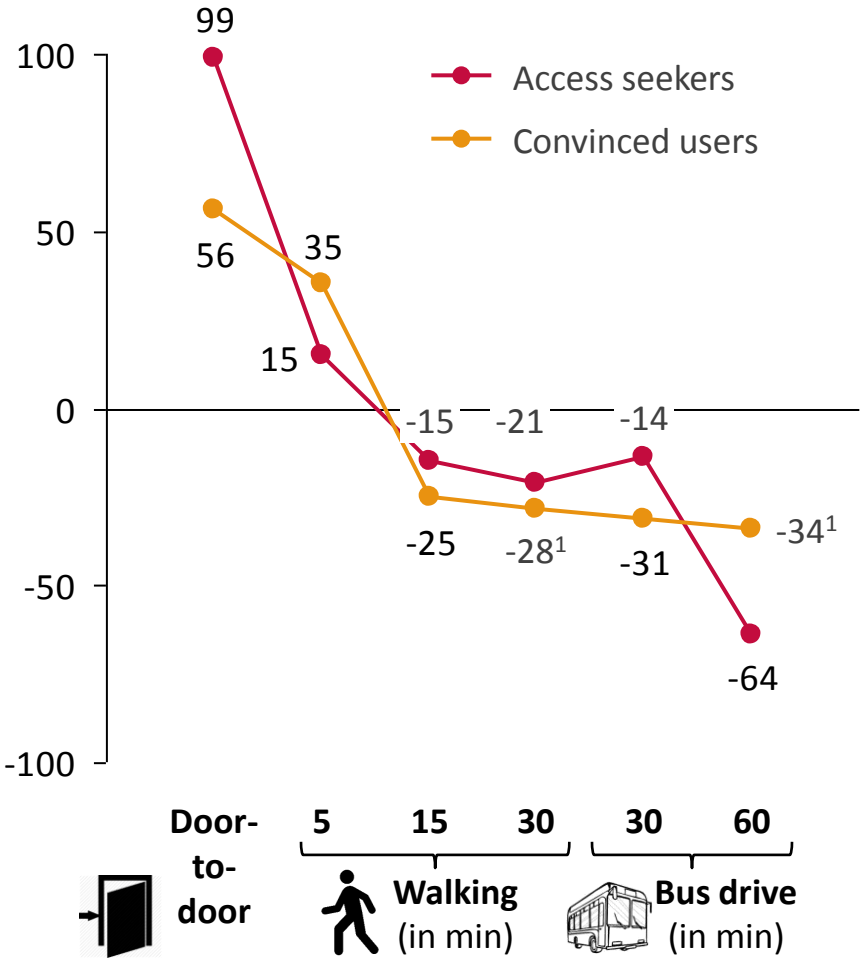
Convinced users indifferent to initially spend more for starting kit, if features are appealing

- Convinced users prioritize obtaining the desired cooker and cylinder over the upfront cost
- *Quote: "I would never sacrifice my current stove. It's just too valuable to me."*

1) IN GHS, LOW, MEDIUM, HIGH AND VERY HIGH PRICES FOR START-KITS DEFINED BASED ON STOVE AND CYLINDERS COMBINATIONS (SEE TABLE IN APPENDIX)

Short distances for Access seekers, while convinced users trade-off convenience and trust

Preferences for distances and means of transportation for decanting stations by segment



Cylinder delivery as a tradeoff between convenience and trust

Convenience of door-to-door delivery favored by most; convinced users with some trust concerns

Access seekers strongly driven by convenience aspects to avoid refill/exchange troubles

- Door-to-door delivery clearly seen as best solution to save time and painful cylinder carrying to refill/exchange station
- If door-to-door is not available, 5 minute duration is preferred; otherwise, duration of journey less important than convenience of a bus ride
- *Quote: "Door-to-door would save me a lot of time, because I am too busy to go to the refill station"*

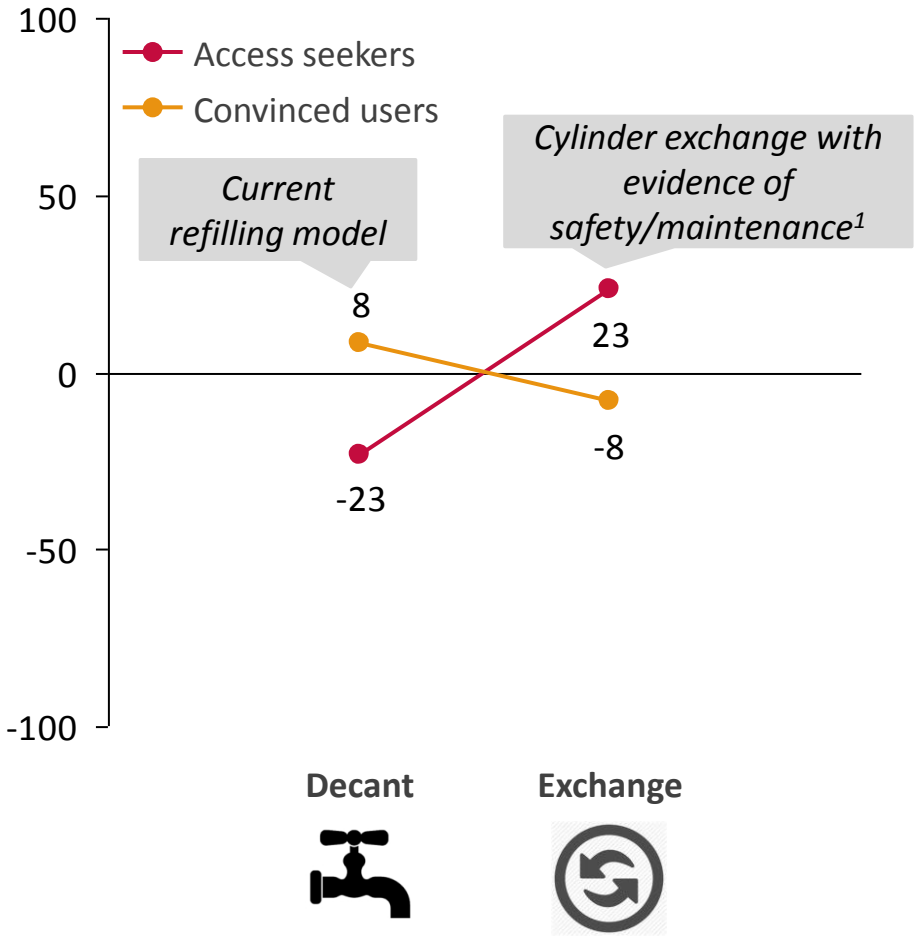
Convinced users prefer door-to-door, but do not mind travelling short distances to refill/exchange cylinder

- More elastic in terms of distance/duration as most customers have a car available to take cylinder to decanting/exchange station
- *Quote: "I don't like door-to-door, because you never know whether they return your own cylinder and whether they fill it properly."*

1) NOT SIGNIFICANT, INTERPOLATED 2) NOT SIGNIFICANT

Cylinder management model polarizes two segments

Preferences for cylinder management model by segment



Safety yes – but who should take care of it?

Opposite preferences in cylinder management models are one of the key differences between two segments

Access seekers prefer ease of exchange transaction and increased safety through certified maintenance

- Many customers "fix" potentially leaking cylinders with stone on valve
- Exchange faster than current decanting process, which takes 5-6 minutes (with queue easily >45min)
- *Quote: "I would feel better if I could replace my current cylinder for a certified one"*

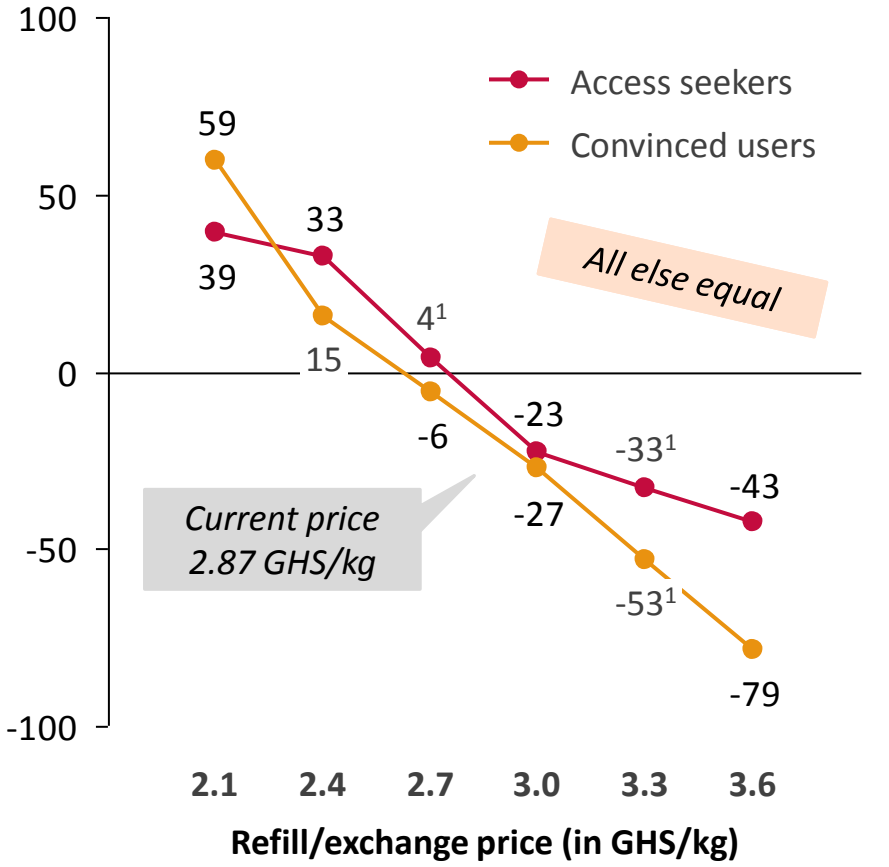
Convinced users interested in well-maintained cylinders, but does not trust the exchange model

- Currently most customers take care of cylinder maintenance themselves
- Doubt feasibility of increased safety in exchange model, partially based on previous experience
- *Quote: "I've seen the exchange model in action. In Ghana it doesn't work. I would always exchange my good cylinder for a bad one"*

