



# Unlocking LPG Finance for Clean Cooking in Nigeria and Ghana

## FINAL REPORT

Clean Cooking Alliance, Shell Foundation,  
African Refiners and Distributors Association, CITAC Africa Ltd

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# UNLOCKING LPG FINANCE FOR CLEAN COOKING IN NIGERIA AND GHANA

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## Research note

Founded in 1998, CITAC Africa Ltd is a UK-based independent consultancy focussed exclusively on the African downstream energy industry. The findings and conclusions presented in this Report are drawn from:

- Virtual and on-the-ground consultation with key stakeholders over February-March 2022.
- Household surveys and focus groups in the Greater Lagos region, with a focus on Epe, Ilaje/Bariga and Makoko in February 2022.
- Household surveys and focus groups in Ayenyah and Kordiabe (both near Ayikuma) on the border of the Greater Accra and Eastern Regions, in February 2022.
- Learnings from the multiple commercial LPG studies CITAC has conducted over the past 20 years.
- CITAC's Africa Downstream Database (ADD+).
- Desk-based research.

In particular, CITAC would like to thank the following stakeholders for their time, openness and valuable insights:



## Abbreviations

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B/d	Barrels per day
CRM	Cylinder Recirculation Model
ECOWAS	Economic Community of West African States
EPA	Environmental Protection Agency
FPSO	Floating Production and Storage Offloading unit
GHS	Ghanaian Cedi
HSEQ	Health, Safety, Environment and Quality
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LPGMC	LPG Marketing Company
Mt	Metric tonne
NGN	Nigerian Naira
NGP	Nigeria National Gas Programme
NLEP	National LPG Expansion Programme
NLNG	Nigeria LNG Limited
NMDPRA/NPRA	Nigerian Midstream and Downstream Petroleum Regulatory Authority
NPA	National Petroleum Authority
PAYG	Pay As You Go
PPAC	Petroleum Planning & Analysis Cell
PRSL	Price Stabilisation & Recovery Levy
SON	Standards Organisation of Nigeria
TOR	Tema Oil Refinery
UPPF	Unified Petroleum Pricing Fund

## Executive Summary

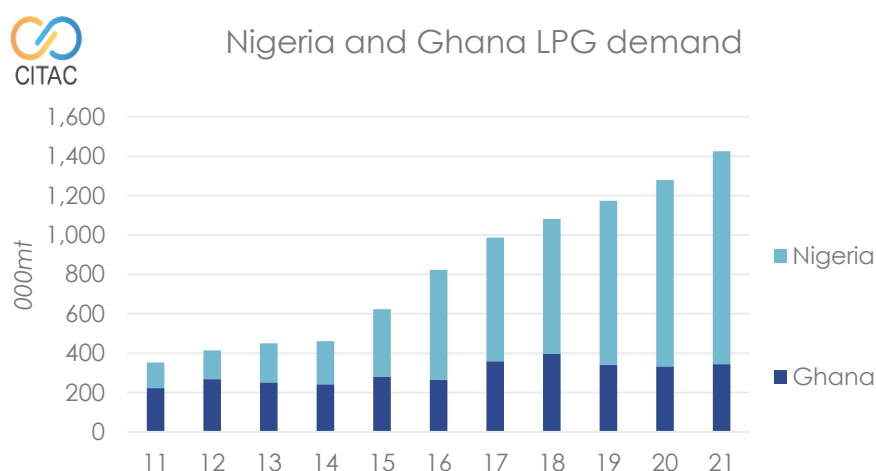
### LPG uptake drivers and barriers

Nigeria and Ghana have both experienced strong demand growth over the past decade, albeit from a low base:

- Nigeria demand rose by 732% from 130,000mt in 2011 to 1.1mn in 2021
- Ghana demand rose by 55% from 223,000mt to 345,000mt over the same period

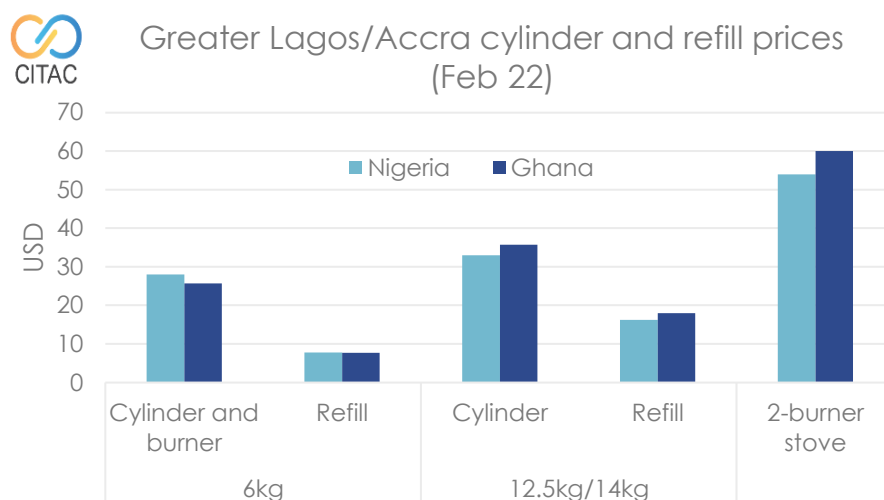
While LPG penetration is high in urban areas, the same is not true of poorer peri urban and rural areas where firewood and charcoal are widely used, leading to significant forest degradation. At a country-wide level, annual per capita consumption is therefore low at just 5kg in Nigeria and 11kg in Ghana, versus 20kg in India, for instance.

By 2050 the populations of Nigeria and Ghana are expected to grow by 190mn (+90%) and 20mn (+64%) people, to 401mn and 52mn, respectively, according to the UN, highlighting LPG's huge potential but also the enormous pressure that will be placed on forest resources.



Source: CITAC, NPA

Uptake of LPG by low-income households has been heavily constrained by affordability barriers, including the up-front price of the cylinder/stove along with subsequent refills. These barriers have grown in 2022 owing to upward pressure on the international flat price of LPG and steady depreciation of the Naira and the Cedi.

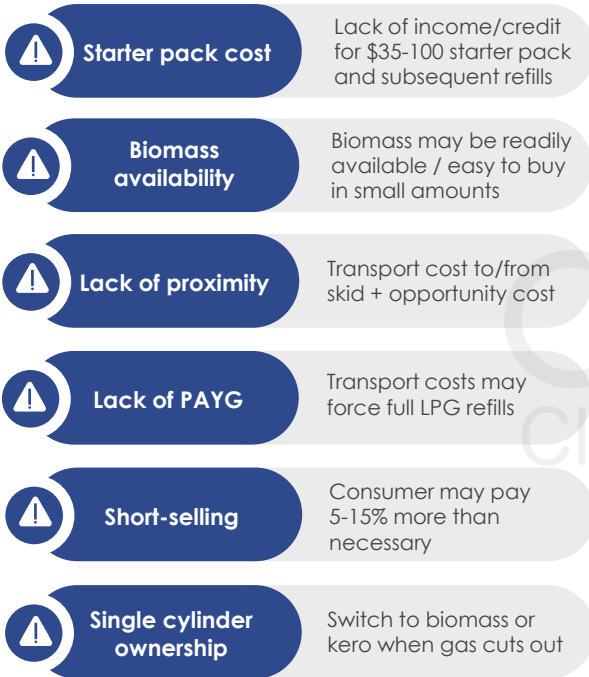


Source: CITAC

Beyond cylinder and refill prices, many other factors have hindered LPG uptake in Nigeria and Ghana over the past decade (see chart below). The importance of cooking habits and the need for education at a very micro level cannot be overstated. Infrastructure constraints have also proved a bottleneck at times but they are not the focus of this Report.



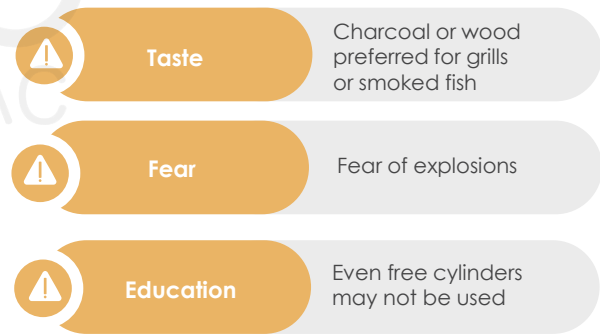
## Affordability factors



## Regulatory factors



## Cultural factors



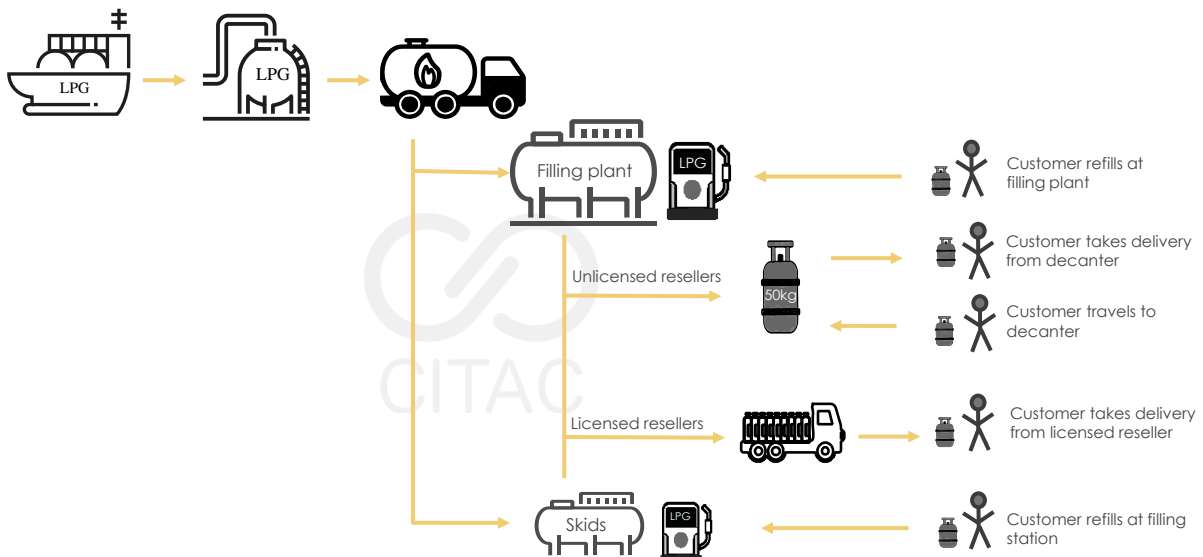
### Barriers to LPG uptake in Nigeria and Ghana

#### Value chain summary

Any attempt to devise solutions to overcome these barriers requires a deep understanding of the LPG value chain in both countries. Nigeria and Ghana both currently operate under decentralised customer-owned cylinder models – in stark contrast to the cylinder exchange systems used in most of French-speaking West Africa. The value chain in Nigeria can be summarised as follows:

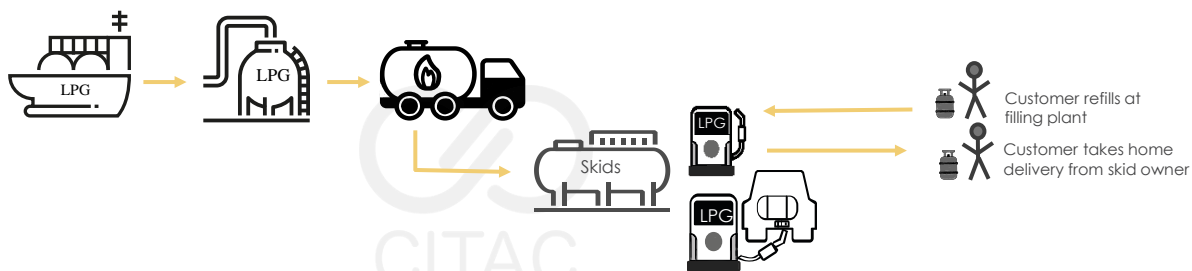
- Product is received into bulk storage from imports or local production.
- It is then transported in bulk to filling plants or filling stations ('skids').
- Customers come to the filling plant/station and wait while their cylinder is filled.
- Unlicensed resellers come to the filling plant/station and fill large 50kg which they subsequently take into residential areas to decant.

Nigerian households have five options when it comes to filling their cylinder:



Nigerian LPG value chain (for residential sales)

The value chain in Ghana is less fragmented than in Nigeria: LPG is transported in bulk from the terminals to the microstations (skids) where consumers and taxis come to fill their cylinders/tanks. Decanters are far less prevalent in Ghana than Nigeria; conversely, Autogas consumption is far more widespread in Ghana.



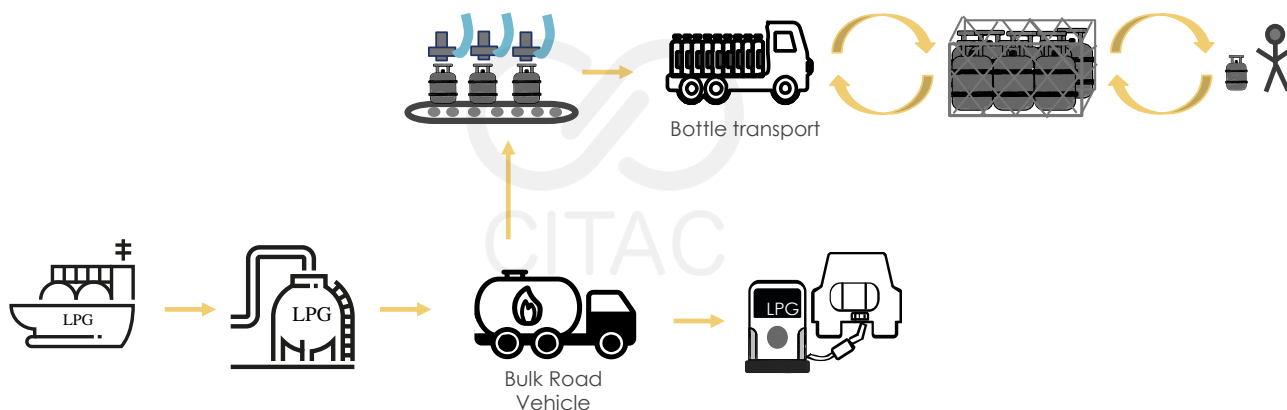
Ghana LPG value chain (for residential sales)

### Regulatory drive to implement best practice

Both countries are currently in the midst of regulatory drives to implement cylinder exchange systems, though Ghana is far more advanced in its plans than Nigeria.

Following a major explosion which killed 7 people and injured over 100 more at a skid near Atomic Junction, Accra, in October 2017, the country's National Petroleum Authority (NPA) has been formally seeking to overhaul the current value chain in favour of a more conventional Cylinder Recirculation Model (CRM). This CRM has the following key characteristics:

- Marketer, not customer, to own the cylinder.
- Two new value chain activities to be created: 1) bottling at large automated plants with carousel filling; 2) bottle transport.
- Skids to be prohibited from serving residential customers.
- Skids to serve Autogas customers only.
- Creation of Cylinder Exchange Points where customers swap empty cylinders for full ones (part-filling no longer possible).



Ghana CRM blueprint

Cylinder exchange systems offer several advantages:

- Safety: as cylinders are currently consumer-owned, they undergo little or no maintenance. Many cylinders in circulation in Nigeria and Ghana are old and unbranded. In addition, some skid plants do not adhere to proper health and safety procedures.
- Quantity: short-selling, even at licensed skids, is a problem in both countries.
- Convenience: there is currently no formal micro-distribution system using kiosks or other shops, in either country. Such a system, common in countries with marketer-owned bottles, would bring LPG closer to the people.