1) E.G. SEALED VALVE

Convinced users optimizing for low refill/exchange costs in the long-run

Preferences on refill/exchange prices by segments



Access seekers willing to pay more for additional services

As expected, both segments show inverted preferences for increasing monthly refill/exchange prices

Access seekers favor lower refill/exchange prices, but willing to pay for additional services[2] and lower upfront price

- Many customers explicitly state willingness to pay for certified safety or door-to-door delivery
- Willing to pay higher recurring payments in order to balance with upfront costs due to lack of cash
- *Quote: "We work a lot. We would pay to have nearby access to safe LPG"*

Convinced users strongly prefer lower refill/exchange prices as long-term nature of LPG investment is considered

- Low willingness to pay for transport services; consumers already have access to automobile
- Willing and financially equipped for higher upfront investments to reduce recurring costs
- *Quote: "Why would I pay someone to go refill my cylinder. I don't trust him and I already have a car"*

1) SAMPLE RESULTS NOT SIGNIFCANT, INTERPOLATED 2) E.G. DOOR-TO-DOOR OR EXCHANGE MODEL

3 Target access seekers with nearby LPG at low costs and convinced users through education on reliability of cylinder exchange model

	Access seekers	Convinced users
Strategic focus	*Increase convenience of cylinder exchange, lower upfront costs and educate on LPG health and safety*	*Achieve widespread acceptance of exchange model by educating users on its reliability*
Price for stove and cylinder configuration	• Reduce upfront cost through microcredit • Target segment with 14.5kg cylinders and double table top cookers; provide street vendors with single mounted burners	• Target segment with 14.5kg cylinder and 4 burner cook stoves (potentially with oven)
a **Distribution channels**	• Increase proximity to consumers by exploring alternative channels (e.g., exchange truck visits local communities)	• Maintain current distribution channel and provide door-to-door exchange for a fee
b **Cylinder management**	• Implement exchange model with safety certified cylinders and eliminate queues • Substitute legacy cylinders by ramping up domestic production and increasing cylinder imports (to be analyzed in depth in supply work stream)	
c **Education**	• Train respected community members (e.g., selected by local Chief) to explain LPG safety rules and health benefits	• Explain benefits of cylinder exchange model (i.e. safety and health aspects) through health centers and LPG retailers
Refill/exchange price	• Decrease prices by building efficiency in LPG value chain (analyze in supply work stream)	
d **Potential increase in market share**	***+31pp***	***-6 to +2 pp***

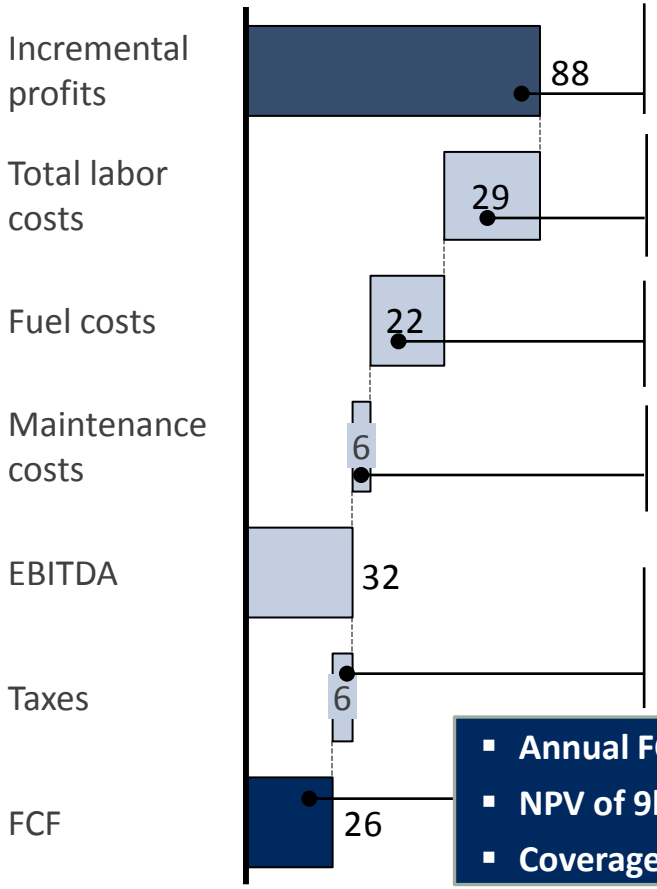
a A single truck could access 9k households distributing cylinders at 5 minutes walking distance with a positive NPV

Description

- Transport cylinders to each location with high concentration of access seekers
- Use 8ton trucks to place cylinders at ~5minutes walking distance from consumers
- Truck should transport ~96 cylinders weighting 14.5kg and visit 3 locations per day

Economics

Cash flow structure, GHS



Assumptions

- Sales of 96 cylinders , of which 20% go to new consumers, at margin of 5GHS/cylinder[1]
- 2 employees loading and unloading cylinders for ~100 minutes and driving 2 hours at 4GHS/man hour
- Average distance to location of 20 km, with truck consuming 20L/100km at 2.7GHS/L
- Annual costs of 5% of truck value distributed throughout 3 trips per working day
- Corporate tax rate of 25%
- Depreciation tax shield based on straight line depreciation for 15 years life

- **Annual FCF of 18kGHS (considers 3 trips per working day)**
- **NPV of 9kGHS throughout 15 year lifetime[2]**
- **Coverage of 9k households[3]**

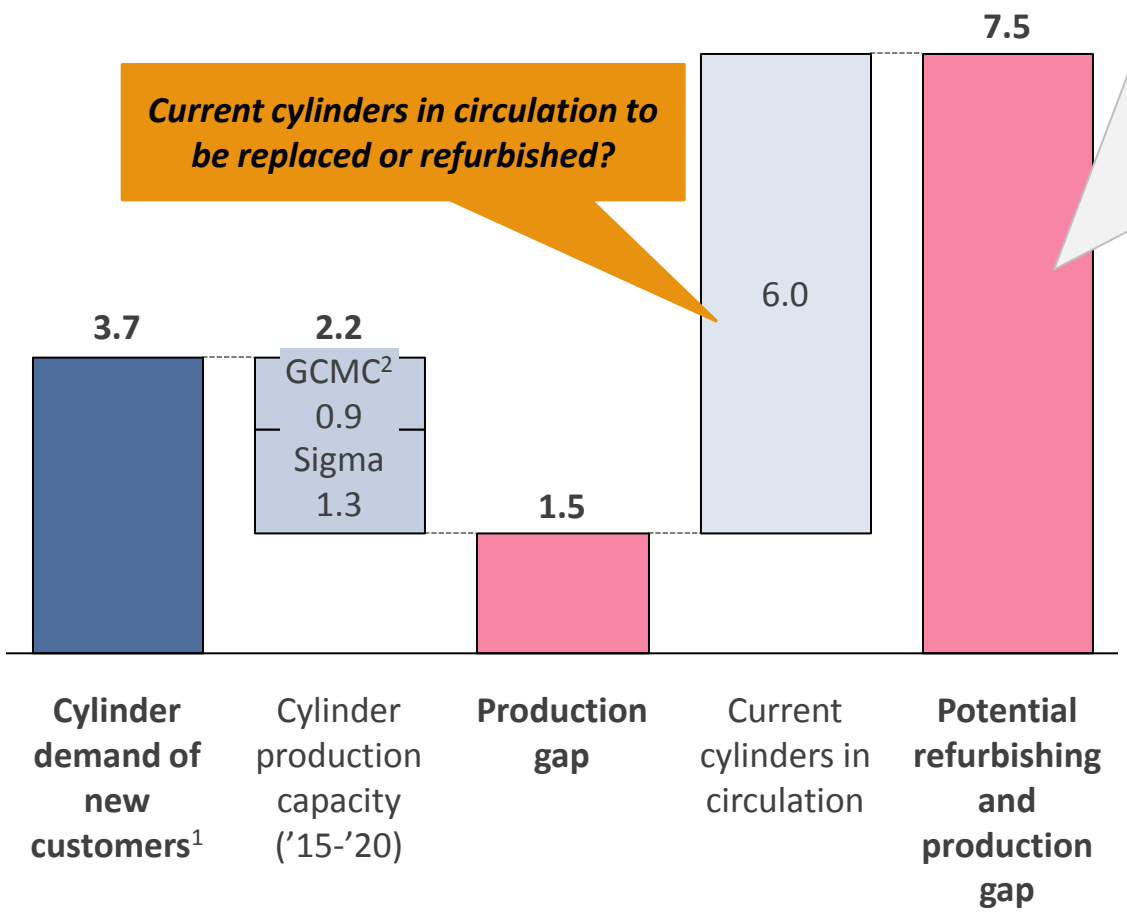
1 Each cylinder weighs 14.5kg, is priced at 2.9GHS/kg with a 4.0% margin to the retailer (current margin), and has an additional transportation fee of 0.2GHS/kg. Calculation only considers incremental market share generated by initiative (detailed ahead).
2 Considers WACC of 19%: β of 1.1 (in line with transport industry); market premium of 6.7%; country equity risk premium of 11.8%; no debt
3 Assumes cylinders last 1 month and a half

SOURCE: DAMADORAN (NYU); KITE; NPA; BLOOMBERG; ALIBABA; CONSUMER SURVEYS; CONJOINT ANALYSIS

b Achieving 50% LPG adoption rate by 2020 with cylinder exchange model demands increase of cylinder supply capacity

Cylinder demand and production (Million cylinders), 2015-2020

- Success of exchange model demands 1) sufficient cylinders to meet demand from new adopters and 2) trust in circulating cylinders
- The latter demands substitution of unsafe cylinders currently circulating



- Supply-demand gap of ~7.5M cylinders likely in 2020 at current installed capacity
- To achieve target adoption rate Ghana needs to ramp-up current yearly cylinder production by 5x (from ~0.4M to yearly average of 2M) or complement it with additional imports

1) 2.5M NEW HH WITH 1.5 CYLINDERS IN CIRCULATION PER HH 2) GCMC PRODUCTION TO REACH CAPACITY IN 2017 SOURCE: KITE (2011); CONSUMER SURVEYS AND INTERVIEWS

c For access seekers, education should be done through community Chiefs, and should focus on explaining that LPG is safe and healthy

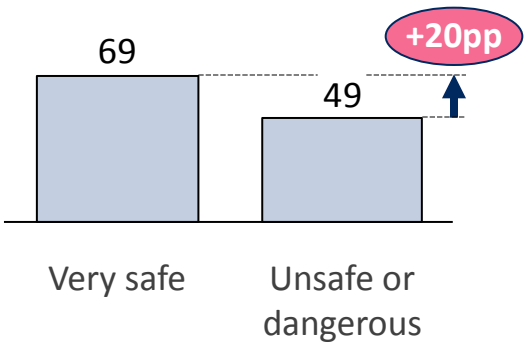
Focus on education for access seekers

Consumers who believe LPG is safe and healthy (vs. other fuels) use it more

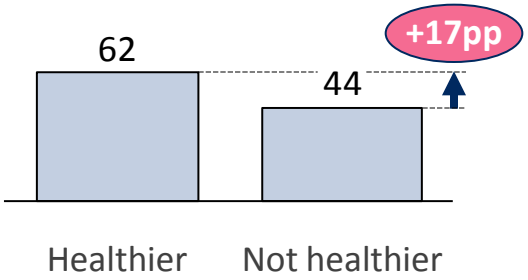
Question

% of participants that use LPG as primary fuel for each response

How safe is LPG?



Is LPG healthier than other fuels?



Education should be spread through local community Chiefs

- Request that each **community's Chief select** a **group** of community members to educate the local population on the use of LPG
- **Educate group** on each of the drivers of LPG adoption
  - How to **use LPG safely**
  - How to detect and react to a leak or eminent explosion
  - What are the **health benefits** of LPG
- Make group accountable for educating community on the use of LPG
- **Monitor group's success** with a visit to the community (e.g., 6 months after LPG is made available), based on reports of accidents and the adoption of LPG within the community

SOURCE: CONJOINT SURVEY; FISH FRYER CHIEF OF JAMESTOWN, ANDRE MAKATTAH

c For convinced users, education should be done through respected community members, and focus on reliability of exchange model

Focus on education for convinced users

Consumers don't trust the safety of their cylinders to others

- **Consumers disliked** the previous **exchange model** because they distrusted the safety of the cylinders they received
  - *"I saw the old [cylinder exchange] model. It doesn't work in Ghana because people don't respect each other. I use to give them a well taken care of cylinder and they'd give me a terrible one"*
- **Consumers don't trust third party door-to-door intermediaries** because they don't like to lose sight of their cylinder
  - *"I never use door to door refilling. The man who takes the cylinders to the station doesn't fill it completely and doesn't take good care of it"*
- **Consumers don't trust those who fix cylinders**
  - *"When I ask someone to fix a leak on my cylinder they usually sometimes they do it right other times they don't. When this happens I ask someone else to fix it. Fixing things is completely random in this country."*

Education should be spread through well-respected community members

- **Leverage health centers** (especially mothers during maternity) and **local LPG retailers** to educate consumers
- **Educate these stakeholders** on
  - The importance of adopting LPG for **health reasons**
  - How LPG has become safer with the new exchange model that includes a **safety guarantee (e.g., certificate, seal)**
  - How to detect and react to a leak or eminent explosion
- **Monitor** the success of the **education** programs with a visit to the community (e.g., 6 months after LPG is made available), based on reports of accidents and the adoption of LPG within the community

SOURCE: CONSUMER INTERVIEWS; KITE: LPG GHANA STUDY

d Proposed initiatives can significantly increase LPG market share in access seekers

	Access seekers			Convinced users	
	LPG market share increase, %		Assumptions	Market share increase, %	Assumptions
Decrease distance to sales point	+8%	0.40	• Decrease distance from 30 min bus to 5 min walking by adding nearby sales point and/or cylinder exchange truck • Increased fee of 0.2 GHS/kg	+2%	• 40% of segment uses door -to-door cylinder exchange • 0.5 GSH/kg cost for those who use this service
Implement exchange system	+12%	0.43	• Implement cylinder exchange model with evidence of cylinder safety • Added maintenance cost of 0.05 GHS/kg to refill/exchange price[2]	-8 to 0%	• Aversion to exchange model – fear of losing current (well maintained) cylinder for a poorly maintained one • Unlikely to stop using LPG. 0-8% share drop is worst case scenario
Decrease upfront payment	+11%	0.57	• 40 GHS decrease of upfront payment for a cylinder and cook stove kit[3] • Amount of discount repaid over 1 year (microfinance)	+/- 0%	• Low elasticity of initial kit expense
Potential increase in market share	***+31pp***			***-6 to +2 pp***	

1) Maximum possible refill/exchange price increase that does not decrease LPG market share below the level prior to the attribute change
2) Cylinder maintenance cost = 8 GHS/year (~10% of cylinder purchase price) 3) Double tabletop burner and 14.5 kg cylinder

GHS/kg *Marginal increase in willingness to pay[1]*

Next steps

- **Characterize demand in other regions** of Ghana and **understand differences vs. Accra** (lower levels of adoption may generate additional segments both among high-income consumers and low-income consumers)
- **Finalize research on LPG supply chain** (including its economics) in Ghana
- **Optimize and fine-tune proposed marketing strategy** initiatives based on supply side economics (i.e., cost structure)

Appendix

Appendix

1. LPG market structure

2. Conjoint methodology

3. Detailed interview results

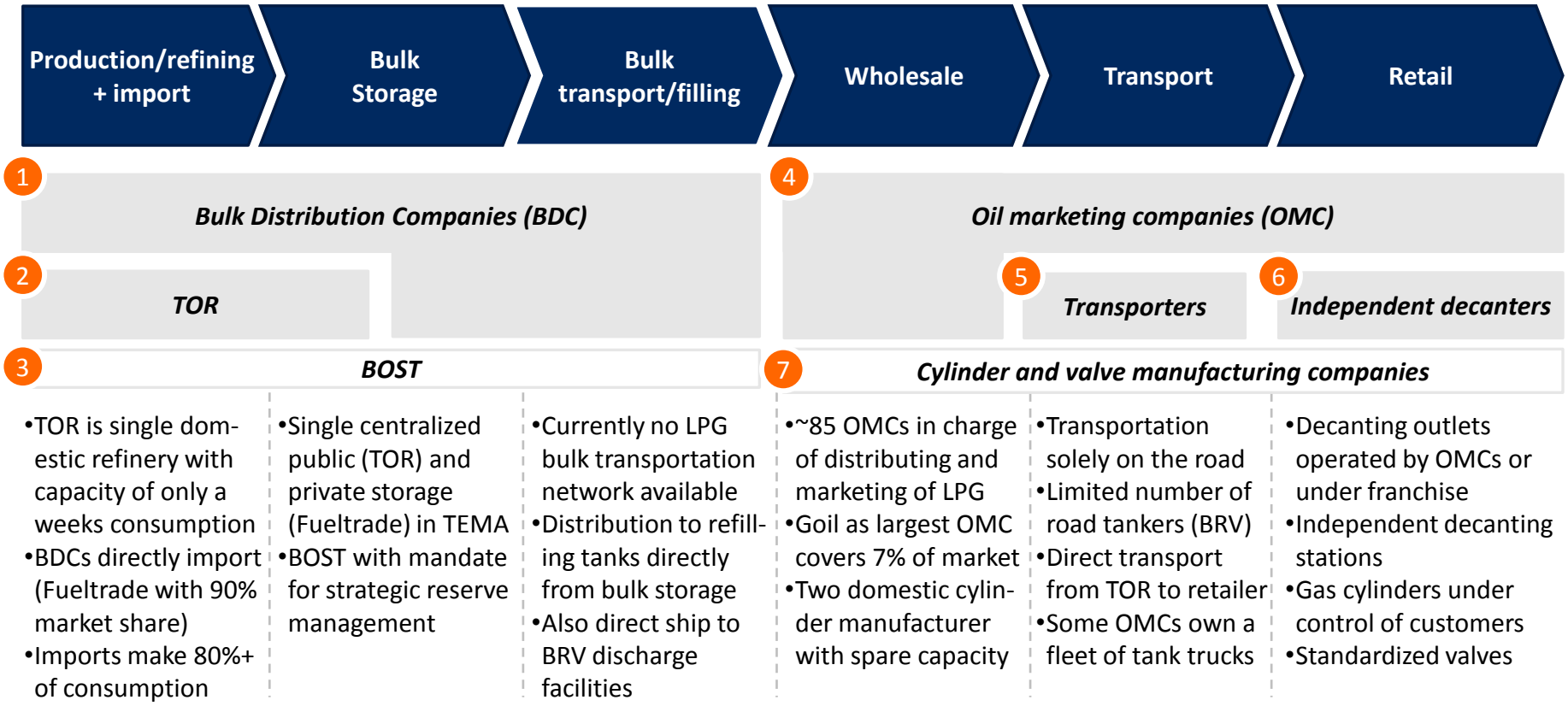
Goals for Reference 4
Supply security, scalability, and curve assessments

REMINDER

TOR Goals	Description
4.1 Characterization of present LPG supply chain link by link, from production/importation to retail	▪ Understand **structure of current value chain** ▪ Describe **links from production to retail** ▪ Assess **performance and economics** of each link