Ghana has been formally developing its CRM since 2018 but pilots have continued to come up against significant implementation barriers:

- Resistance from LPGMCs (skid owners) who would in theory be banned from making ex-skids sales to residential customers under the CRM.
- Cylinder disappearance: even where pilot cylinders are distributed free of charge, customers often never bring the cylinder back for an exchange. This is partly because consumers have a cultural preference for filling at local skids where filling can be observed.
- Culture of ownership: it is difficult to convince consumers who already own a bottle to relinquish ownership of that bottle under a deposit scheme.

NPA will be conducting further CRM pilots over the course of 2022.

Nigeria's LPG landscape is more complex and involves far more players than Ghana's, making a CRM-type system even more challenging to implement. Marketer attempts to launch such schemes in the past, even in a targeted area, have encountered additional stumbling blocks:

- Nigeria, like Ghana, has an 'ownership culture'. It is counter-cultural for a (low-income) household to transfer cash for something they will not subsequently own.
- Price: low-income households in particular will always seek out the lowest price available in their area, making it difficult to establish brand loyalty. Even if the customer were to gain access to a cylinder via a deposit scheme, there is a significant risk that the customer would fill it with various suppliers, depending on price.
- Migration and fluid household membership (in urban areas) can make it difficult to track consumers and cylinders. Addresses are often not traceable.

### **Nigeria 'Honest Gas' Pilot – Phase 1**

Nigeria's downstream LPG industry is heavily decentralised. There are hundreds of players and thousands of filling points. CITAC believes this system is too deeply rooted to revert to a more centralised system, meaning uptake solutions are likely to revolve around continued skid development.

Irrespective of affordability barriers, the simplest way to increase LPG uptake among low-income households is to make supply available through skids. An instructive case study is provided by a major LPG/fuel importer and retailer which speculatively established an LPG filling station in Delta State. To the surprise of the company's management, the pilot proved a resounding success, attracting customers from villages up to 30km away.

Perpetuating the skid model has several drawbacks in relation to quantity assurance, cylinder maintenance and safe filling. CITAC believes, however, that a new generation of skid, which we have dubbed 'Honest Gas', can help to overcome these barriers while at the same time minimising affordability impacts.

Given the high level of LPG penetration in Lagos and other cities, the Pilot should target a rural area with minimal LPG uptake. The development of a skid siting investment optimisation tool, using population mapping and existing skid location data, can be considered as a means of selecting the Pilot location

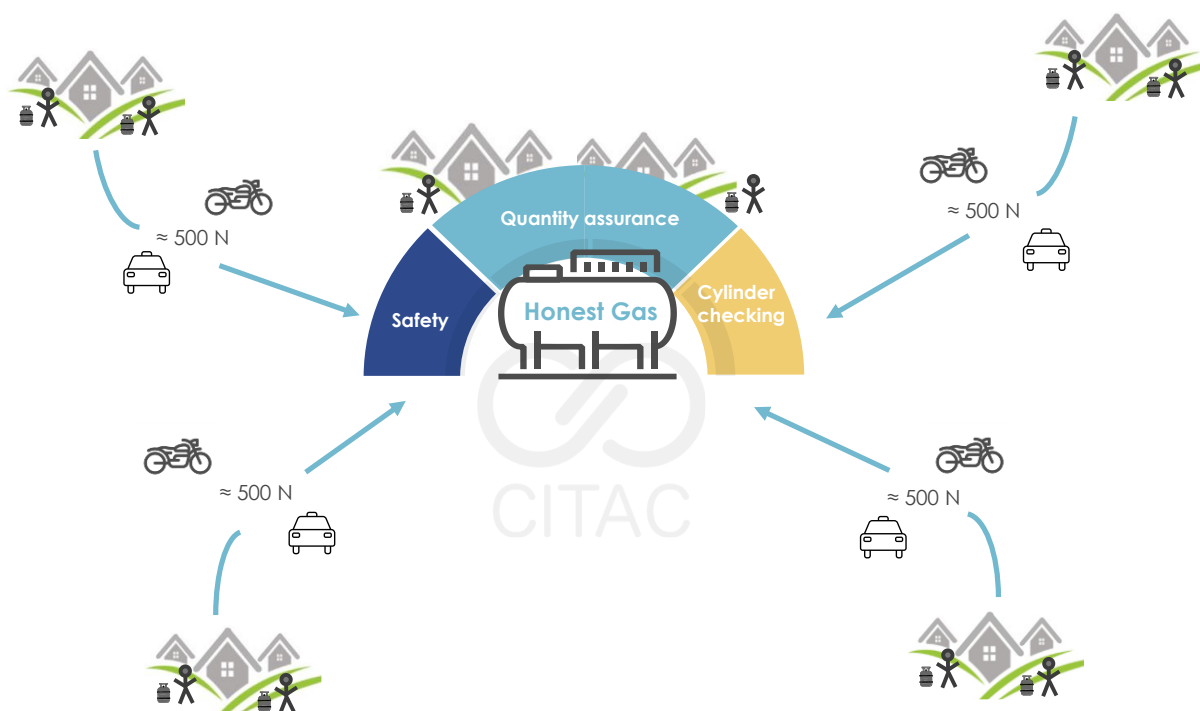
During its First Phase, the Honest Gas skid Pilot can differentiate itself from the current ex-skids offering in Nigeria in three main ways.

- **Quantity assurance:** The Nigerian market is characterised by a conspicuous lack of transparency around quantity assurance at filling stations and unofficial reseller outlets. Given the price sensitivity of low-income households, this represents a clear gap in the market. Appropriate quantity controls, including regular recalibration and sealing of scales, should be explicitly communicated to customers ('We don't short-change you'). Quantity receipts and/or tamper-proof shrink wrapping can be used to satisfy customers they are receiving the quantity they have paid for. Such an explicit disavowal of short-selling would help to generate brand attachment among consumers, while at the same time reducing their refill costs. This would also have the effect of reducing Honest Gas's margins until such time as the sales volume generated by customer loyalty outweighs the 'loss' of revenue from honest selling.
- A low-cost no-obligation **Cylinder maintenance service** can be offered on site, with clearly displayed price lists for replacement parts and basic servicing (leakage tests, rubbers, valves, regulators, burners, dented foot ring or handle): such an offering, even if not used by many customers, would help to raise awareness around the

importance of cylinder integrity. Basic air/water/oil services are available for motorists in most service stations but there is no such offering for LPG customers. In practice, this means that most cylinders undergo zero maintenance.

- **Safety procedures:** The Honest Gas skid should have prominently displayed safety procedures including:
  - Floor markings to guarantee safe distance between customer and filler.
  - Filler to wear safety goggles and appropriate anti-static clothing.
  - Clear signage around the use of cigarettes and mobile phones.
  - Clearly identified gas detectors.

The three sources of differentiation above can be implemented as part of a conventional customer-owned cylinder model. Under this model customers would continue to travel to the skid.



Pilot 1: Honest Gas

## Nigeria 'Honest Gas' Pilot – Phase 2

As brand attachment is developed, and customers are taught to value quantity assurance, maintenance and safety, the Pilot can enter a more ambitious Second Phase targeting the development of a closed area-specific exchange system fed from the central skid(s). CITAC believes it will be challenging to move directly to a Second Phase without first educating customers about the benefits of quantity assurance, maintenance and safety.

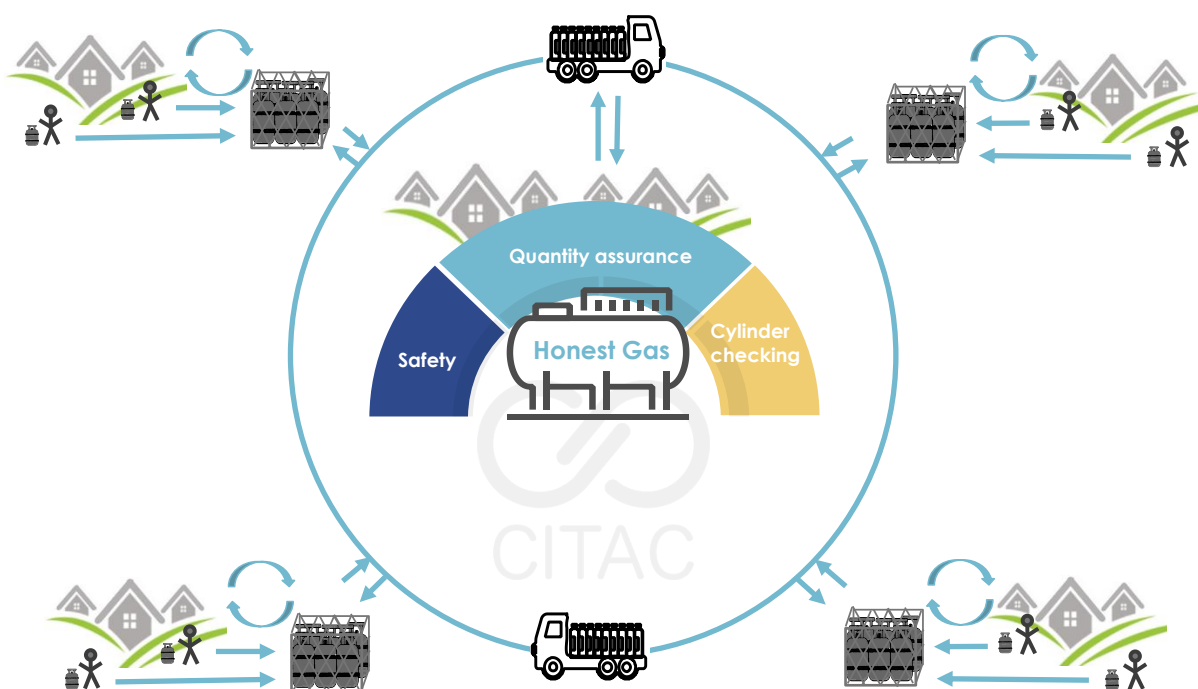
Core characteristics of the second phase are envisaged as follows:

- New company-owned cylinders consigned to customer. Alternatively, existing customer-owned cylinder is relinquished into the exchange system in lieu of a deposit (subject to a maximum age limit of, say, 5 years) and repainted/branded.
- Cylinder to be consigned at cost. This avoids the uncertainty and scepticism that some consumers may experience when marketers bundle cylinder recovery costs into the price of the refill. It also lessens the impact on the marketer if the bottle disappears. Where customers require credit for the cylinder deposit, this can be concluded under a separate agreement, potentially involving in-community microfinance institutions. Credit administration in a rural setting is generally considered less complicated than in urban settings.
- Exchange system to be administered using a micro-distribution cage system. The price of an exchange will therefore include marketer transport and cylinder maintenance costs, as well as the cost of running/managing the cage. The cage can be a standalone enterprise or attached to another business (eg a local shop). In order to

reinforce its business model, Honest Gas would ideally seek to recruit ex decanters as cage operators (if any such decanters are active in the area in question). If the cylinder exchange point is attached to another business, the business owner will need to be paid for each exchange carried out. Either way, the ex-cage 'surcharge' (versus the ex-skids refill price) needs to be as competitive as possible with 'typical' customer travel costs to/from the skid. In practice, the distribution activity of Honest Gas would likely operate at a loss in the first instance.

- Exchange point to include weighing scales so that any residual LPG in returned cylinders can be reimbursed to the customer. Cage attendant to act as local opinion leader, repeatedly reinforcing educational messaging around quantity and safety.
- Cylinder exchanges to encourage cashless transactions, using mobile money, where possible.
- Second phase to include injection of 3kg cylinders as cage exchange model will require full refills. The smaller cylinder size makes full refills more affordable. It also has the benefit of simplicity: customer swaps empty 3kg cylinder for full 3kg cylinder. This smaller cylinder format is currently rare on the Nigerian market.
- Cage system to be accompanied by repeated, human resource intensive, house-to-house engagement at the most micro of levels, without which bottle disappearance will remain an issue.

Home delivery is an alternative distribution model but CITAC believes it would be extremely challenging to implement in a low-income environment. Bottle-by-bottle delivery is invariably more expensive than bulk cage distribution, making it more suited to wealthier households willing to pay a premium for convenience.



Pilot 2: Honest Gas exchange system

### Advocacy

The development of the Honest Gas pilot, and the wider LPG industry, would be supported via the following pieces of advocacy work:

- Import duty and VAT to be discontinued
- Skid/truck importation processes to be streamlined in collaboration with the marketers/importers
- Duty exemption for cylinders, stoves and skids to be maintained

## Ghana: Pilot 1

Designing an uptake pilot in Ghana is complicated, at present, by the transition to the CRM system. If implemented, this will fundamentally change the way the country's LPG sector operates. Even so, Ghana arguably lends itself to more complex uptake solutions than Nigeria.

CITAC believes the CRM and the existing skids-based distribution system will run in parallel for many years, with new bottling plants (Puma, Goil, NewGas) likely to focus on Accra/Tema and Kumasi. It remains to be seen exactly how the different value chain activities will be organised but the LPG uptake challenge will remain focussed on affordability, particularly in relation to starter packs.

CITAC's field work in Ayenyah/Kordiabe is instructive here:

- Despite the presence of two skids, within a short taxi ride of both locations, around 90% of households did not use LPG because they could simply not afford the upfront cost of the cylinder/stove, subsequent refills, or both. This was a recurring theme.
- Firewood was readily available in both locations though charcoal was the preferred fuel for many households, even in the dry season, owing to its superior heat value and convenience. The average daily spend on charcoal was 3-5 Cedis (\$0.43-\$0.71). CITAC witnessed charcoal production taking place on the outskirts of Ayenyah.
- Where respondents did have experience of using LPG, if only occasional, they identified fast cooking/re-heating as a key benefit of the product and one that would always make it the preferred option in specific cooking applications. Several respondents also commented that LPG was cheaper than charcoal on a daily basis.

If successful, greater LPG penetration in rural and peri-urban areas would therefore increase LPG's presence in the fuel stack, rather than completely replace charcoal and firewood.

While it is very rare for skid owners to offer credit to clients, more tech-centric credit solutions are emerging. Smartphone penetration is low in rural areas but access to mobile money (at a household level) is almost universal, with MTN's MoMo the market leader by far. Loan services are available via the platforms of the main mobile money providers (MTN, Vodaphone, Tigo). MTN uses the JUMO platform, offering loans provided by ABSA, Ecobank and Letshego. In theory, credit is readily available to households wishing to purchase an LPG starter pack.

In reality, mobile money loans are only available to people who have demonstrated extensive use of mobile wallets over time. New customers with the appropriate mobile wallet history are only able to borrow small amounts to begin with (eg 50 cedis). Over time, available loan amounts grow, and interest rates fall, as creditworthiness is built up but even preferential interest rates remain high (at 8-10% *per month*) and the majority of loans have to be paid back within one month. These constraints mean that for many low-income consumers, mobile money does not currently offer a rapid or realistic means of acquiring a cylinder. At the same time, partial filling is not open to all, owing to the high cost of transport to/from the skids.

CITAC sees a gap in the market for longer-term credit to combine with smart metering solutions such that the cost of both the cylinder (whether acquired outright or via a deposit scheme) and the gas inside it can be spread over a much longer period than one month. The natural cost comparison benchmark is the daily cost of charcoal acquisition, which CITAC has assumed at 4 cedis/day.