Preliminary assessment

LPG supply chain is specific and complex with many actors involved

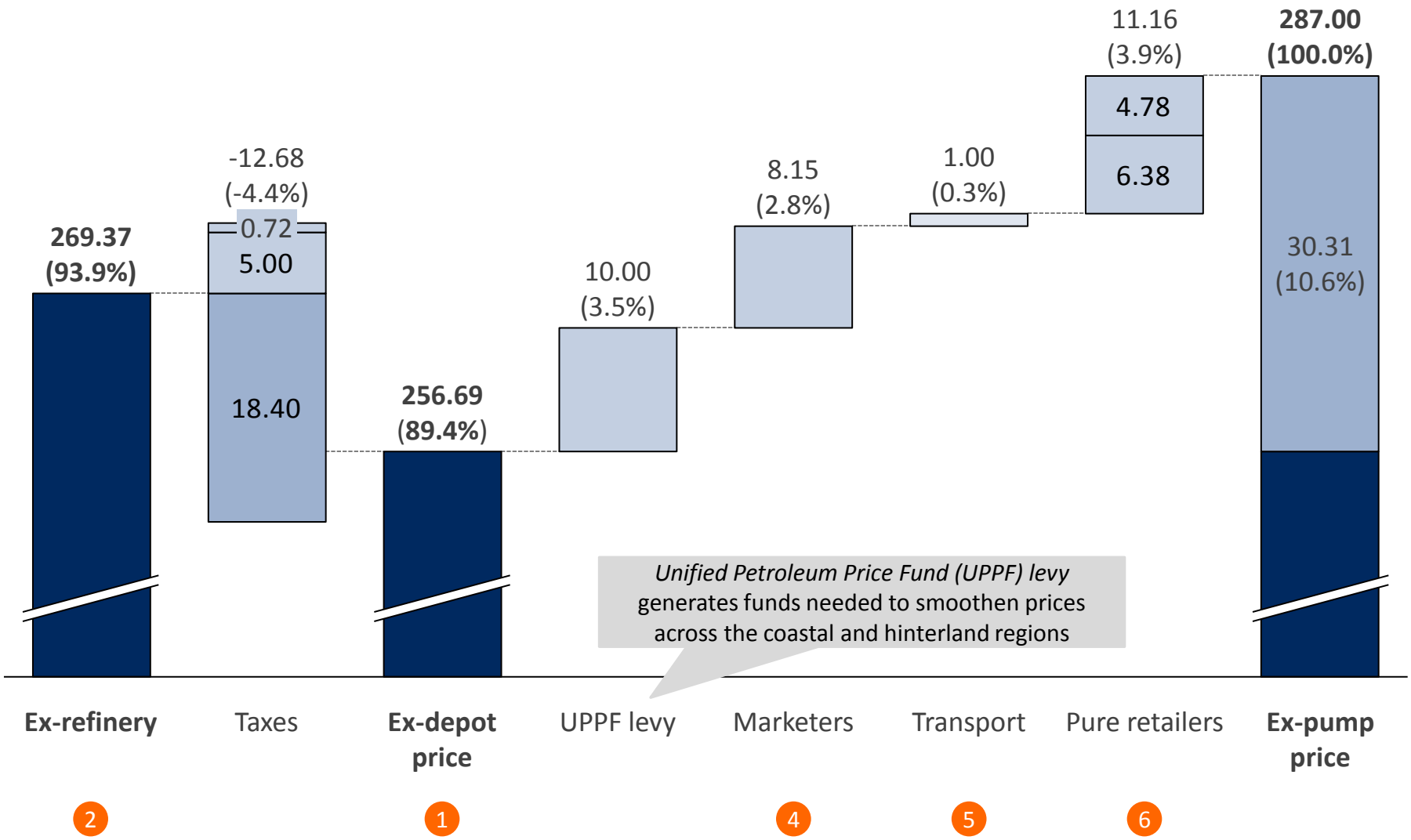


Policy and regulation

- *National Petroleum Authority (NPA):* regulate, oversee and monitor activities in the deregulated petroleum downstream industry
- *Overall responsibility with Energy Commission (EC), Ghana Standards Board (GSB) set safety and measurement standards*
- Reduction of LPG subsidy from 50% to 0% decreased consumption in 2014 compared to 2013 by about 30%

Preliminary assessment

LPG price build up as of May 16, 2014 (in GHp/KG)

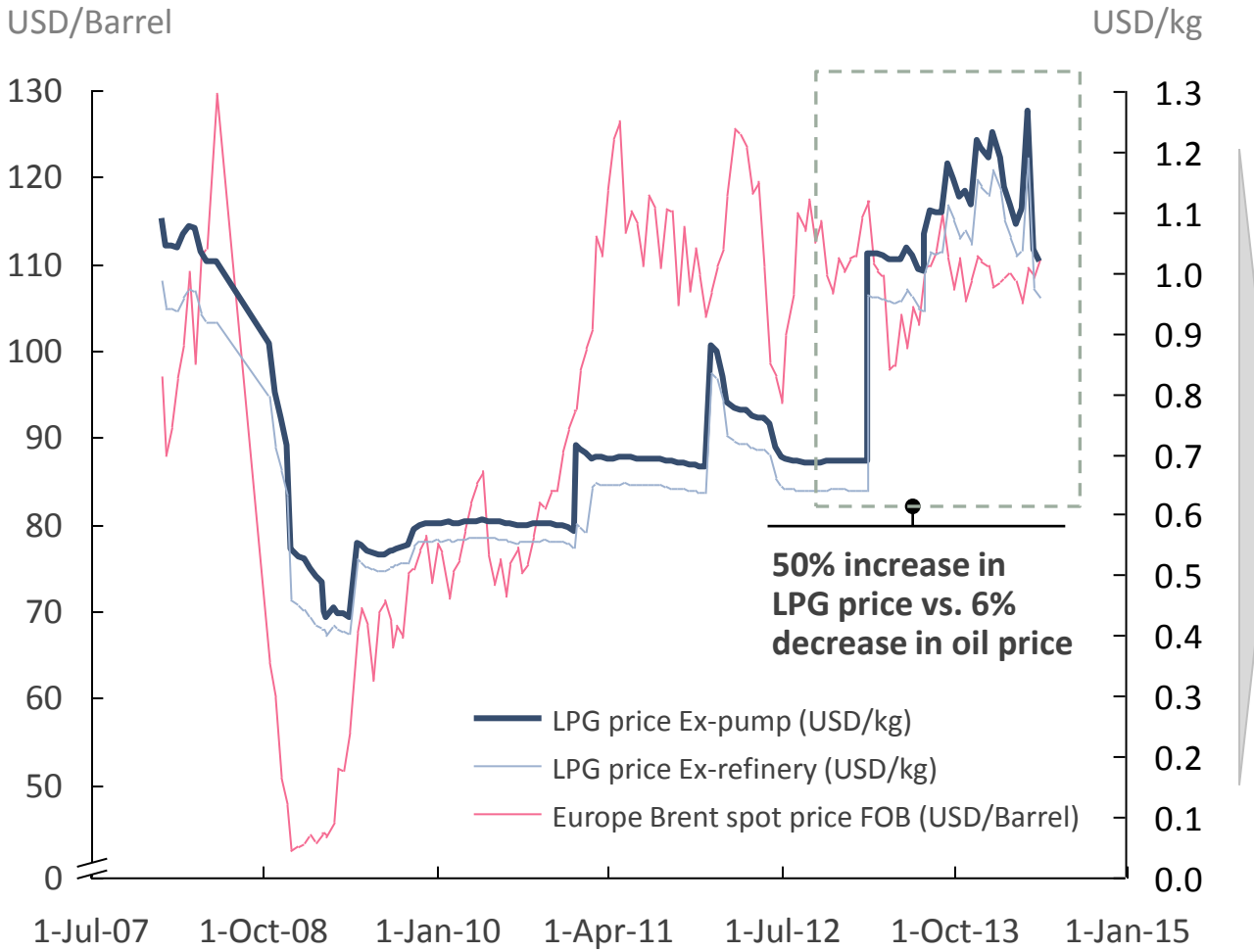


1) INDICATIVE MAXIMUM PRICE SOURCE: NPA

Preliminary assessment

Drive down prices by increasing efficiency in LPG value chain (especially up to refinery section)

Comparison of international oil and Ghanaian LPG prices, USD



- Price of LPG to consumer is mainly driven by its price at refinery (92% of price to consumer)
- Until 2013, LPG price evolution remained in tandem with that of oil (with less volatility)
- Post 2013, LPG prices increased 50% while oil prices decreased by 6%

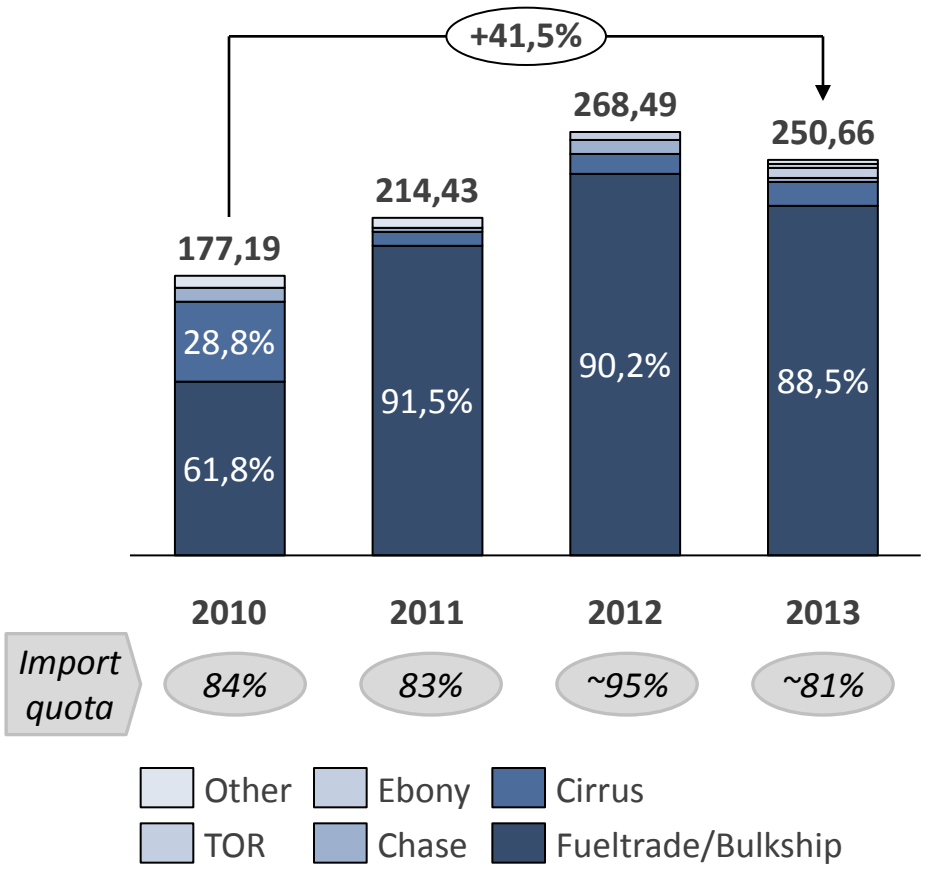
Survey data suggests that Access seekers are spending on average 17% of their income on cooking fuels (middle 50%: 4-24%), while Convinced users 3% (middle 50%: 1-6%)