For the cost of both the cylinder AND the gas to be spread, a PAYG solution such as smart metering is required. Each customer would therefore require the following hardware:

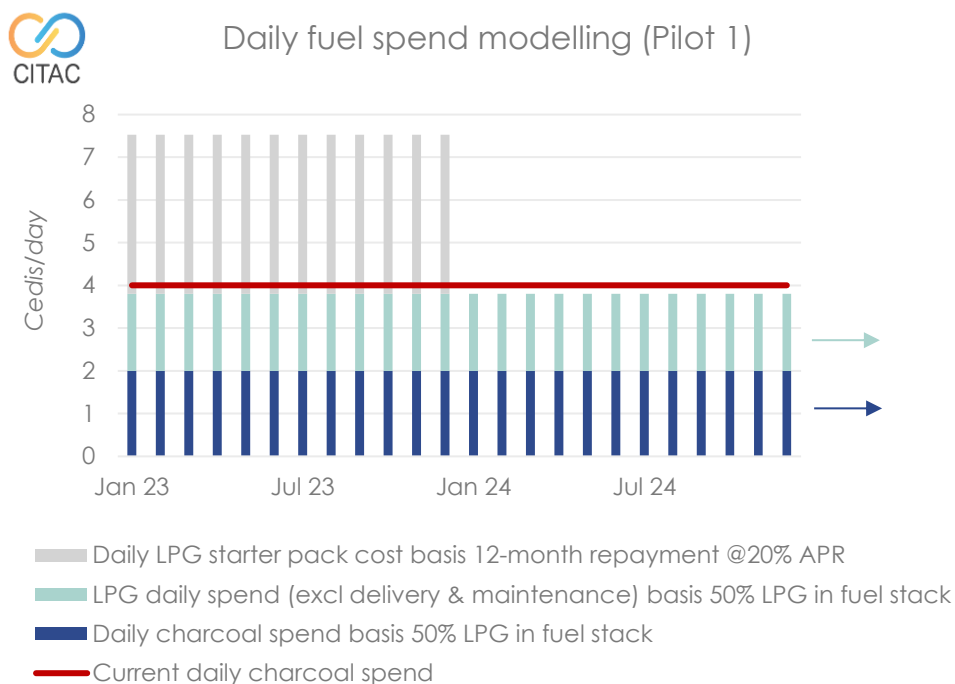
- 6kg cylinder - \$25
- Two-burner stove - \$60 (this has to be acquired as 'plug and play' grates cannot be affixed to cylinders with smart meters)
- Smart meter - \$90

Total hardware cost: \$175

Customers will have a strong preference for the cylinder financing and PAYG purchases to be clearly unbundled as they will invariably seek to benchmark the cost of the gas itself with the price available at the local skid.

The graph below shows the daily cost of administering the PAYG solution. Key assumptions are as follows:

- Total hardware cost is \$175. The customer is assumed to obtain a 12-month loan at 20% APR, making 12 monthly repayments. The daily equivalent repayment cost the consumer is therefore just under 4 cedis/day. To CITAC's knowledge no such loan facility currently exists for the targeted consumer profile.
- The hardware can be acquired by the consumer under a mini deposit scheme or as an outright purchase.
- After acquiring the LPG cylinder and smart meter, the customer replaces 50% of their existing charcoal consumption with LPG.
- Monthly consumption of LPG per household is 1 x 6kg refill.
- The daily cost of LPG, paid for via mobile money top-ups to the smart meter, is 1.8 cedis/day (based on February 2022 prices). This figure excludes the operating costs, including delivery and maintenance, of the scheme operator. The scheme operator's unit costs will be very heavily influenced by the size of the ultimate customer base, so they have not been modelled here but they would initially add several cedis to the daily LPG price.
- Charcoal continues to account for the other 50% of the fuel stack at a cost of 2 Cedis/day.



Source: CITAC

This basic modelling shows that, if the refill cost is spread such that it is incurred daily rather than in the form of one-off purchases then the daily fuel cost (50% charcoal, 50% LPG) to the household (excluding scheme administrator opex) is similar to the current 4 cedis/day spent on charcoal. But once hardware amortisation (and scheme operator opex) are added, the daily cost quickly becomes untenable for the target customer base.

For a smart meter solution to be more accessible and scalable, it is clear that additional price support is required. This could take the following form:

- Government or scheme operator to purchase and retain ownership of smart meter and two-burner stove, making them available to customer free of charge. This would reduce hardware costs to the consumer by 85% but would need to be financed by government subsidies. Cylinders with smart meters cannot be used without scheme operator intervention which reduces the risk of hardware disappearance.
- Government or scheme operator to finance 'free' smart meters and stove via the generation and sale of carbon credits.

CITAC notes that this first Pilot would be difficult to implement if residential ex skids filling is banned across the country. This is because refilling cylinders with smart meters requires agents to physically enter people's homes and unlock the meter, making the system human resource intensive and better suited to small batch filling from skids.

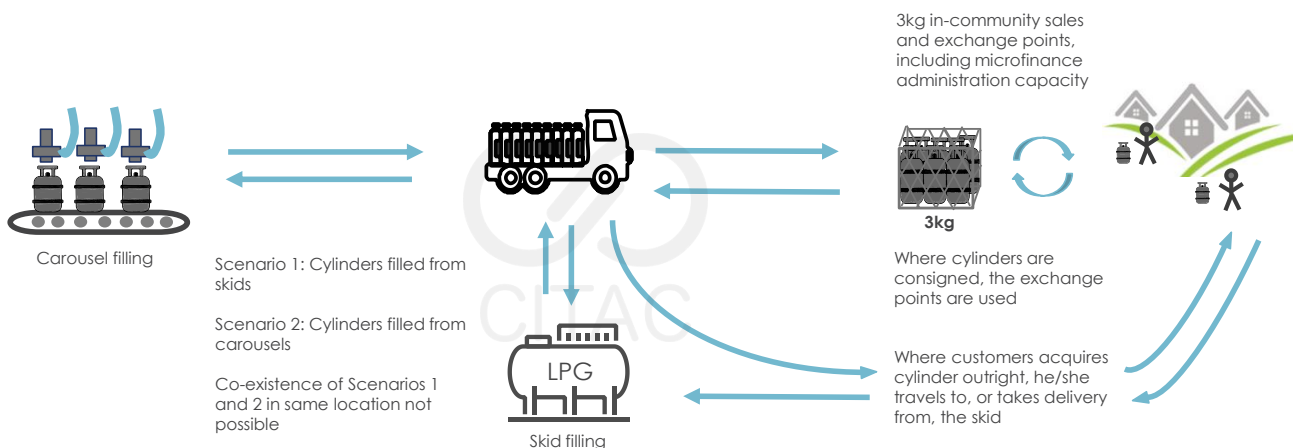
## Ghana: Pilot 2

The second proposed pilot has a different focus, targeting households with more predictable/formal income in peri-urban areas. The second pilot is centered on making 3kg cylinders and refills available to consumers on an in-community basis. The rationale behind this pilot is as follows:

- The 5kg cylinder is currently the smallest format on the Ghana market, though the 6kg format is far more common.
- From an affordability perspective, this creates cylinder acquisition and refill challenges.
- The introduction of a 3kg format can be administered either via the current skids system OR the CRM OR both, depending on location, giving it significant regulatory resilience.

Key characteristics of Pilot 2 are as follows:

- LPGMCs to work with microfinance banks or mobile money platforms to offer in-community sales kiosks for 3kg cylinders. The cylinder can be made available as an outright sale or under a deposit scheme arrangement. Either way, the credit needs to be more accessible, in terms of tenor and interest rates, than the current mobile money loan offerings.
- Scenario 1: If the customer acquires the cylinder outright (something that would not be possible if the CRM were to be universally enforced), he/she can decide to refill by either travelling to the skid or by taking a delivery option from the skid operator.
- Scenario 2: If the customer acquires the cylinder under a deposit arrangement (whether with a CRM operator or a skid owner), he/she will exchange the empty cylinder for a full one at an in-community exchange point. The empty cylinders will be refilled either at the local skid (if this model is allowed to continue) or at a centralised CRM bottling plant.
- As the cost of centralised bottling and cylinder exchange points is generally higher than skid-filling, particularly for small 3kg cylinders, it is important that skid filling and the CRM do not co-exist in the same location, as customers will always be drawn to the cheaper prices offered by the skid.



Pilot 2: Ghana

## Advocacy

The development of these pilots would be supported by the removal of all taxes on LPG: such a move would likely have the unintended consequence of boosting demand for Autogas (thereby reducing tax receipts on gasoline sales). This gradual move from gasoline to LPG can nevertheless be considered a de facto first step on Ghana's path to decarbonising road transport.



# Part I: Nigeria



## 1.1 Nigeria demand

### 1.1.1 Historical LPG demand in Nigeria

#### 1.1.1.1 Demand records 732% growth in the space of a decade

Nigerian LPG demand has grown rapidly from a very low base, rising by 732% from 130,000mt in 2011 to 1.1mn mt in 2021.



Source: CITAC

Figure 1: Nigeria LPG demand

Nigeria's uptake of LPG is unprecedented on the continent among non-subsidised markets, thanks to several factors.

#### 1.1.1.2 LPG demand boosted by kerosene subsidy withdrawal in 2016

The primary accelerator of demand growth was the repeal of subsidies on kerosene in 2016 which caused kerosene prices to rocket from N50/l to a peak of N455/l in the 12 months following subsidy repeal. Prices of kerosene have since fluctuated in line with international market movements, typically trending between N200-300/l.

The fall in kerosene consumption has been further exaggerated by limited supply of the product; national oil company NNPC typically imports the product for distribution inland, but NNPC has been prioritising the supply of gasoline, leaving few resources available for kerosene. This has resulted in limited supply or outright shortages of the product. In the absence of kerosene, households with the means to afford LPG as an alternative have switched to the product.

#### 1.1.1.3 Macro factors

In recent years (2014-2021) the lower oil price environment has reduced the costs associated with consuming LPG. This has lowered the barriers to entry for consumers, facilitating the switch away from cheaper alternatives such as biomass and charcoal. With prices rising to multi-year records in 2022, the barrier to entry and regular use of LPG is once again rising and will dampen LPG demand growth prospects.

Nigeria has a large and growing population, currently estimated at 211mn inhabitants by the UN. By 2050, the population is expected to increase by 90% to over 400mn people. With each member of the population requiring energy to carry out their daily tasks (including cooking) there is a growing need for incremental energy supply.

LPG is typically consumed in the highest per-capita concentrations in urban centres because that is typically where wages are higher and the supply of biomass and charcoal is constrained by a lack of local production and higher prices. Nigeria's urban population currently stands at 113mn inhabitants and is rising at a rate of 4.2%/year (versus 2.6% for overall population

growth). By way of comparison, India consumed 27.9mn mt of LPG in 2021, according to the government's Petroleum Planning & Analysis Cell (PPAC), giving per capita consumption of 20kg.

Nigeria's economy remains in a relatively early stage of development: as a result, growth in economic output has been rapid. While the growth has been uneven, largely due to swings in the oil price, the expanding economy has supported increased energy demand, placing greater pressure on the supply of all forms of energy, including biomass and charcoal, creating a growing energy shortfall that can be met, in part, by LPG.

Despite the strong uptake, LPG demand has still underperformed some projections. The Nigeria National Gas Plan, published in 2017, projected demand would rise to 5mn mt by 2022 – but this has not materialised. At the same time, annual per capita consumption (calculated as total LPG demand divided by total population) remains among the lowest in the world at just 5kg.

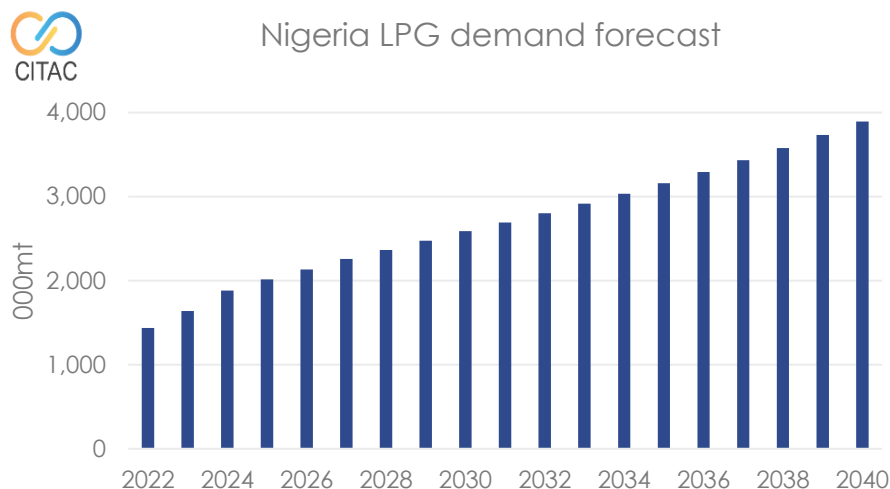
#### 1.1.1.4 Infrastructure constraints

Part of the underperformance of actual demand, against projected demand, has been supply constraints: infrastructure development is being rolled out at a rapid pace but remains a bottleneck. Imports have been further constrained by the limited availability of hard currency. Currency and logistical considerations also explain why Nigeria has continued to export much of its local butane production, rather than divert it to the local market, though this state of affairs could change following a pledge by NLNG in early 2022 to keep 100% of its (butane) output in Nigeria.

### 1.1.2 Forecast LPG demand in Nigeria

#### 1.1.2.1 Nigeria presents very strong growth potential

CITAC expects Nigerian LPG demand to grow rapidly, rising 139% to 2.6mn mt by 2030 and on to 3.9mn mt by 2040.



Source: CITAC

Figure 2: Nigeria LPG demand forecast

#### 1.1.2.2 Forest degradation a growing challenge

The growing energy demands of the rapidly expanding population are driving a trend of forest degradation. Citizens seeking out free or low-cost sources of energy are encouraging a growing, and largely unregulated, industry in firewood and charcoal. As biomass resources are depleted over time, citizens will be forced to seek alternatives, with LPG presenting a scalable and realistic solution.

### 1.1.2.3 Infrastructure expansion

The private sector in Nigeria is highly entrepreneurial. There has been a proliferation of infrastructure investment in recent years as private enterprises have sought to capture the rapidly growing LPG market. Import terminals, storage, trucking fleets, filling plants and filling stations are attracting significant local investment that is supporting the transition to LPG. While LPG shortages are still relatively common, the strength of investment is playing a role in closing the gap between supply and demand.

### 1.1.2.4 Growing urban populations opting for LPG

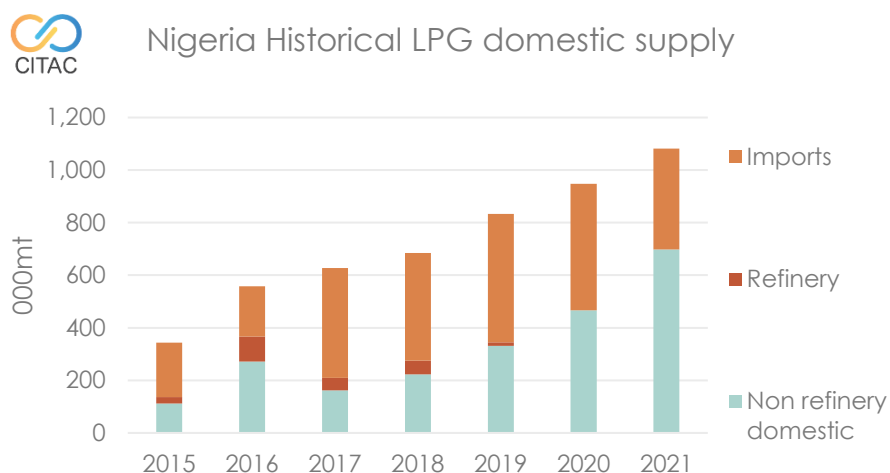
Nigeria has a growing urban population. These urban citizens typically have higher disposable income and demand a higher quality of life, relative to lower income households, leading to widespread adoption of LPG. Limited availability of firewood and charcoal in urban areas has led to further LPG uptake. In Lagos, for instance, the vast majority of households use at least some LPG, even in the most deprived areas. This is because biomass is not readily available and kerosene is expensive.

## 1.2 Nigeria supply

### 1.2.1 Supply sources

#### 1.2.1.1 Supply summary

Nigerian LPG supply is diversified across local field production, refinery output and imports.



Source: CITAC

Figure 3: Nigeria historical LPG domestic supply

While Nigeria both consumes domestic and imported LPG, the country is also an LPG exporter. This is due mainly to the economic advantages derived by exporting the product (avoiding currency challenges and logistical delays), when compared with selling these volumes on the local market. In addition, the propane element of Nigeria's LPG production does not currently have a natural home on the local market so it is often exported to the East. As the domestic market has grown, the government has sought to mandate that increasing volumes of locally produced LPG are sold on the domestic market.

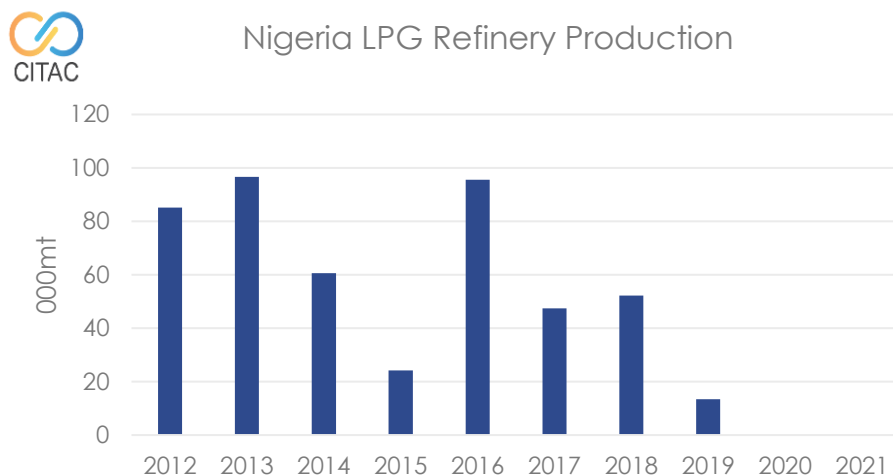


Source: CITAC

Figure 4: Nigeria historical LPG exports

### 1.2.1.2 Refinery supply

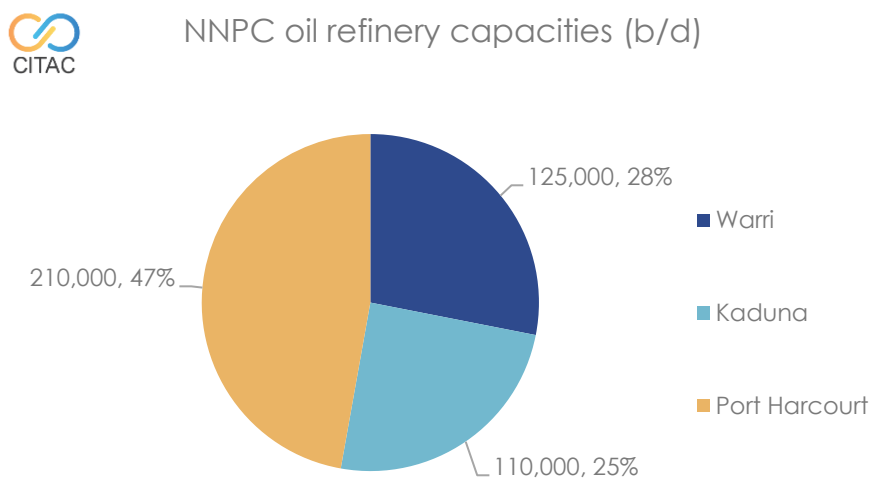
Refinery supply has historically varied, but production has gradually fallen from a recent peak of 96,000mt in 2016 to zero in 2020 and 2021.



Source: CITAC

Figure 5: Nigeria LPG refinery production

LPG production is limited to the three NNPC refineries whose nameplate capacities are shown in the graph below:



Source: CITAC

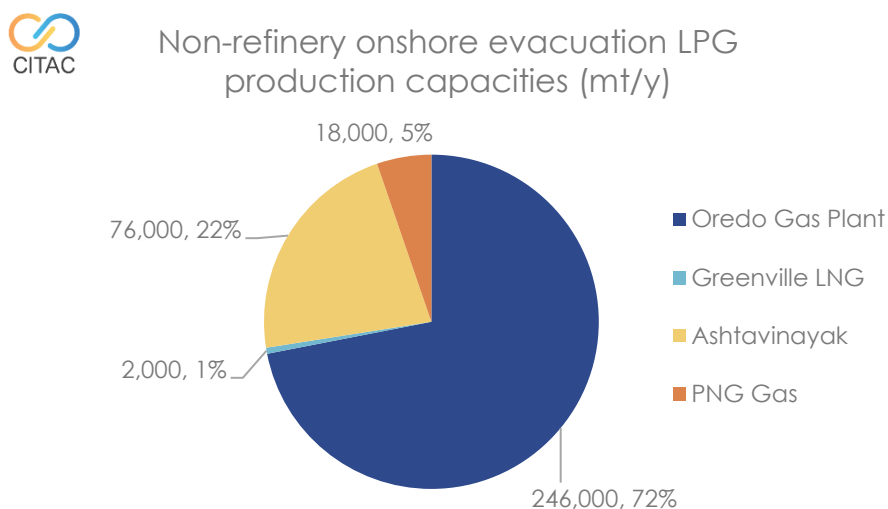
Figure 6: NNPC oil refinery capacities

All three of these facilities have long been under-maintained and suffered from crude feedstock shortages, dynamics which have chronically constrained output and ultimately led to these facilities being taken offline entirely in 2020. While work is underway to restore the Port Harcourt Refinery, it remains offline. None of the refineries have operated since mid-2020. The other refineries in the country do not commercialise LPG. They instead use the product as a fuel in the refining process or flare it.

### 1.2.1.3 Non-refinery supply

Nigeria currently produces significant volumes of LPG via its non-refining production operations. These are typically linked to natural gas production sites. The LPG is either supplied to the local market or exported – depending on regulatory or economic pressures. These production sites are split between those which have onshore evacuation options and those that

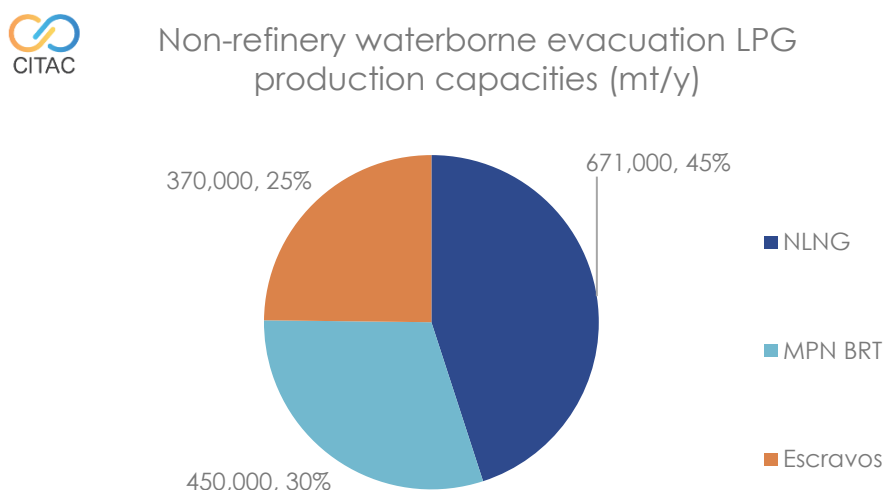
can only evacuate LPG by vessel. Facilities with onshore evacuation optionality have the following approximate maximum capacities:



Source: CITAC

Figure 7: Non-refinery onshore evacuation production capacities

Facilities with marine-only evacuation optionality have the following approximate maximum capacities:



Source: CITAC

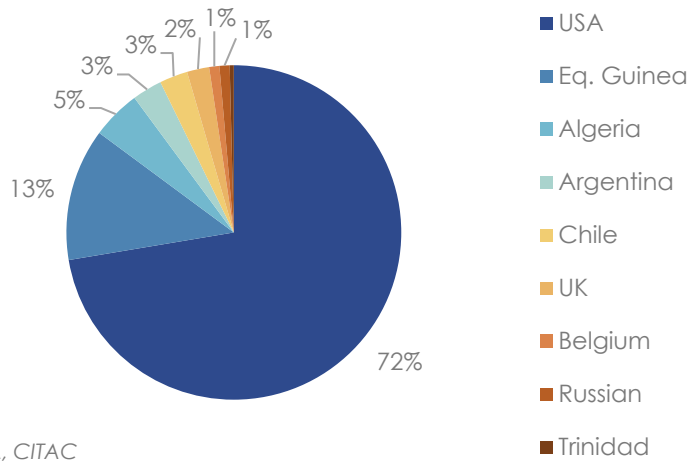
Figure 8: Non-refinery waterborne evacuation production capacities

#### 1.2.1.4 International supply

The shortfall between local demand and local production is met by the import of LPG from the international market. These volumes are typically sourced from either inside the West Africa zone, from countries such as Equatorial Guinea or occasionally Republic of Congo, or from outside of the zone, from the USA, Latin America, or Europe.



### Nigeria imported LPG sources (2021)



Source: NMDPRA, CITAC

Figure 9: Nigeria imported LPG sources

## 1.2.2 LPG supply by port and jetty

### 1.2.2.1 Supply by port

The supply of waterborne LPG, whether from international imports or from domestic production sites, is diversified across Nigeria’s key ports of Lagos, Warri, Port Harcourt, and Calabar. In 2021, Lagos – typically the destination for the bulk of LPG imports into Nigeria – received a total of 552,000mt, equating to 59% of total LPG imports.



### Nigeria waterborne LPG supply by port

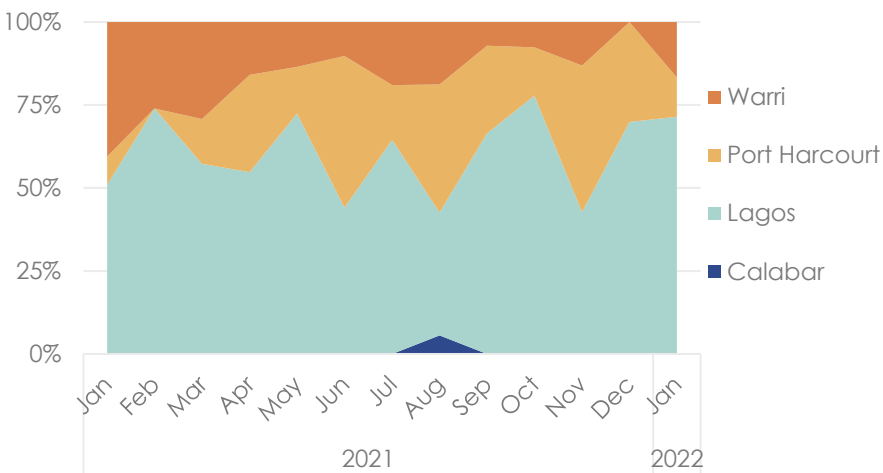
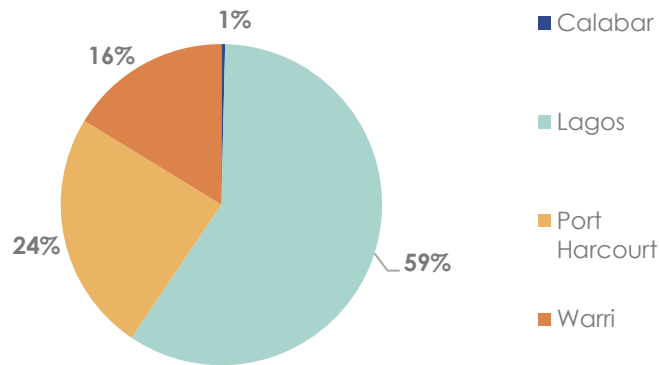


Figure 10: Nigeria waterborne LPG supply by port





## Nigeria waterborne LPG supply by port 2021



Source: CITAC

Figure 11: Nigeria waterborne LPG by port 2021

The reasons for Lagos's dominance in the supply chain are twofold. Firstly, the port has the most extensive infrastructure, with a total of 143,000m<sup>3</sup> of storage across terminals operated by NIPCO, Navgas, Techno Oil and others. Secondly, Lagos is the largest agglomeration in Nigeria, with a population of around 18mn.

### 1.2.2.2 Supply by jetty

The key berths for discharging LPG into Lagos are the Lister Jetty, which is connected to the Navgas terminal, the three Federal Jetties (NWA, BOP, NOJ), which are connected to the depots in Apapa (namely NIPCO, 11PLC), and the Techno Oil and Rainoil jetties in Satellite.



## Waterborne supply of LPG into Lagos by jetty

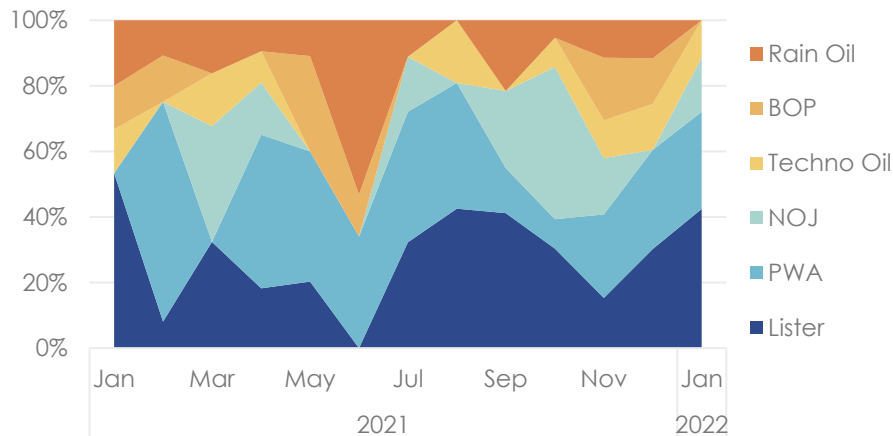
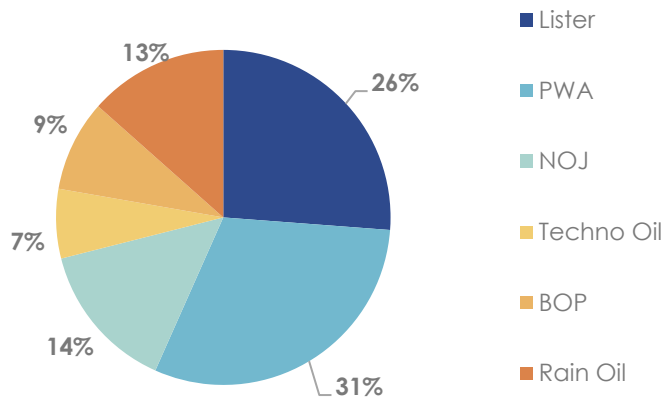


Figure 12: Waterborne supply of LPG into Lagos by jetty



## Lagos 2021 waterborne LPG supply by jetty



Source: CITAC

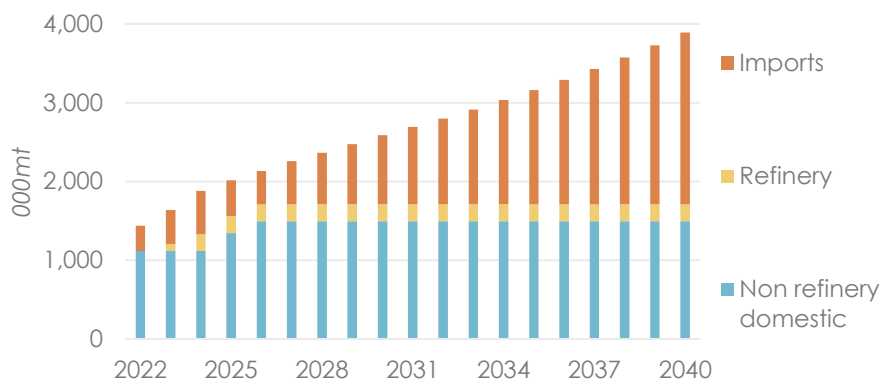
Figure 13: Lagos 2021 waterborne LPG supply by jetty

### 1.2.3 Supply forecast

CITAC's forecast scenarios indicate a medium-term increase in supply from domestic sources, but that ultimately reliance on imports is set to grow. Import requirements from the international market are forecast to rise from 320,000mt in 2021 to 880,000mt in 2030 and 2.2mn mt by 2040.