SOURCE: NPA; EIA

Preliminary assessment

BDCs: Fueltrade largest bulk distributer with ~90% market share

LPG bulk distribution market size and share by BDC 2010 – 2013 (in '000 kg)



Outlook

Challenges

- LPG shortages and insufficient cylinder production capacity limits demand and the ability to estimate what the true demand is
- Perceived lack of safety of LPG limits demand for this fuel

Potential strategies proposed by fuel trade

- Expand bulk transportation infrastructure (e.g., Takoradi pipeline and bulk transport ship)
- Potentially, integrate vertically into OMC and eventually retail section of value chain (accomplish this through initiatives in which fuel trade has full control)

1) OTHER INCLUDES ECO, OILCHANNEL, BLUE OCEAN, DEEN, FIRSTDEEPWATER, VIHAMA

Preliminary assessment

OMCs: Three different types of marketers in Ghanaian LPG market

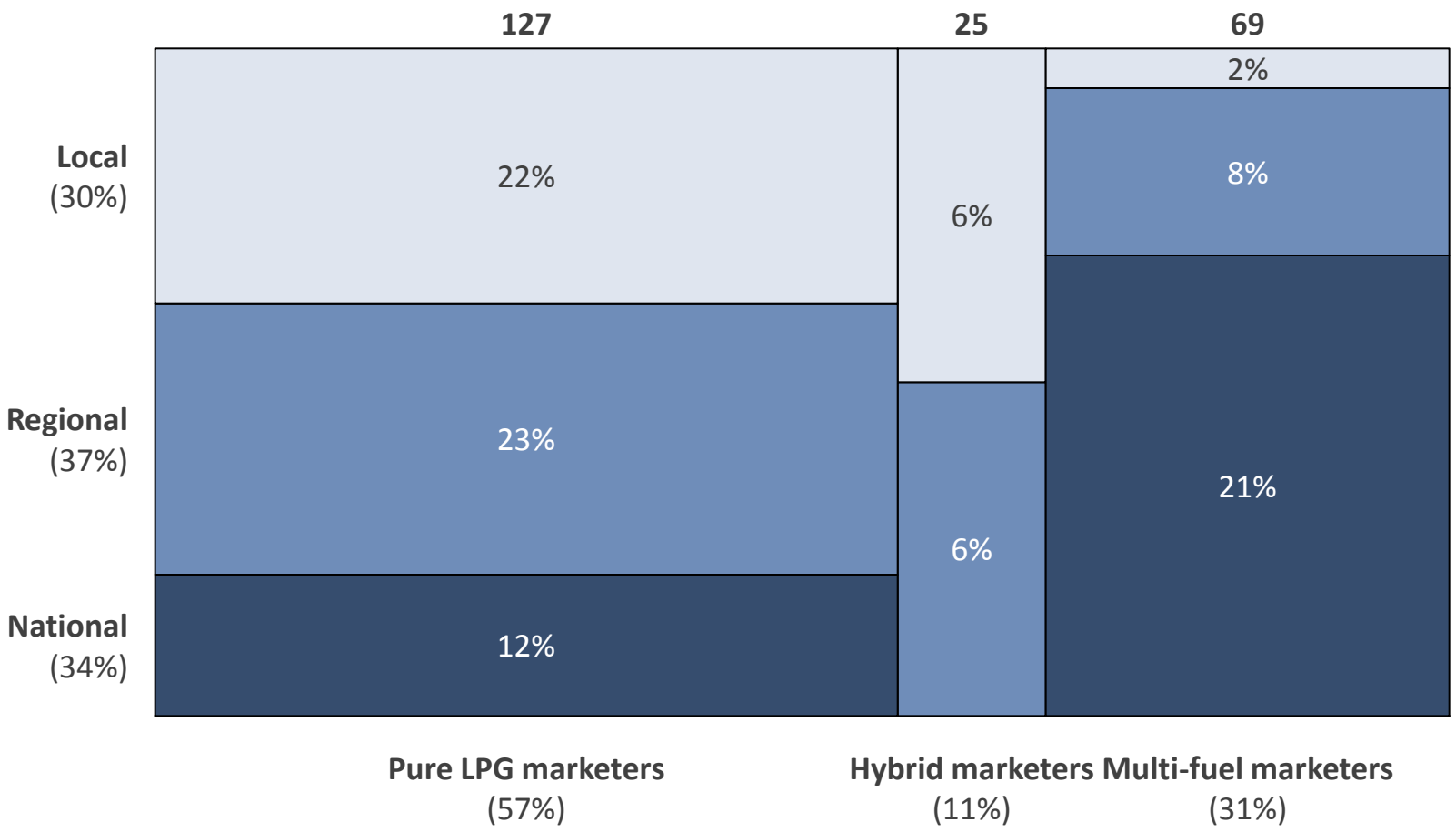
	Pure LPG OMCs	Multi-fuel OMCs	Hybrids
Typical characteristics			
1 **Market share**	~ 57%	~ 31%	~ 11%
2 **LPG share/sales**	Almost exclusively LPG (more than 90%)	Small share in sales portfolio (less than 10%)	LPG w/ significant share in sales mix (10-90%)
3 **Geographic focus**	Mainly local and regional	Mainly national and some regional	Only local and regional
4 **Network size**	Less than 10 outlets	More than 15 outlets	Less than 10 outlets
Examples	• Trinity Oil • Manbah Gas • Joekona	• Ghana Oil • Agapet • Quantum Petroleum	• Superior Oil • Unique Oil • Lucky Oil