## Nigeria Forecast LPG domestic supply



Source: CITAC

Figure 14: Nigeria forecast LPG domestic supply

The increases to domestic supply, rather than imports, are expected to come from the following developments:

- The government has mandated NLNG to focus its supply on the domestic market, rather than exporting the product. The facility currently produces approximately 670,000mt of LPG per year, with this set to rise to over 1mn mt/y with the streaming of Train 7, currently expected in 2025 at the earliest.
- The ramping up of production at the Oredo Gas Plant, which has encountered some initial operating challenges.
- The streaming of the Dangote refinery, anticipated in 2023 or 2024, will add 200,000mt/yr of LPG production.
- Note that a restart of the NNPC refineries does not currently feature in CITAC's forecast.

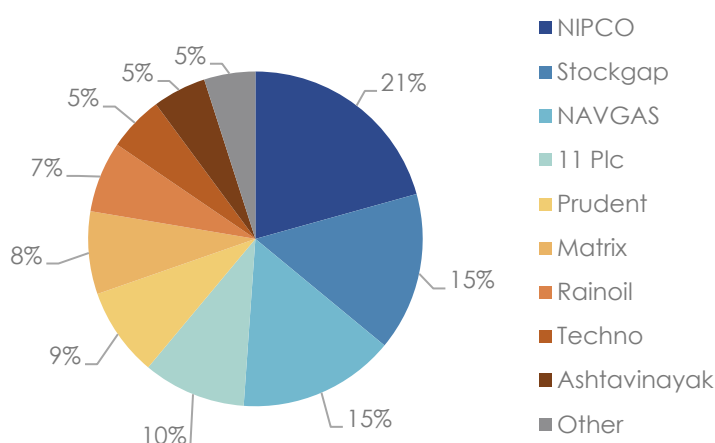
## 1.3 Downstream value chain

### 1.3.1 Bulk storage

LPG supply from the local and international market is received into bulk storage facilities. NIPCO is the largest receiver of LPG, with a 21% share of volumes in 2021, followed by Stockgap with 15% and Navgas with 15%. Going forward, these market shares are likely to shift, given that new storage has been streamed by certain companies such as Rainoil and Techno which are expected to ramp up operations and claim increased market share.



Nigeria LPG receivers (2021)



Source: NMDPRA, CITAC

Figure 15: Nigeria LPG receivers (2021)

Depending on the source of the LPG, the product is sold by different parties. LPG produced at the NNPC refineries is sold by NNPC to local retailers. LPG produced at onshore domestic facilities linked to natural gas such as the Oredo and Greenville facilities is typically sold directly to local offtakers; any surplus propane produced would, however, need to be blended with butane at a third-party facility such as Navgas.

Waterborne LPG supply is typically purchased by companies that operate coastal terminals, such as Nipco and Techno Oil, whether that be from domestic supply such as the NLNG plant or from the international market. These companies typically then sell to local traders/marketers which lift directly from the terminal and then either distribute through their own retail channels or transport to third party retailers.

### 1.3.2 From bulk storage to filling

From the bulk storage terminals, LPG is lifted by bulk storage trucks and delivered to either 'filling plants' or 'filling stations'. Large bulk storage depots have hundreds of offtakers, some of whom act as traders. Bulk B2B customers receive product direct from the terminals.

Filling plants typically have 30-100mt of storage on site. Customers can bring their cylinder to the site, hand it over to a member of staff and wait while it is filled.

Filling stations typically have skid-mounted storage with capacity in the 5-10mt range. They are often, but not always, sited at service stations (selling gasoline and diesel).



Figure 16: Banner Gas skid (source: Banner Gas)

There is only conventional bottling plant (using an automated conveyor/carousel system to fill cylinders) in Nigeria. Located in Benin State, the plant belongs to Banner Gas, which acquired it from Total. End users cannot visit this site.

### 1.3.3 Last mile distribution

#### 1.3.3.1 Filling plants and filling stations

Filling plants and filling stations offer a 'while you wait' service: the customer brings his/her bottle to the site and hands it to a member of staff for filling. Customers include not only private individuals but also unlicensed resellers who usually fill large 50kg bottles which they then transport deep into residential areas, with a view to reselling smaller quantities to end users. They achieve this by decanting the 50kg bottle using a rudimentary hose. Unlicensed resellers are also called 'decanter' or 'Category D' sellers by the NMDPRA.



Figure 17: Unofficial resellers advertise their services in Lagos (source: CITAC)

This unlicensed decanting system allows end-consumers to purchase small quantities, for example 1kg, at a time, though CITAC's research suggests that even low-income households often fill their cylinder, whether 3kg, 6kg or 12.5kg, to capacity. This is because customers often have to incur pick up/delivery costs with the decanters, or travel costs to get to the filling stations. In the Lagos area, customers typically pay 200-700 Naira in travel costs (round trip) each time they refill, according to CITAC's research. The amount charged by the decanters for pick-up/delivery varies by location, distance, and the extent to which consumers are being short-sold on quantity.

In addition to the home delivery service offered by the decanters, a number of licensed companies, including OVH and Sargas, offer home delivery. In Lagos, these services have to contend with heavy traffic.

In the B2B sector, supply contracts with formal restaurants, hotels, hospitals and residential service companies (buying LPG on behalf of an entire apartment block) generally include delivery.

In summary, households have five options when it comes to filling their cylinder:

- Travel to a filling plant
- Take home delivery from an unlicensed reseller (decanter)
- Travel to an unlicensed reseller (decanter)
- Take home delivery from a licensed company
- Travel to a filling station

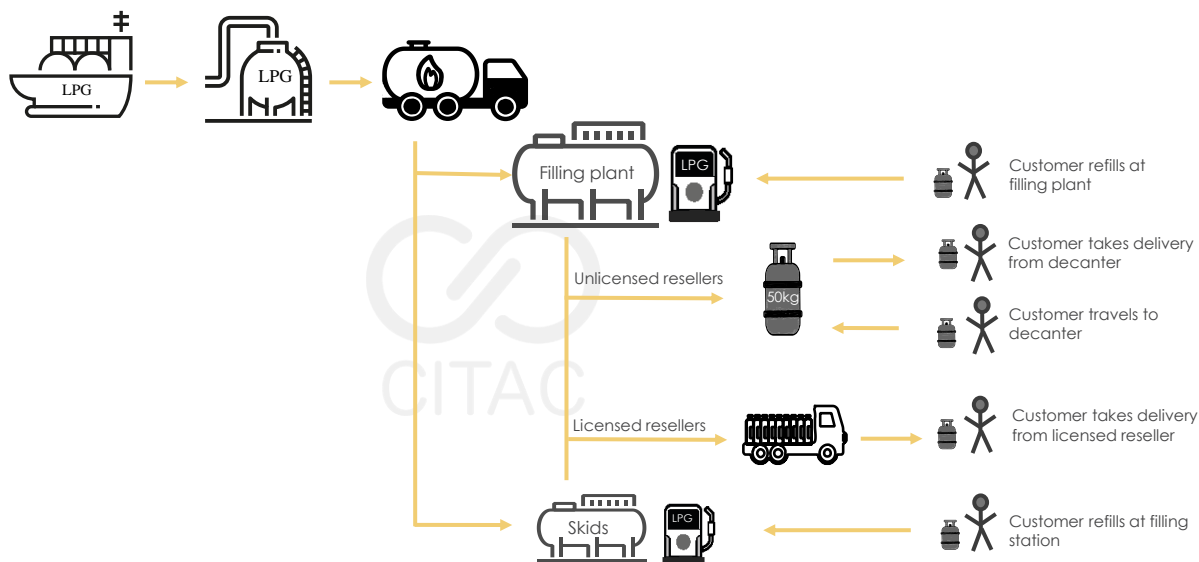


Figure 18: Nigerian LPG value chain (for residential sales), source: CITAC

### 1.3.3.2 Cylinder ownership

The Nigerian LPG sector operates under a customer-owned cylinder model. This is in stark contrast to the deposit schemes (also known as cylinder exchange systems) in operation in many francophone countries in West Africa.

In theory, cylinder exchange systems would bridge a number of gaps inherent in the prevailing distribution model, namely:

- Safety: as cylinders are currently consumer-owned, they undergo little or no maintenance
- Quantity: short-selling, even at licensed skids, is systemic in Nigeria
- Convenience: there is currently no formal micro-distribution system using kiosks or other shops, in Nigeria. Such a system, common in countries with marketer-owned bottles, would bring LPG closer to the people.

Several marketers, most notably Total, have attempted to launch mass-market deposit schemes in Nigeria in recent years, but they have all failed. Niche exclusivity/exchange contracts are currently being trialled by companies including Sargas and Smart Gas but they are focussed on higher end consumers in specific areas. Low-income individuals do not currently use such schemes in Nigeria: they acquire LPG using one of the five options listed above.



Figure 19: Sargas and Smart Gas operate mini exchange systems (source: Sargas, Smart Gas)

In the B2B sector, exclusivity arrangements are more common:

- Larger commercial customers may conclude exchange agreements with a given marketer.
- Alternatively, commercial customers may retain ownership of the cylinder but conclude an exclusive resupply agreement whereby a selected marketer fills the cylinders 'on the spot'.

Among marketers, there is broad consensus as to why mass market deposit schemes are particularly challenging to implement in Nigeria:

- Nigeria has an 'ownership culture'. It is counter-cultural for a (low-income) household to transfer cash for something they will not subsequently own. Similarly, having paid for a new cylinder, it is counter-cultural to exchange it for a potentially older, less attractive cylinder under an exchange system.
- Price: low-income households in particular will always seek out the lowest price available in their area, making it difficult to establish brand loyalty. Even if the customer were to gain access to a cylinder via a deposit scheme, there is a significant risk that the customer would fill it with various suppliers, depending on price. Bottles injected under previous attempts to launch deposit schemes 'did not come back', according to every marketer CITAC engaged with. The same is not necessarily true of middle-class customers who, in certain cases, may be willing to pay for the peace of mind afforded by a marketer-owned cylinder scheme in terms of cylinder maintenance and protection from short-filling.
- Migration and fluid household membership (in urban areas) can make it difficult to track consumers and cylinders. Addresses are often not traceable.

Despite the absence of deposit schemes, some marketer-branded bottles are currently in circulation in Nigeria. Some of these are 'legacy' bottles from failed deposit scheme pilots. Others are injected in the hope of generating brand attachment i.e. they serve as an advertising vehicle. The Techno Oil cylinder manufacturing plant offers a branding service for those marketers who want it.

Many bottles in the Nigerian market are old and unbranded. Most of them never undergo safety checks or maintenance. The National Gas Policy (2017) estimated that only 10% of cylinders in circulation could be cleared as safe. Cylinder import licences should, in theory, specify a given cylinder colour for each importer/marketer but this is no longer enforced.

For these reasons, marketers are acutely concerned about the reputational risk associated with a branded bottle being involved in an explosion. Most of them do not get involved with buying, selling or branding cylinders. The market is dominated by general traders who source unbranded cylinders from China, Turkey and other countries.



Figure 20: Empty cylinders for sale in Lagos (source: CITAC)

### 1.3.3.3 Cylinder production

Techno Oil is the only company with cylinder production capability at present. It produces and brands cylinders for itself and other marketers. As of February 2022, it was operating well below capacity, partly because of strong competition from China-origin cylinders.

Run Gas is building two cylinder production plants – one in Lekki and one in Bayelsa state. Neither plant was yet operational in February 2022.

## 1.4 Pricing, Inter-fuel competition and fuel stacking

### 1.4.1 Refill pricing and taxation

#### 1.4.1.1 Liberalised pricing

LPG pricing in Nigeria is liberalised, with prices varying nationally and dictated by the laws of supply and demand, and by fluctuations on international commodity and currency markets. With no centralised price controls, or any mechanism for creating uniform prices nationwide, prices vary throughout the country. According to the National Bureau of Statistics, the three states with lowest average prices for 5kg refills across 2021 are all major centres of supply: the coastal states of Bayelsa, Delta and Lagos.

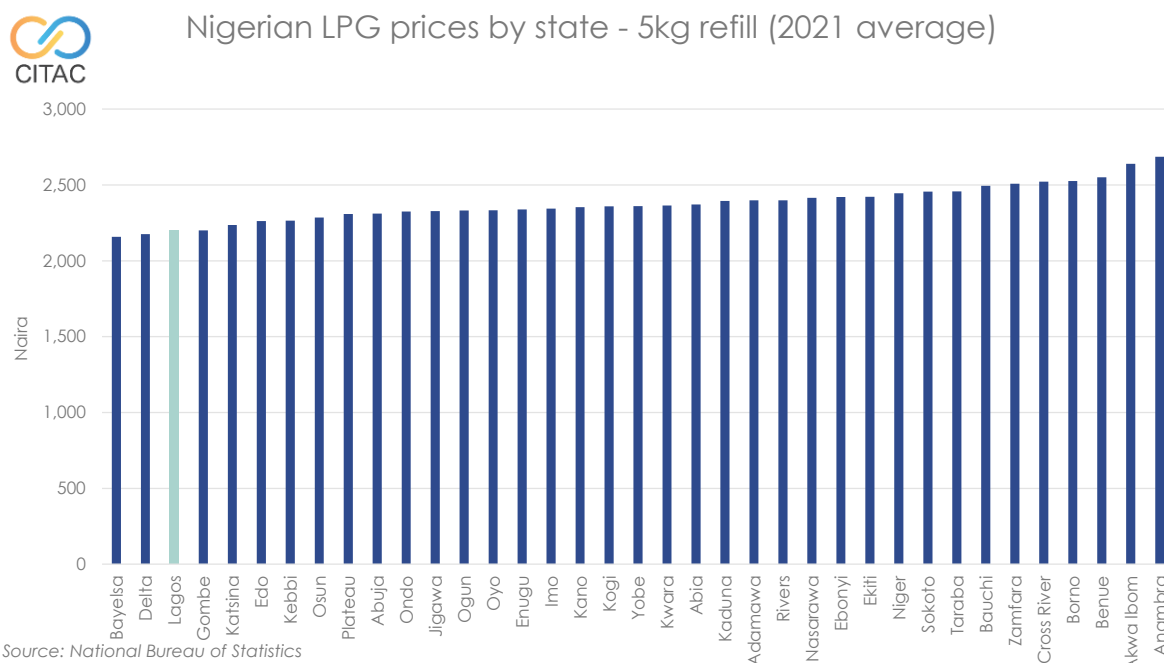


Figure 21: Nigerian LPG prices by state - 5kg refill (2021 average)

#### 1.4.1.2 Refill prices in Lagos

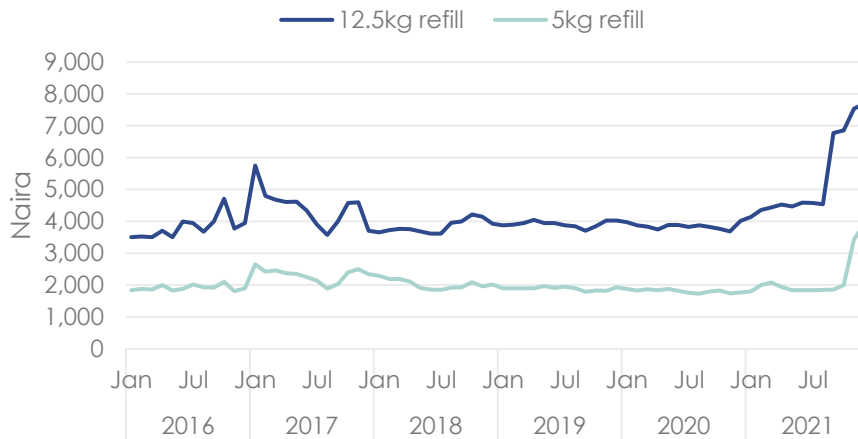
Nigeria's National Bureau of Statistics offers historical prices for 5kg and 12.5kg, with historical data going back to the start of 2016. Prices have increased sharply since mid-2021 owing to:

- Flat price movements on the international market
- The depreciation of the Naira
- The reintroduction of import duty (5%) and VAT (7.5%) in August 2021





### Lagos LPG prices (local currency)



Source: National Bureau of Statistics

Figure 22: Lagos LPG prices (local currency)

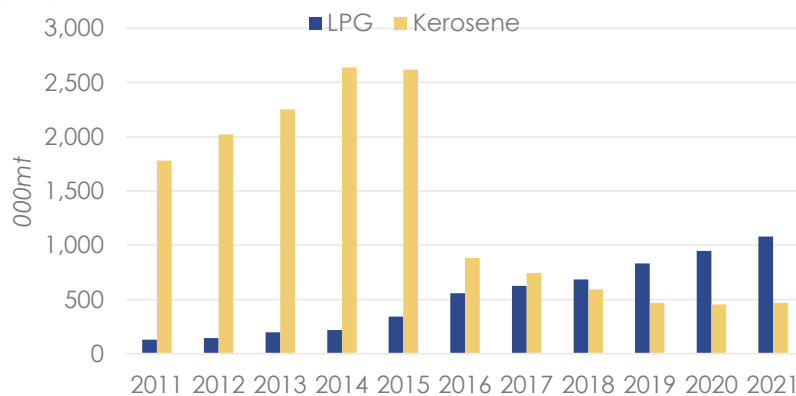
By February 2022, refill prices for 6kg and 12.5kg bottles had risen further, as shown in Table 1: Lagos cylinder prices (February 2022) below. The 6kg, rather than 5kg, refill price has been shown as this was the bottle size most frequently encountered by CITAC during its field research in Lagos.