Preliminary assessment

1 Pure LPG marketers command 57% of LPG market in 2012

Market share by company type and geographic focus, in m litres

Total LPG sales in 2012: 228.548m litres

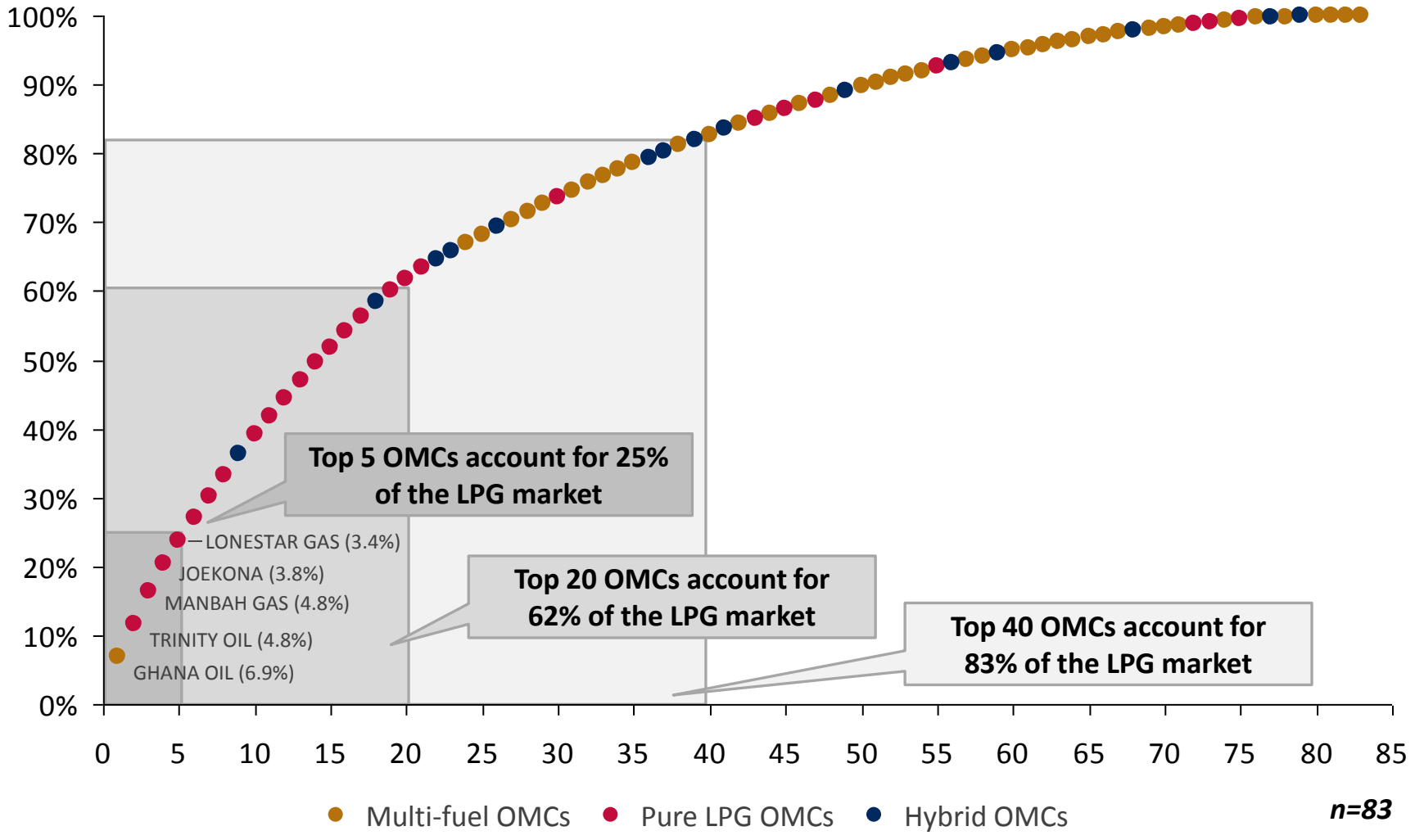


SOURCE: NPA

Preliminary assessment

2 Top 20 OMCs account for 62% of Ghanaian LPG market

17 out of 20 top OMCs exclusively sell LPG

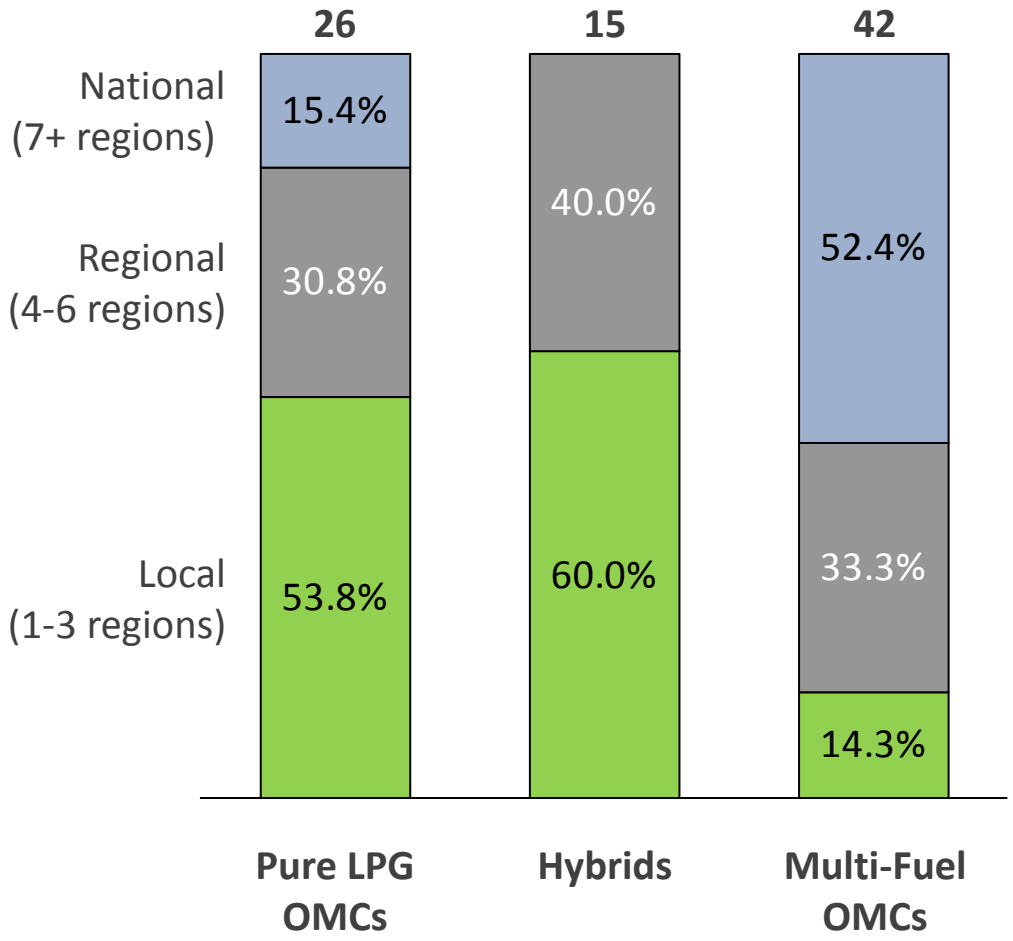


NOTE: BASED ON LITRES SOLD IN 2012
SOURCE: OMC PERFORMANCE STATISTICS 2012 (NPA)

3

3 Most pure LPG marketers with local retail network, while most Multi-fuel marketers with national retail strategies (1/2)

Preliminary assessment



Geographic focus of outlet network

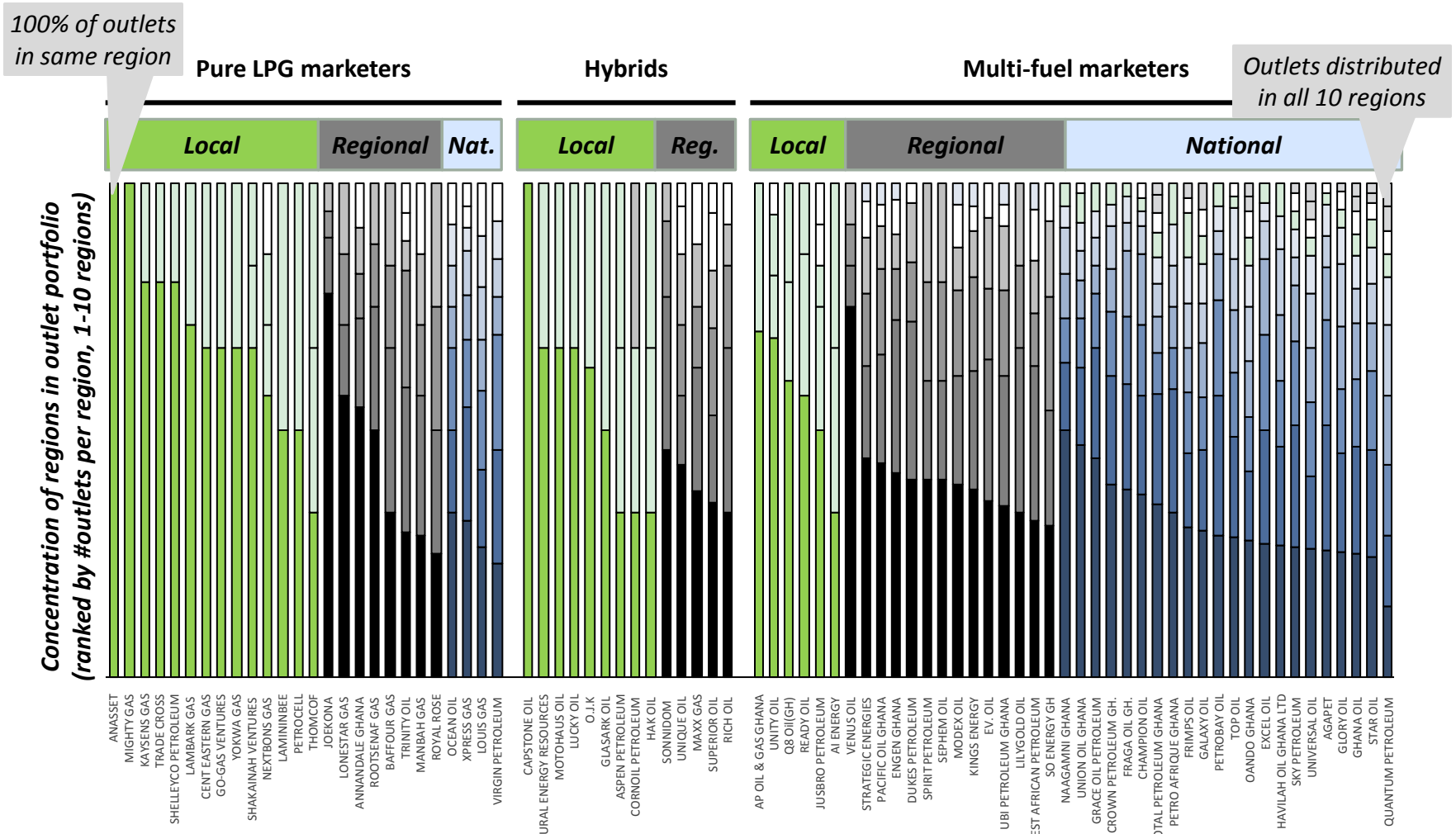
- Majority of pure LPG OMCs focus their outlet network on 1-2 regions (mainly urban areas)
- Majority of Multi-fuel OMC's with national retail network (more than 7 regions)
- Hybrids only with local and regional networks, no national coverage

SOURCE: BASED ON NPA STATISTICS

Preliminary assessment

3 Most pure LPG marketers with local retail network, while most Multi-fuel marketers with national retail strategies (2/2)

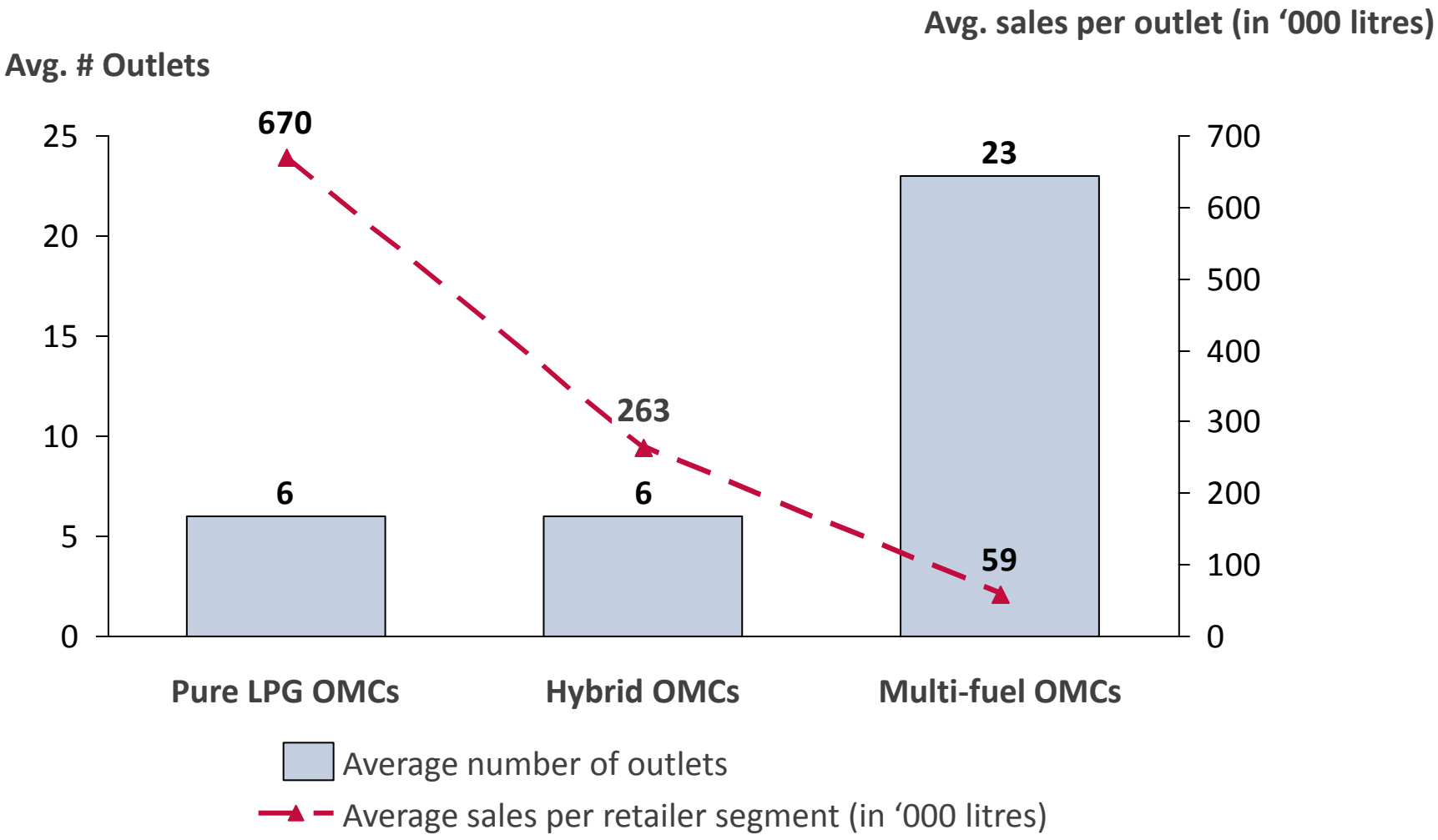
Concentration of outlets among 10 regions by OMC, each bar represents an OMC



SOURCE: BASED ON NPA STATISTICS

Preliminary assessment

4 Pure LPG marketers drive more sales per outlet (1/2)

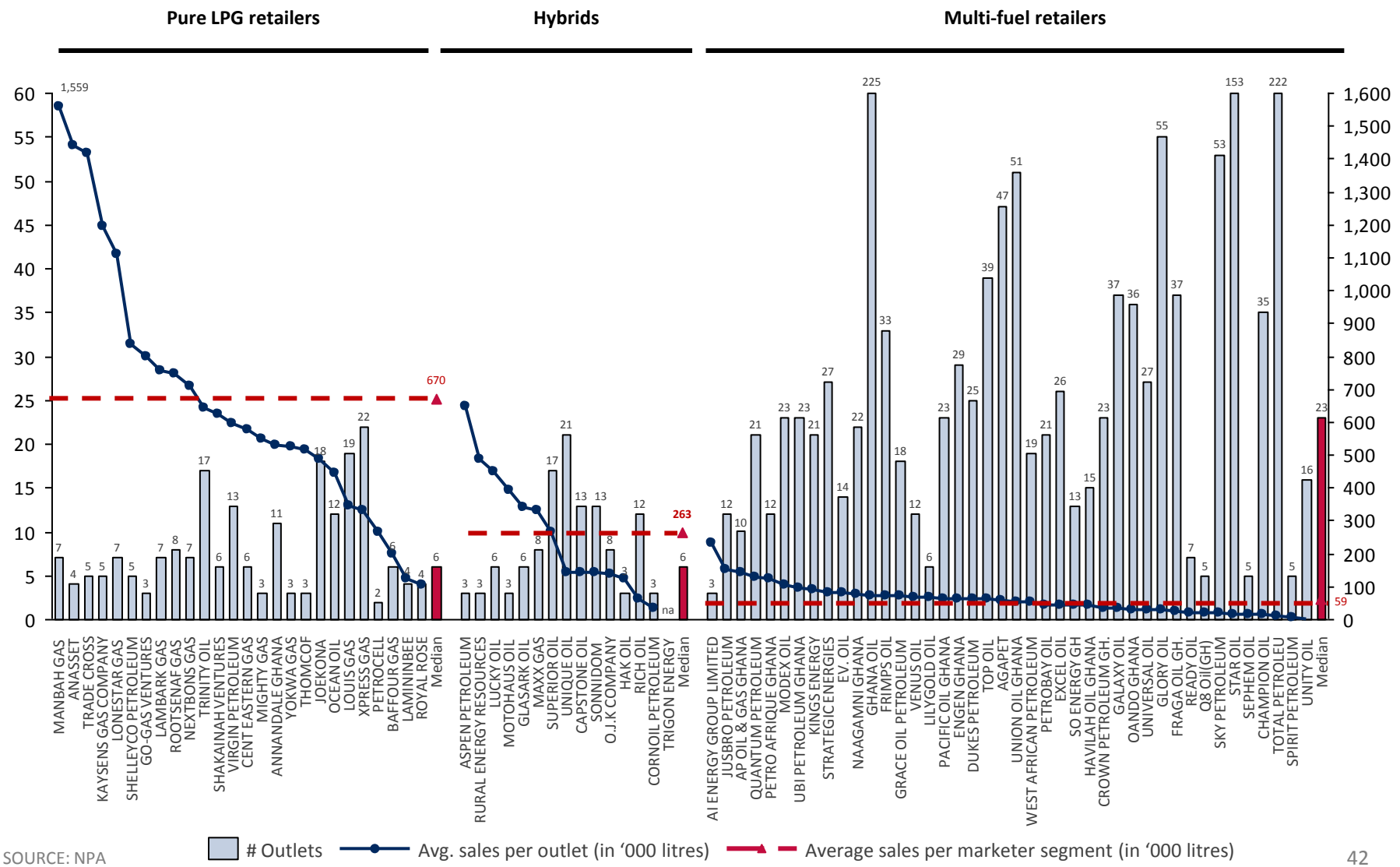


SOURCE: NPA

Preliminary assessment

4 Pure LPG marketers drive more sales per outlet (2/2)

Number of outlets per OMC (bar), average sales per outlet per OMC (line, in '000 litres)

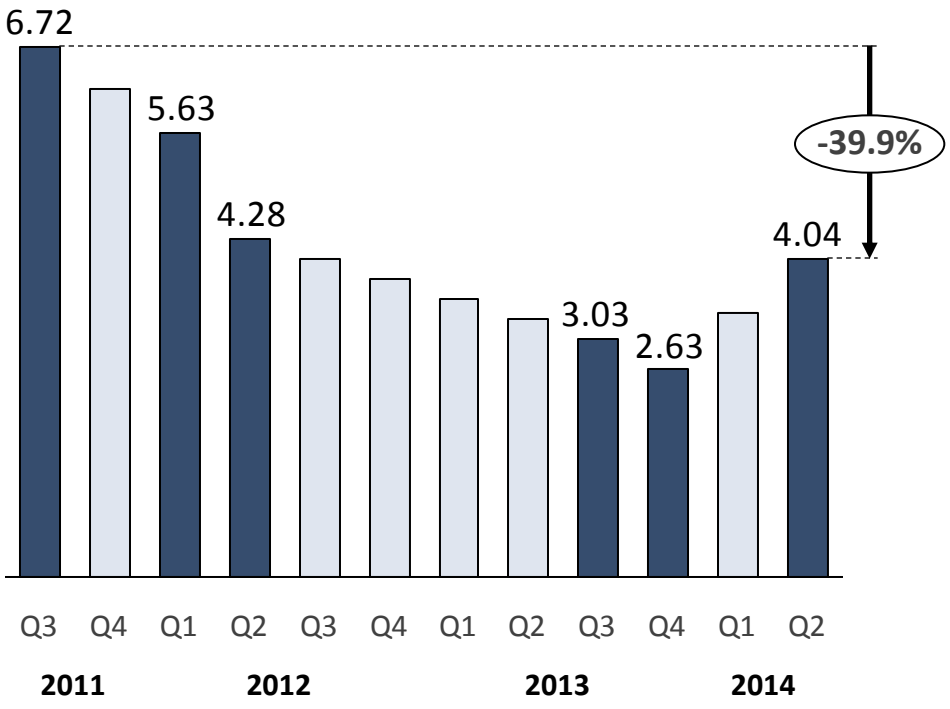


SOURCE: NPA

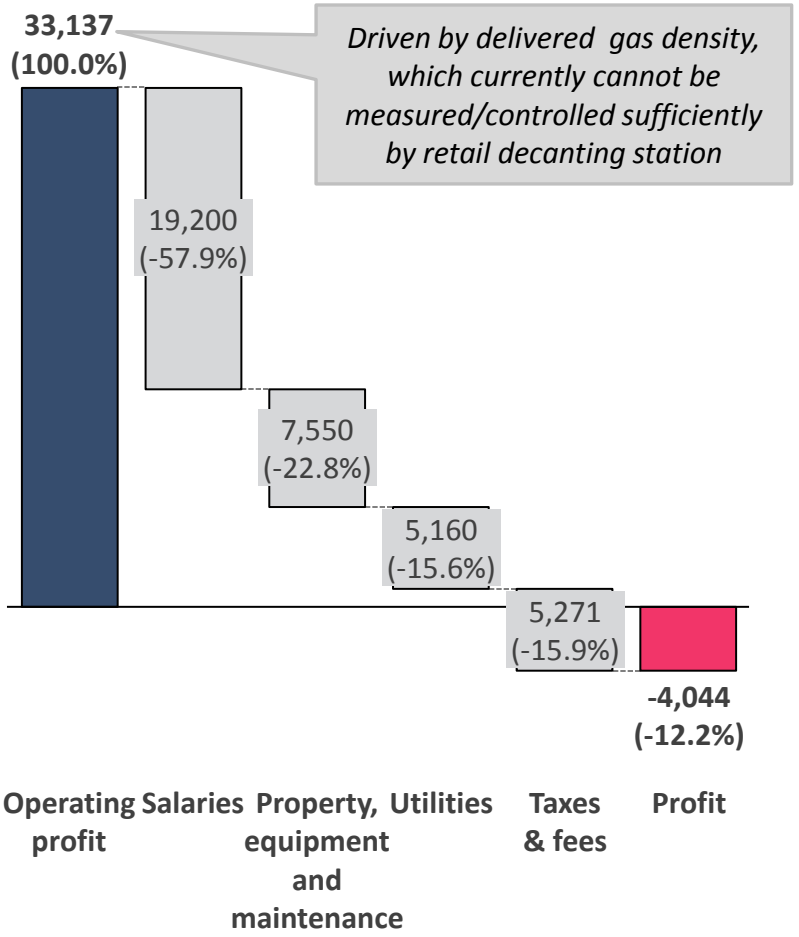
Independent decanters turned unprofitable due to 39.9% margin reduction since 2011

Preliminary assessment

Significantly reduced retailer margin (in % of retail price)…



…not sufficient to cover cost base of an average LPG decanting station



SOURCE: GHANA LPG RETAIL ASSOCIATION

Preliminary assessment

Cylinders: Domestic cylinder production inefficient & below capacity

Cylinder production overview

Two cylinder manufacturing companies currently active in Ghana (GCMC and Sigma)

Ghana Cylinder Manufacturing Co. Ltd. (GCMC) officially mandated to provide market with cylinders (40% market share)