#### 1.4.1.3 Effect of kerosene subsidies on LPG consumption

Until the end of 2015, kerosene received substantial state subsidies, reflecting its perceived status as the fuel of the poor. When subsidies were removed kerosene prices in Lagos quadrupled overnight, from 50 NGN/ltr (25 ¢/ltr) to 203 NGN/ltr (101 ¢/ltr), causing consumption to collapse. Equally significant from a demand perspective is the fact that with subsidies removed it was no longer attractive for unscrupulous traders to adulterate expensive automotive gasoil with cheap kerosene.



### Nigeria LPG & kerosene demand



Source: CITAC

Figure 23: Nigeria LPG & kerosene demand

#### 1.4.2 Cylinder prices

During CITAC's field visit to Lagos in February 2022, the following average prices for empty cylinders were recorded. The delta between 12.5kg and 6kg cylinders was relatively small.

Lagos cylinder prices (February 2022)		
Product	Price (Naira)	Price (USD)
3kg cylinder (empty)	9,500	19
6kg cylinder (empty)	14,000	28
12.5kg cylinder (empty)	16,500	33

Source: CITAC

Table 1: Lagos cylinder prices (February 2022)

### 1.4.3 Price of competing fuels

During CITAC's field visit to Lagos in February 2022, the following prices for LPG and rival domestic fuels were identified. The price of firewood (by weight) varied significantly depending on location.

Lagos domestic fuel prices (February 2022)		
Product	Price (Naira)	Naira/100MJ
Per-kg refill price	650	1,311
Half-refill of 6kg cylinder	2,200	1,478
Refill of 6kg cylinder	4,500	1,512
Refill of a 12.5kg cylinder	8,000	1,210
Short bundle of firewood	120	-
Long bundle of firewood	300	-
500ml of kerosene	500	2,782

Source: CITAC

Table 2: Lagos domestic fuel prices (February 2022)

As shown in Table 2: Lagos domestic fuel prices (February 2022) above, kerosene works out approximately twice as expensive as LPG on a per-Megajoule basis, before the relative inefficiency of kerosene stoves versus LPG stoves is taken into account.

Energy equiv. of 1kg of Propane (49.6 MJ/kg)	
Butane	1.01kg
Gasoline	1.43 litres
Kerosene	1.38 litres
Gasoil	1.30 litres
Wood	3.1kg
Charcoal	1.83kg
Electricity	13.8kWh
Natural gas	47 cu ft.

Sources: ESMAP, Energy Education

Table 3: Energy equivalence of 1kg of propane

## 1.4.4 Stove prices

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The price of stoves varies depending on model, brand and number of burners. In the Greater Lagos area, two-burner stoves were retailing for around 27,000 Naira (\$54) in February 2022. The most accessible LPG kit is the 'plug and play' 6kg cylinder with grate, which was retailing for around 14,000 Naira (\$28) in Lagos in February 2022.



Figure 24: 6kg 'plug and play' cylinder and grate (source: CITAC)

## 1.4.5 Fuel stacking

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CITAC's field work suggests that most households in the Lagos area consume at least some LPG. This is true even of households in peri-urban areas and the most deprived inner-city areas. While LPG is widely regarded as expensive, it is seen as a fast, convenient cooking solution that leaves pots and pans clean.

Fuel stacking is common, however: low-income households typically hold one small LPG bottle (6kg or 3kg), which they supplement with a kerosene stove and, in some cases, waste timber (from building sites). The kerosene stove is widely used as 'emergency back-up' when the LPG runs out. Kerosene is generally more expensive on an energy content basis, but it can be purchased in small amounts. CITAC found very little evidence of households using firewood or charcoal in the Greater Lagos area.



Figure 25: Peri-urban Lagos household using both gas and waste timber (source: CITAC)

## 1.4.6 Credit offerings and PAYG

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Neither filling stations nor decanters offer credit to their customers. Several microfinance solutions do, however, exist: Lapo Microfinance Bank, for instance, has a specific LPG-related offering called the 'O-gas loan' (in partnership with OVH). Other digital 'quick loan' providers include Kuda, Page Financials and Renmoney.

In theory, consumers can purchase any amount of LPG they can afford, as all skids offer part-filling. In reality, travel costs to/from the skid mean that many consumers prefer to wait until they have enough cash to purchase a full refill.

## 1.5 LPG regulation

### 1.5.1 NPRA and SON: areas of responsibility

Since August 2021 regulation of the LPG sector in Nigeria has been the responsibility of the new Nigerian Midstream and Downstream Petroleum Regulatory Authority (NPRA).

The newly-established NPRA has responsibility for all regulated areas of the LPG sector in Nigeria, with the exception of setting specifications and associated equipment such as cylinders, valves, burners, stoves, gauges etc., which is the responsibility of the Standards Organisation of Nigeria (SON).

The NPRA is responsible for enforcing licensing requirements and health and safety standards, a mammoth task given the fragmented nature of Nigeria's LPG industry and the high number of unlicensed operators. The National Gas Policy of 2017 called for 'criminal prosecution for instances of gross negligence or wilful misconduct that lead to a serious breach of health and safety standards or serious incidents that lead to loss of life'. In reality, such prosecutions are rare.

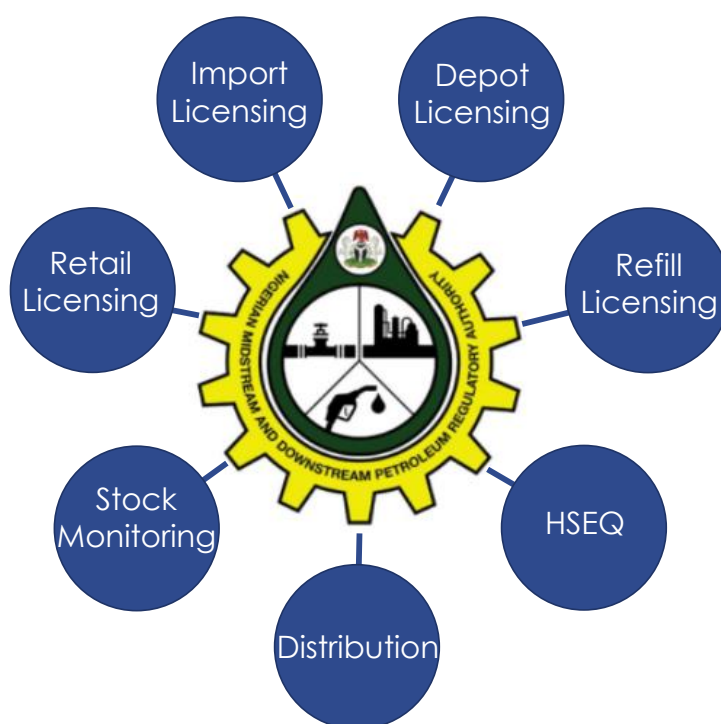


Figure 26: NPRA areas of responsibility

### 1.5.2 Cylinder regulation

SON and NPRA have joint responsibility for ensuring the integrity of Nigeria's cylinder fleet. Nigerian Industrial Standard NIS 63:2013 states that the following should appear on all cylinders in circulation in the country:

- Country of origin
- Brand name
- Empty weight
- Test pressure
- SON registration number
- Year of manufacture (embossed)

In addition, all bottles should, in theory, be recertified every five years, and withdrawn from circulation after 15 years.

### 1.5.3 The Office of the Vice President and the National LPG Expansion Programme

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In 2020, the Office of the Vice President, in partnership with the government of Delta State, launched the National LPG Expansion Programme, aided by \$60mn of funding from the Central Bank of Nigeria.

The aim of the NLEP is to increase the use of LPG as the fuel of choice for transportation, domestic cooking, captive power and small industrial complexes. Its stated aim is to increase the national consumption of LPG tenfold over the next 10 years. As part of this drive, the VP's Office is seeking to implement an ambitious countrywide marketer-owned cylinder scheme system under which:

- The government plans to inject millions of cylinders via the marketing companies
- The government retains ownership of the cylinders
- Consumers pay back a small portion of the upfront cylinder cost every time they fill their cylinder.
- Refills and cylinder repayments would be carried out using a unique card system
- Cylinder geo-tagging would be used (most likely using RFID technology) in order to track and punish customers who opt to fill their cylinder outside of the unique card system
- Cylinder exchange would take place in people's homes, thanks to a significantly expanded cylinder truck fleet.

As of February 2022, various pilots and technological proofs of concept were still being carried out.

### 1.5.4 Charcoal/firewood regulatory bodies

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Nigeria's Federal Department of Forestry regulates the charcoal and firewood industries, but intervention is light. In May 2016 the department imposed a ban on charcoal production after producers and exporters were found to be ignoring the official 'cut one, plant two' policy. However, the ban was lifted after only two months. In 2017 the department rescinded all licences for exporting charcoal in response to widespread forest degradation. Since then no new licences have been issued.

At state, rather than federal level, individual assemblies are free to impose restrictions on charcoal and firewood activity. As an example, in November 2021 Adamawa State Assembly adopted a bill banning tree felling, prescribing a 3-month jail term or a fine of 20,000 NGN (\$48) for felling a single tree. It is not clear if any fines or other punishments have since been issued.

## 1.6 Barrier analysis and uptake solutions

### 1.6.1 Barrier analysis

The following factors are key downstream barriers to greater LPG uptake among low-income households in Nigeria:

#### 1.6.1.1 Starter pack costs

The cost of obtaining a starter pack (cylinder, regulator, hose, stove) is between \$35-\$100. This is a material expense for many households. Some microcredit solutions exist but they are not widely used by low-income households. Only one of the customers interviewed by CITAC had used microfinance (a cylinder financing arrangement with Lapo). Microfinance, particularly in urban settings, is complicated by migration, fluid households and a lack of collateral.

#### 1.6.1.2 Biomass availability

In many rural communities, firewood and charcoal are readily available at low or no cost, apart from the opportunity cost of time spent collecting the firewood and/or making the charcoal. This presents a major barrier to greater LPG uptake.

#### 1.6.1.3 Lack of proximity

While the skid concept was born out of a drive to bring LPG closer to the people, consumers often still have to pay (motorbike-)taxi or minibus fares to and from the filling station. Alternatively, they have to pay unofficial resellers for a home delivery service. Unlike in francophone West Africa, there are no formal reseller networks within residential areas. Obtaining a refill can therefore be time-consuming and expensive (the average roundtrip cost in the Lagos area was 500 Naira, or 1 USD, according to CITAC's research). The system also carries an opportunity cost for the customer as they cannot work during their travel to/from the filling station.

#### 1.6.1.4 Lack of pay-as-you-go refilling

In theory, filling stations can dispense any amount of LPG but owing to prohibitive transport costs, customers often fill their bottle to capacity. For some customers, this requires a short period of saving during which they may need to use alternative fuels.

#### 1.6.1.5 Short-selling

Customers are in many cases paying more than necessary for their refills. Short-selling by decanters and even filling stations is said to be widespread in Nigeria. If customers paid for the actual quantity filled, they would pay less. For example, if a customer pays for 6kg but only receives 5.5kg, they are paying 9% more than they should.

#### 1.6.1.6 Single cylinder ownership and quantity gauges

Low-income households tend to own only one cylinder. When the gas cuts out, they are therefore forced to switch to kerosene while they arrange a refill. Wealthier households have multiple cylinders. The vast majority of customers do not have pressure gauges, smart meters or in-home weighing scales, so they have no way of knowing when the gas will cut out (other than by lifting the bottle and guesstimating what quantity is left).

#### 1.6.1.7 Taxation

The reintroduction of import duty (5%) and VAT (7.5%) in August 2021 led to increased retail prices throughout Nigeria, with many consumers bemoaning higher prices 'since mid-2021', a period during which flat prices on the international also spiked.

### 1.6.1.8 Customs clearance for skids and bulk trucks

Currently, the process for importing skids and other LPG equipment is slow and complicated. First, clearance needs to be obtained from SON. Then, a duty exemption needs to be obtained from the Ministry of Finance. Once the cargo is imported (often in a container) clearance fees need to be agreed with Customs.

### 1.6.1.9 Taste

For reasons of taste, charcoal/firewood will always be the preferred fuel choice for certain dishes (smoked fish, grills).

### 1.6.1.10 Fear

Nigeria's consumer-owned cylinder system and 'culture of ownership' mean that cylinders are not routinely checked for leaks or properly maintained. LPG is widely regarded by customers as more dangerous than firewood or charcoal. This is because LPG's flammability attracts far more attention than the health impacts caused by firewood and charcoal.

### 1.6.1.11 Education

Removing affordability barriers does not necessarily result in reliable LPG usage. In Ghana, for instance, marketing companies have reported limited LPG consumption even when cylinders and stoves are distributed free of charge. One LPGMC visited homes in Tamale where full LPG cylinders were being used as ornaments and status symbols, without ever actually being consumed. Education, covering everything from the practicalities of the cylinder/stove set-up to the relative cost of an LPG refill versus competing fuels, is essential at a very micro level if new behaviours are to become ingrained.

These barriers can be divided into Affordability, Regulatory and Cultural factors as follows:

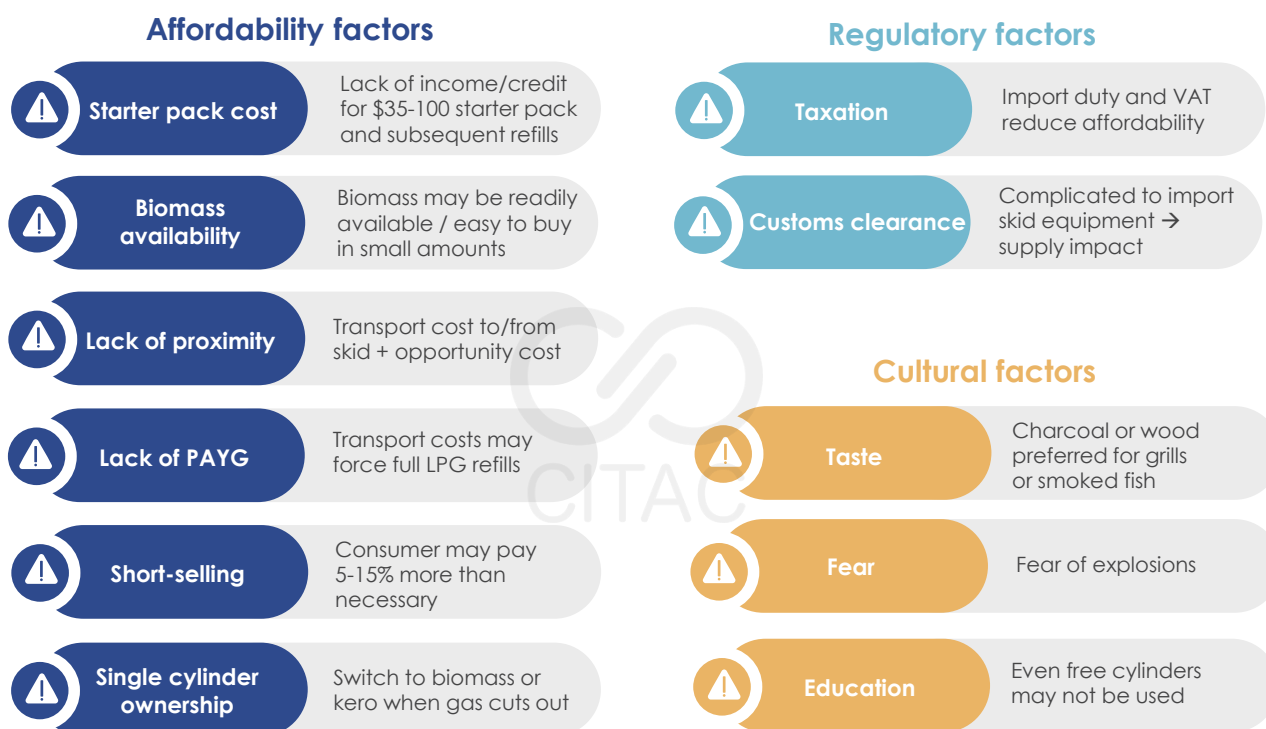


Figure 27: Barriers to LPG uptake

## 1.6.2 Uptake solutions: towards an 'Honest Gas' Pilot

### 1.6.2.1 Skid model to persist

Nigeria's downstream LPG industry is heavily decentralised. There are hundreds of players and thousands of filling points. CITAC believes this system is too deeply rooted to revert to a more centralised system controlled by a handful of key players, as is the case in countries such as Senegal and Cote d'Ivoire. For this reason, uptake solutions are likely to revolve around continued skid development.

Irrespective of affordability barriers, the easiest way to increase LPG uptake among low-income households is simply to make supply available through skids. An instructive case study is provided by a major LPG/fuel importer and retailer which speculatively established an LPG filling station in Delta State. To the surprise of the company's management, the pilot proved a resounding success, attracting customers from villages up to 30km away.

Perpetuating the skid model has several drawbacks, however, in terms of global best practice:

- Decentralised nature makes standards enforcement more difficult.
- Scales are often not recalibrated.
- Safe distances/filling are not always practised.
- Cylinder maintenance responsibility rests with the consumer.

CITAC believes that a 'new generation' of skid offering could help to overcome these drawbacks, in many key respects, while at the same time addressing the main barriers identified in *1.6.1 Barrier analysis*. We have dubbed this 'new generation' of skid offering the 'Honest Gas' Pilot.

### 1.6.2.2 Pilot to target rural area using investment optimisation tool

Given the high level of LPG penetration in Lagos and other cities, the Pilot should target a rural area with minimal LPG uptake. Rural settings have the added benefit of offering greater scope for running pilots as their communities tend to be more stable and cohesive.

The development of a skid siting investment optimisation tool, using population mapping and existing skid location data, can be considered as a means of selecting the pilot location (and broader industry skid investment strategies).

### 1.6.2.3 Three key areas of responsible differentiation

During its First Phase, the Honest Gas Pilot can differentiate itself from the current ex-skids offering in Nigeria in three main ways:

#### 1.6.2.3.1 Quantity assurance

The Nigerian market is characterised by a conspicuous lack of transparency around quantity assurance at filling stations and unofficial reseller outlets. Given the price sensitivity of low-income households, this represents a clear gap in the market.

Appropriate quantity controls, including regular recalibration of scales, should be explicitly communicated to customers ('We don't short-change you'). Quantity receipts and/or tamper-proof shrink wrapping can be used to satisfy customers they are receiving the quantity they have paid for, particularly where the cylinder owner entrusts the filling to another member of the household. Occasionally, cylinders considered empty by customers still contain some residual gas (e.g. 0.5kg). These quantities should be deducted from the filling cost.

Such an explicit disavowal of short-selling would help to generate brand attachment among consumers, while at the same time reducing their refill costs. This also has the effect of reducing Honest Gas's margins until such time as the sales volume generated by customer loyalty outweighs the 'loss' of revenue from honest selling.

Educating consumers to understand that weighing scales are the only reliable means of measuring LPG quantity will require time and repeated messaging.



CITAC notes that PayGas is currently piloting a new skid offering in Abuja whereby consumers use pre-paid vouchers to acquire a precise quantity of LPG from a containerised skid.



Figure 28: PayGas offers part refills based on pre-paid vouchers (source: PayGas)

### 1.6.2.3.2 Maintenance offering

A low-cost no-obligation cylinder maintenance service can be offered on site, with clearly displayed price lists for replacement parts and basic servicing:

- Leakage tests
- Rubbers
- Valves
- Regulators
- Burners
- Dented foot ring
- Dented handle

More substantial requalification and repainting would need to be carried out off site.

Such an offering, even if not used by many customers, would help to raise awareness around the importance of cylinder integrity. CITAC notes that basic air/water/oil services are available for motorists in most service stations; some also offer more substantial repairs/tyre replacement services. There is no such offering for LPG customers. In practice, this means that most cylinders undergo zero maintenance.

### 1.6.2.3.3 Safety procedures

The Honest Gas skid should have prominently displayed safety procedures including:

- Floor markings to guarantee safe distance between customer and filler.
- Filler to wear safety goggles and appropriate anti-static clothing.
- Clear signage around the use of cigarettes and mobile phones.
- Clearly identified gas detectors.

All of these basic safety procedures can be implemented at minimal cost. Like the proposed maintenance workshop, they also help to educate the consumer about the value of best practice.

### 1.6.2.4 Phase 1 Honest Gas summary schematic

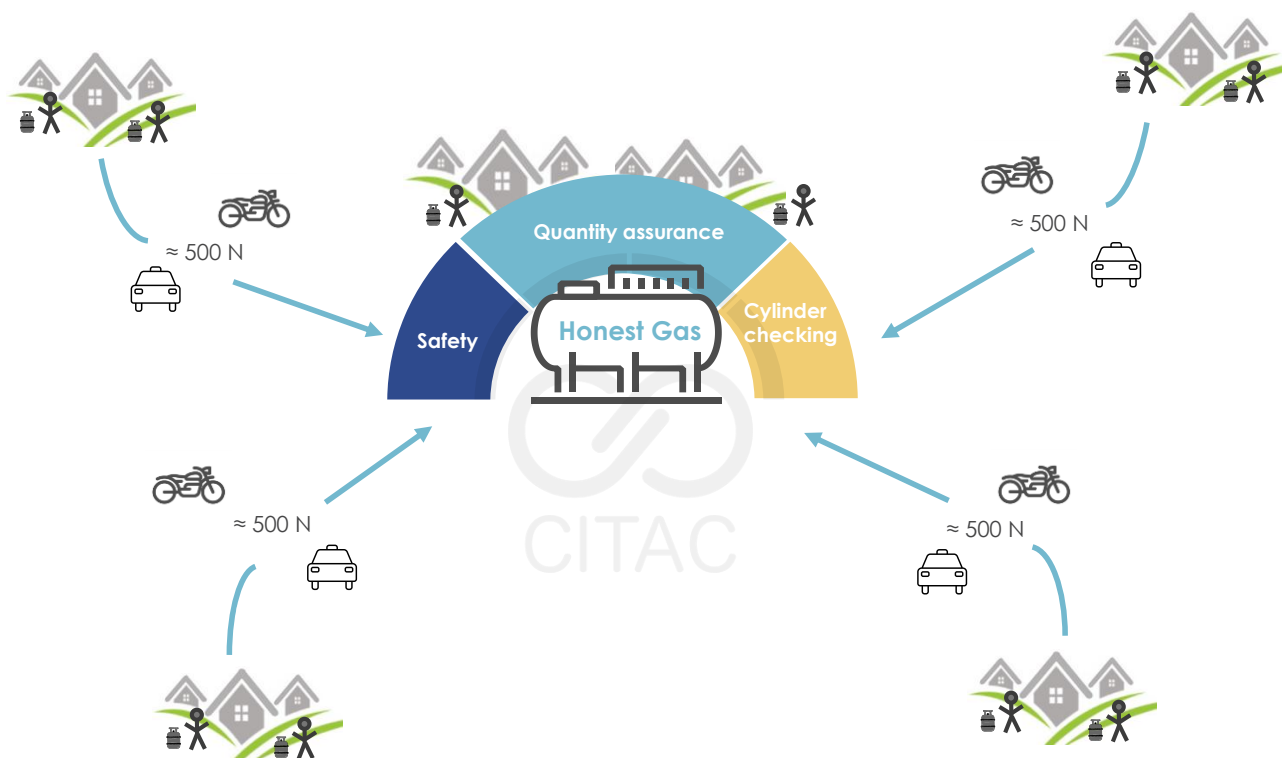


Figure 29: Phase 1 Honest Gas summary schematic

### 1.6.2.5 Two-phase Pilot leading to hybrid refilling system

The three sources of differentiation above can be implemented as part of a conventional customer-owned cylinder model. Under this model customers would continue to travel to the skid.

As brand attachment is developed, and customers are taught to value quantity, maintenance and safety, the Pilot can enter a more ambitious Second Phase targeting the development of a closed, area-specific exchange system fed from the central skid(s). CITAC believes it will be challenging to move directly to a Second Phase without first educating customers about the benefits of quantity assurance, maintenance and safety.

Core characteristics of the second phase are envisaged as follows:

- New company-owned cylinders consigned to customer. Alternatively, existing customer-owned cylinder is relinquished into the exchange system in lieu of a deposit (subject to a maximum age limit of, say, 5 years) and repainted/re-branded.
- Cylinder to be consigned at cost (including cost of capital). This avoids the uncertainty and scepticism that some consumers may experience when marketers bundle in capex recovery costs within the price of the refill. It also lessens the impact on the marketer if the bottle disappears. Where customers require credit for the cylinder deposit, this can be concluded under a separate agreement, potentially involving in-community microfinance institutions. Credit administration in a rural setting is generally considered less complicated than in urban settings.
- Exchange system to be administered using a micro-distribution cage system. The price of an exchange will therefore include marketer transport and maintenance costs, as well as the cost of running/manning the cage. The cage can be a standalone enterprise or attached to another business (eg a local shop). In order to reinforce its business model, Honest Gas would ideally seek to recruit ex-decanter as cage operators (if any such decaners are active in the area in question). If the cylinder exchange point is attached to another business, the business owner will need to be paid for each exchange carried out. Either way, the ex-cage 'surcharge' (versus the ex-skids

refill price) needs to be as competitive as possible with 'typical' customer travel costs to/from the skid. In practice, the distribution activity of Honest Gas would likely operate at a loss in the first instance.

- Exchange point to include weighing scales so that any residual LPG in returned cylinders can be reimbursed to the customer. Cage attendant to act as local opinion leader, repeatedly reinforcing messaging around quantity and safety.
- Cylinder exchanges to encourage cashless transactions where possible. This can be achieved using PAYG mobile phone credit or mobile money. The vast majority of low-income households are accustomed to PAYG mobile credit; some, but by no means all, use mobile money services.
- Second phase to include injection of 3kg cylinders as cage exchange model will require full refills. The smaller cylinder size makes full refills more affordable. It also has the benefit of simplicity: customer swaps empty 3kg for full 3kg. This smaller cylinder format is currently rare on the Nigerian market though tech start-ups including Smart Gas are offering it.



Figure 30: Smart Gas exchange cylinders range from 3kg to 50kg (source: Smart Gas)

- Cage system to be accompanied by repeated, human resource intensive, house-to-house engagement at the most micro of levels, without which bottle disappearance will remain an issue.

While the two phases would likely run in parallel, the focus would be on maximising uptake of the Phase 2 Exchange System.

Home delivery is an alternative distribution model but CITAC believes it would be extremely challenging to implement in a low-income environment. Bottle-by-bottle delivery is invariably more expensive than bulk cage distribution, making it more suited to wealthier households willing to pay a premium for convenience. In mono-cylinder households it is also generally quicker to source resupply at a nearby cage than order home delivery from a centralised service. Home delivery can be optimised using various new technologies (Smart meters, in-home scales) that allow customers to anticipate resupply needs but these technologies add another \$35-90 to the upfront cylinder cost. These technologies also work best where customers own Smart phones and/or have mobile money accounts, neither of which are widespread in the poorest communities in Nigeria. Attempts at launching 'mass market' home delivery services in other countries, including Senegal, have encountered significant difficulties in terms of supply planning, scale, delivery vehicle sizing and end-user affordability.

#### 1.6.2.6 Phase 2 Honest Gas summary schematic

Please see schematic on the following page.