- Produced 130k cylinders in 2013 (140k expected in 2014), which is highest output in company history
- Positioned at price premium as quality cylinders, which optimally meet standards (e.g. thicker walls)
- Cylinder production complemented with manufacturing of LPG stoves (output 2013: 5k)
- Currently excess capacity of 150k cylinders due to inefficiencies and shortages
- Expansion and new production facilities in Accra planned to be kicked off in late 2014

Sigma Gas Ghana Ltd. Accounts for 60% of the market, known to reduce material cost by pushing cylinder design for lower end of standard measures

Cylinder ownership model

Currently three standard sizes in market available – 3.0kg, 6.0kg and 14.5kg

- 14.5kg most popular size in the market
- More sizes up to 52.0kg available, but mostly for industrial and commercial applications

Ownership of cylinders in Ghana is vested in practice with end-users

- Model initially based on deposit/refund and exchange system evolved to local decanting motivated by LPG shortages that led to consumer desire to cross-fill, and by lack of cylinder maintenance that led to consumers exchanging good-condition cylinders for bad-condition cylinders
- Lack of knowledge about cylinder lifespans; lack financial resources for carrying out refurbishment and cylinder recertification
- Inability to manage cylinders in circulation due to end-user cylinder control and lack of exchange

Appendix

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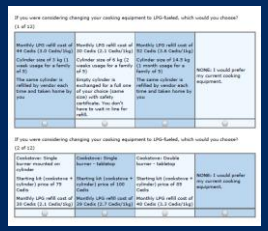
3. Detailed interview results

Conjoint study methodology (1/2)

1 Definition of attributes

- A pool of attributes (e.g., cylinder size, cleanliness, cook stove type) of a future LPG model was defined
- Six most important attributes (refill/exchange price, cylinder size, distance to a exchange/decanting station, cylinder exchange/refill model, cook stove type and price of a set: cylinder + cook stove) were selected to test their importance with customers

2 Survey design



- Values for attributes were defined based on information gathered during local interviews (e.g., cylinder sizes were set to 3 popular ones in Ghana: 3kg, 6kg and 14.5 kg)
- Specialized software (Sawtooth Software SSI Web and its additional modules)[1] was used to design 8 versions of a questionnaire, 12 conjoint questions each, giving a set of 96 unique questions
- Each question consisted of 3 combinations of attributes and a blank choice („your current configuration")

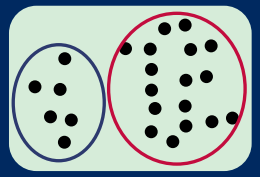
3 Fielding survey

- Printed picture-based questionnaires were used to field the survey among the inhabitants of several Accra neighborhoods (Jamestown, Chorkor, Korle-Bu, Korle-Gonno, Russia, Circle, Mango Lane)
- 84 surveys were conducted; in each survey respondent was choosing their preferred configuration of attributes out of 4 choices in 12 questions for a total of 1008 selections being made from 4032 options

1) WWW.SAWTOOTHSOFTWARE.COM (CBC MODULE FOR SSI WEB)

Conjoint study methodology (2/2)

4 Clustering analysis



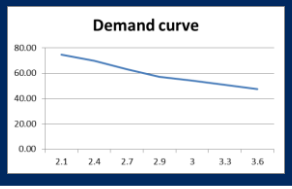
- All survey answers, together with respondents' demographic data were imported to Sawtooth specialized software[1]
- Latent Class using logit regression was performed to identify homogenous groups of respondents, based on their attribute preference
- Identified two preference-based segments were then characterized demographically (income being the best differentiator)

5 Preference estimation

Variable	Effect	Std Error
Door-to-door	1.92670	0.44544
5 min walking	1.28427	0.45748
15 min walking	-0.78536	0.57998
30 min walking	-0.63443	0.54201
30 min by bus	-1.27749	0.56004
1 hour by bus	-0.51369	0.50038
2.1 GHS/kg	2.06585	0.43122
2.4 GHS/kg	0.51319	0.49877
2.7 GHS/kg	0.91006	0.43043
3.0 GHS/kg	-0.96965	0.58141
3.3 GHS/kg	-0.03121	0.55512
3.6 GHS/kg	-2.48824	0.74074

- Individual survey data was analyzed within segments with HB regression, logit regression and partial utilities counts to determine which attributes and attribute values are preferred by customers
- The software analyzes how frequently certain attributes were chosen whenever they were available and based on 1008 selections determines the average importance of each parameter and a preferred value of attributes (e.g., most preferred cylinder size is 14.5 kg as respondents were more likely to choose options with this cylinder size as compared to other sizes)

6 Demand curve approximation



- A model of a two-fuel market (charcoal and LPG) was built and market shares of each fuel were estimated based on the preference scores from the previous step (explained in detail on the following slides)

1) WWW.SAWTOOTHSOFTWARE.COM (LATENT CLASS MODULE FOR SSI WEB)

This methodology produced statistically significant results for both segments

Segment 1
Access seekers
(low-income, 83% of respondents)

Logit regression model used to calculate attribute relevance and part-worth utilities

- Chi-square = 828
- P-value at 26 degrees of freedom ≈ 0

Segment 2
Convinced users
(high-income, 17% of respondents)

Logit regression model used to calculate attribute relevance and part-worth utilities

- Chi-square = 202
- P-value at 26 degrees of freedom ≈ 0

Latent class segmentation process used to find most adequate set of segments

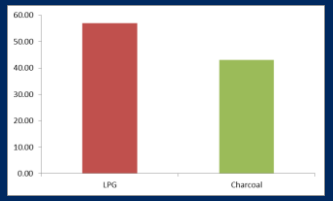
- **Chi-square for a 2 segment model = 956**
- **P-value at 26 degrees of freedom ≈ 0**

Market share and willingness to pay estimation (1/2)

1 Definition of two competing products

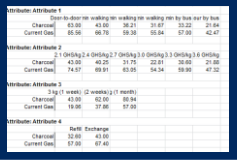
- Charcoal was defined with the use of parameters characterizing LPG: 5 min walking distance to a store, price of 2.1 GHS/kg LPG[1], 3 kg cylinder (short-lasting supply), refill model, low initial set price, single mounted burner (one cooking space per charcoal burner)
- Current most common LPG configuration was described with a set of attributes. For example, for the Access Seekers Segment these are the following: 30 min by bus to a decanting/exchange station, price of 2.9 GHS/kg, 14.5 kg cylinder, refill model, high initial price, double burner

2 Estimation of a share of preference



- Utility of each product to individual customers was calculated based on the individual preferences of respondents captured with the survey (with Sawtooth Software SMRT module[2])
- Product providing more utility was “chosen” by each individual. Percentage of choices won by LPG is its Share of Preference, or an estimated market share (57% among Access Seekers, equal to the value observed with the survey)

3 Sensitivity analysis (market share estimation)



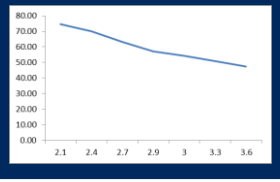
- LPG attributes were changed one by one and the resulting changes in the Share of Preference were estimated. Below is the example of the SoP sensitivity to the initial LPG set (cylinder + cook stove) price levels. By decreasing price from High to Low, the market share increased from 57% to 70.07% (increase of 13.07pp)

Upfront Payment	Low	Medium	High	Very high
Charcoal	38.57	43.00	45.11	46.47
Current Gas	61.43	57.00	54.89	53.53

1) MONTHLY SUPPLY OF CHARCOAL EQUIVALENT TO A 14.5 KG COSTS ~30 GHS 2) WWW.SAWTOOTHSOFTWARE.COM/PRODUCTS/MARKET-SIMULATORS/SMRT

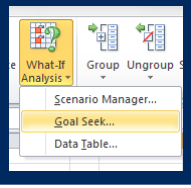
Market share and willingness to pay estimation (2/2)

4 Share of Preference regression on price



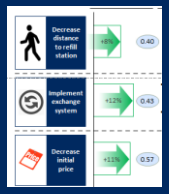
- Based on the Share of Preference sensitivity against prices (step 3), regression line was fitted: SoP=114.88-19.26*Price (R^2 of 0.95)

5 Estimation of a corresponding price level



- Using the regression model, refill/exchange price levels were calculated to resemble Shares of Preference achieved by various attribute levels. For example, the Low initial set price SoP of 70.07 is equal to the SoP determined by the refill/exchange price of 2.33 GHS/kg (all other parameters fixed at the base-case level), significantly below the base-case value of 2.9 GHS/kg

6 Willingness to pay calculation



- The difference between the base-case scenario price and the estimated price equivalent for various attribute levels is the willingness to pay.
- For example, the willingness to pay for a Low initial price of equipment is equal to 0.57 GHS/kg (2.9-2.33)

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Community LPG workshop Jamestown (May 22, 2014)

Meeting summary (1/2)

Date

Thursday, 5/22/2014,
3.00 pm – 4.00pm

Location

House of Chief Andre Mankattah, Jamestown

Participants

- *Andre Mankattah*
- *Somoa Hansen*
- *Gifty Akgtoe*
- *Sera Tegoe*
- *Esther Ainagyei*
- *Eunice Tetteh*
- *Regina Amaley*
- *Rebecca Aguatey*
- *Rebecca Tetteh*
- *Abigril Commey*
- *Joyce Tetteh*
- *Charity Quaye*

- *Mervis Nee Quaye*
- *Elizabeth Ayer*
- *Abigril Arytey*
- *Lydia Laptey*
- *Las Tagoe*
- *Elizabeth Cottoy*
- *Essy Ashey*
- *Ayshetu Ayre*
- *Mevis Adarku Ayre*
- *Georgina Okine*
- *Victoria Labia*
- *Sara Baah*
- *Rahel Ayre*
- *Julianna Baah*

Community LPG workshop Jamestown (May 22, 2014)

Meeting summary (2/2)

Current stove usage practices

Heavy usage of charcoal stoves for fish frying (~25 GHS/day)

LPG as potential alternative

Test users clearly see advantages of using LPG for fish frying:

- Cooking is faster
- Weather-resistant (especially rain)
- Healthier (no burning eyes)

14.5kg cylinder lasts for 2-3 days due to heavy frying usage

Main barriers of adoption

- Refilling is too painful, as station too far away and unavailability/shortage
- Initial outlay unaffordable
- Safety concerns (e.g. kids run around)

Strong preference for LPG if refilling easier and cylinder available