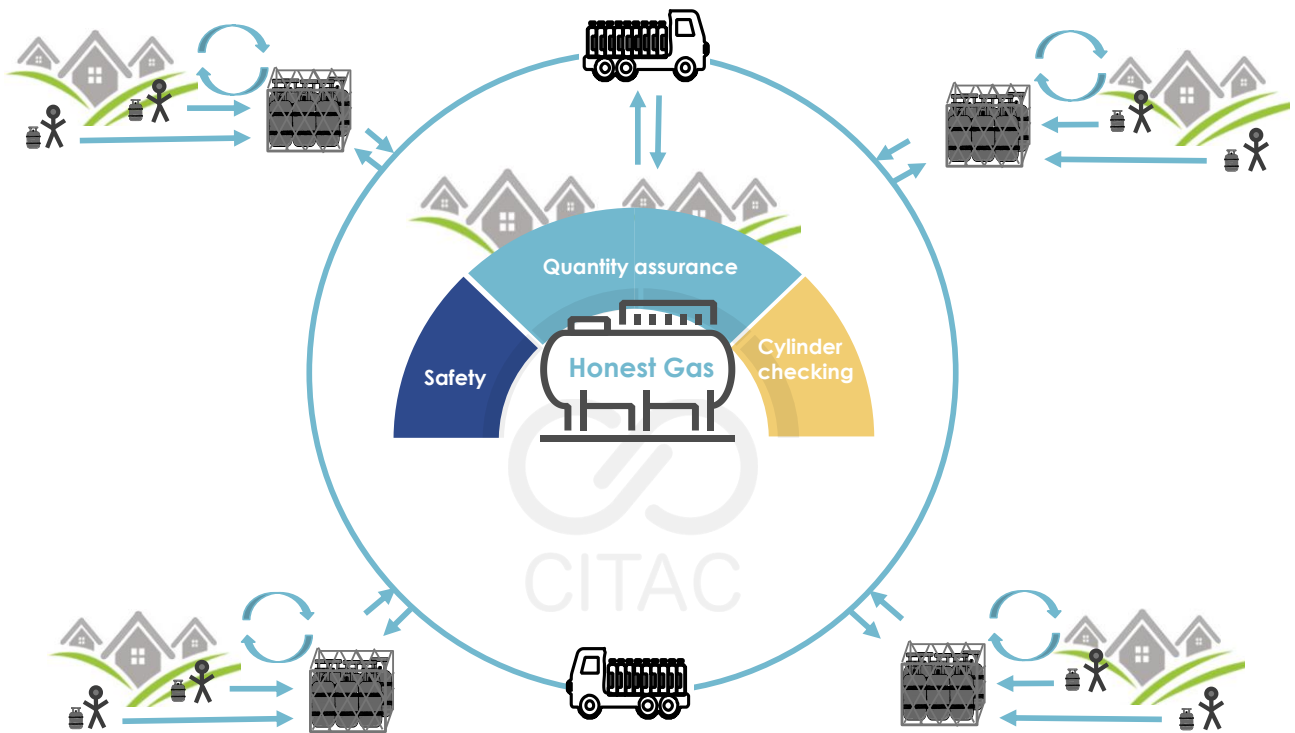


Figure 31: Phase 2 Honest Gas summary schematic

### 1.6.2.7 Advocacy

The development of the Honest Gas pilot, and the wider LPG industry, would be supported via the following pieces of advocacy work:

- Import duty and VAT to be discontinued
- Skid/truck importation processes to be streamlined in collaboration with the marketers/importers
- Duty exemption for cylinders, stoves and skids to be maintained

# Part II: Ghana



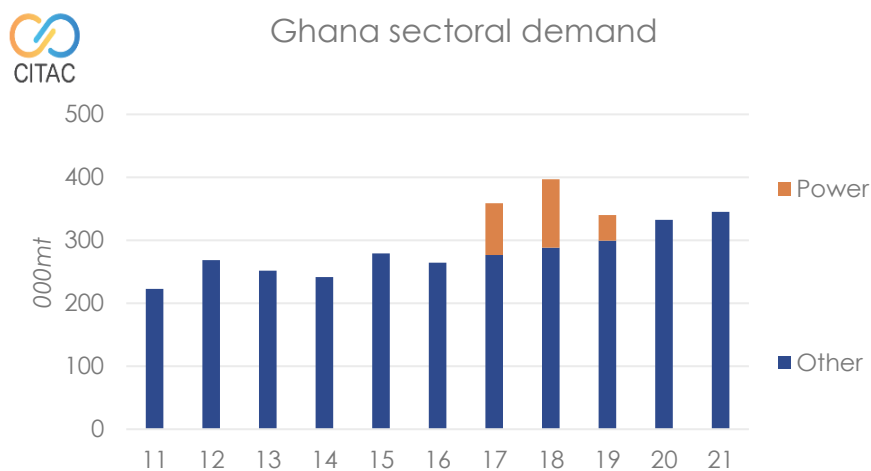
## 2.1 Demand

### 2.1.1 Historical demand

#### 2.1.1.1 Historical LPG demand in Ghana

LPG demand has grown steadily over the past decade, rising by 55% between 2011 and 2021 to reach 345,000mt. Demand growth has been distorted historically by government subsidies between 2000-2013 which super-charged residential demand in the country. The subsidies also had the unintended effect of encouraging the vehicle fleet, particularly taxis, to convert to LPG. Due to this distortion, the Ghanaian government ultimately opted to repeal subsidies in 2013.

Since 2020, higher prices in local currency terms have caused demand to stagnate. In 2021, per capita consumption stood at 11kg, versus 5kg in Nigeria.



Source: CITAC, NPA

Figure 32: Ghana sectoral LPG demand

#### 2.1.1.2 Effect of kerosene subsidies on LPG consumption

Until June 2013, both kerosene and LPG received substantial state subsidies. The subsidy on kerosene was greater, set at 52% of the market price, whereas LPG prices attracted a subsidy of 12%. Upon withdrawal of the subsidies, kerosene demand collapsed, falling from 46,000mt in 2012, the last full year of subsidies, to 9,000mt in 2014, the first full year without subsidies.

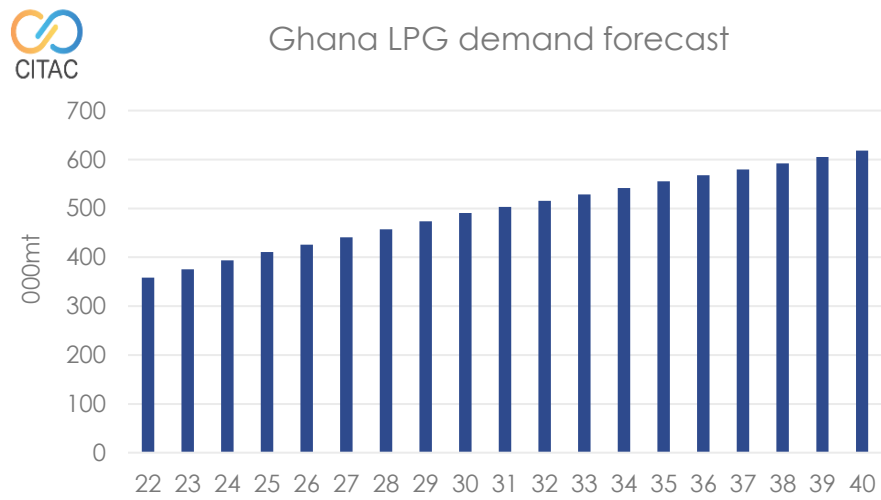
#### 2.1.1.3 Rapid infrastructure development

Ghana's liberalised market and coherent regulatory framework supported the roll-out of strong private sector involvement in the LPG sector. The proliferation of marketers in Ghana saw strong investment in LPG production facilities such as the Atuabo Gas Plant, as well as in import infrastructure, such as the Quantum LPG terminals (see infrastructure section for full details). This has helped to secure sufficient supply of LPG to meet demand, fostering a competitive and reliable LPG supply chain.

### 2.1.2 Forecast LPG demand in Ghana

CITAC forecasts that LPG demand will grow strongly, rising 79% to 619,000mt by 2040, thanks to strong population growth and supportive government policies aimed at stemming forest degradation. Ghana's total population stood at 32mn people in 2021, but this is projected to rise at an average annual rate of 2% through to 2040, when the population will total 45mn – an increase of 41%. Over this time period, the urban population will rise from 6mn to 11mn people, an increase of

55%, according to the UN. The rapid urbanisation rate presents a problem for urban infrastructure but an opportunity for LPG penetration, as urban populations typically consume greater per-capita volumes of LPG relative to rural populations.



Source: CITAC

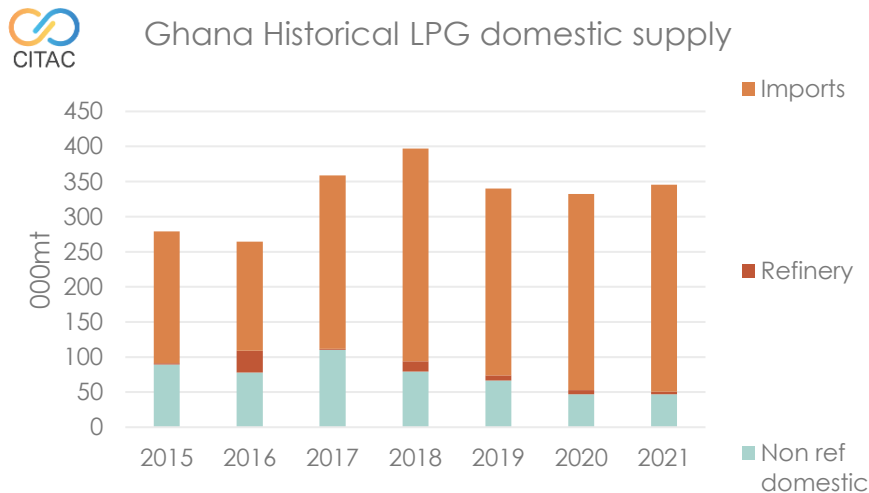
Figure 33: Ghana LPG demand forecast

## 2.2 Supply

### 2.2.1 Supply sources

#### 2.2.1.1 Supply summary

Ghana enjoys some diversification of LPG supply, with imports supplemented by domestic output from the TOR refinery and the Atuabo Gas Plant.

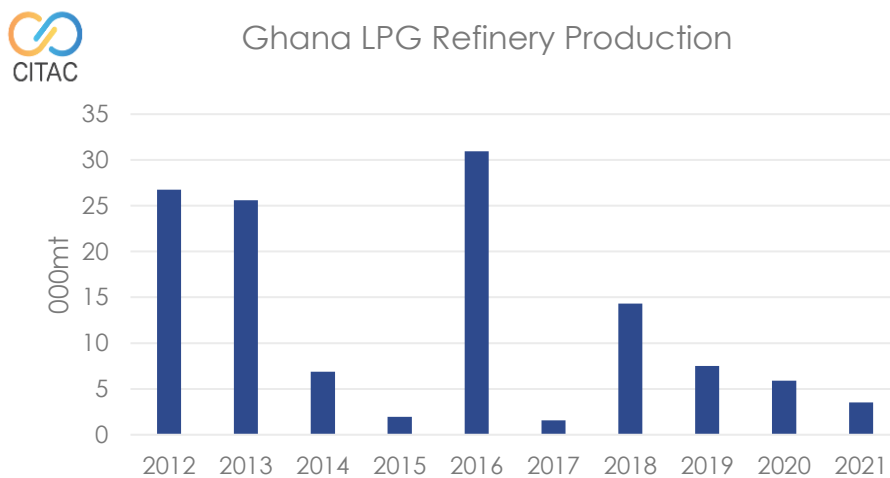


Source: CITAC

Figure 34: Ghana historical LPG domestic supply

#### 2.2.1.2 Refinery supply

LPG output from the Tema Oil Refinery (TOR) in Ghana has fluctuated over the past decade, with production reaching a peak of 31,000mt in 2016 but subsequently slumping to just 4,000mt in 2021. The refinery has faced numerous challenges in recent years, including financing difficulties as well as a fire in 2017 that cut crude throughput capacity from 45,000 b/d to 28,000 b/d.



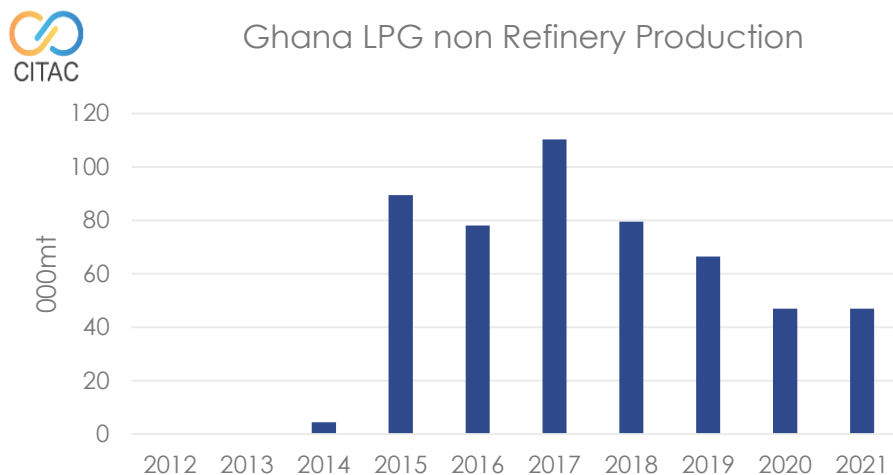
Source: CITAC

Figure 35: Ghana LPG refinery production



### 2.2.1.3 Non-refinery supply

Ghana Gas operates the Atuabo Gas Plant, which produces LPG from natural gas, fed by pipeline from the Jubilee field. The Atuabo Gas Plant's output of LPG has fluctuated, due to FPSO maintenance and resulting feedstock supply issues. Following its launch in 2014, the plant ramped up production to a peak of 110,000mt in 2017, but production rates slumped to 47,000mt in 2020.



Source: CITAC

Figure 36: Non-refinery supply

### 2.2.1.4 International supply

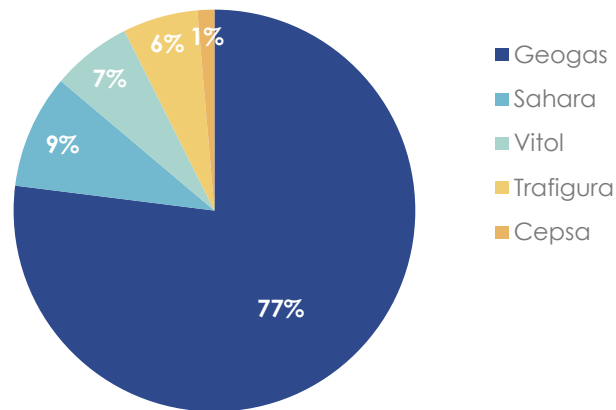
The shortfall between local demand and local production is met by LPG imports from the international market. These volumes are typically sourced from either inside the West Africa zone, from countries such as Equatorial Guinea or occasionally Republic of Congo, or from outside of the zone, from the USA, Latin America, or Europe.

## 2.2.2 LPG supply by port and supplier

LPG is delivered almost exclusively into Tema, thanks to robust import infrastructure at the port. Some volumes are also occasionally delivered into Takoradi, although here importers are required to discharge directly from vessels into trucks which is less efficient. The Takoradi supply route has typically only been used to cater to specific requirements such as the Genser power facilities that have operated in the West of the country in the past. In 2021, the major suppliers of LPG into Ghana were as follows:



## Ghana LPG suppliers 2021



Source: CITAC

Figure 37: Ghana LPG suppliers 2021

### 2.2.3 Supply forecast

The outlook for the TOR refinery is challenged by poor refining economics, financial difficulties and strong competition from international imports. Further exacerbating the outlook is the introduction of new product specifications at a national level in 2017, which the refinery is unable to meet. TOR has been granted a quality waiver until 2024 and there are tentative plans to invest in the refinery to enable it to meet national specifications at the end of the period - but the facility is struggling to attract the necessary financing to fund the required upgrades.

The outlook for the Atuabo Gas Plant is robust, provided that feedstock supply remains reliable. Plans for expansion of the plant, however, appear to have been shelved due to financing challenges at plant operator Ghana Gas as well as a lack of new gas production being streamed.

With limited upside to domestic production, forecast demand growth is expected to be met predominantly by imports. Import requirements are therefore forecast to rise from 295,000mt in 2021 (86% of total supply) to 437,000mt in 2030 and on to 572,000mt in 2040 (92% of total supply).

## 2.3 Downstream value chain

### 2.3.1 BDCs and bulk storage

Ghana's regulatory environment is characterised by a strict division between BDCs (bulk distribution companies) and OMCs (oil marketing companies). BDCs are licensed to import and store products, while OMCs are licensed to sell products to final consumers.

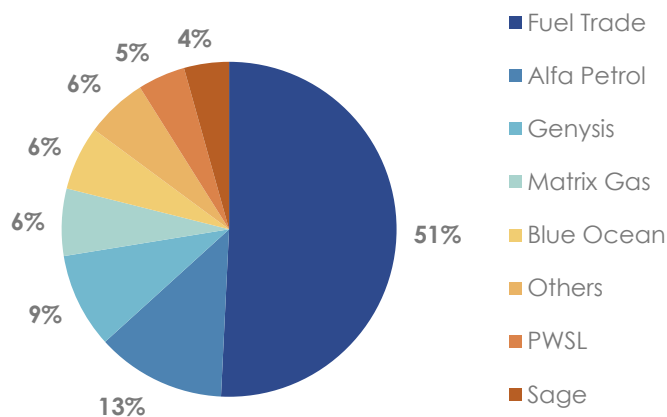
TOR has been operated under a processing agreement made between the refinery on one side and international trader Vitol and local marketer Woodfields on the other. While the refinery was running, this agreement entitled the partners to any products produced from the refinery – including LPG. Historically, the refinery has also run as a commercial operation, selling products directly to marketers.

Ghana Gas sells the product from its Atuabo Gas Plant to local BDC Sage under a long-term offtake agreement.

For imported product, BDCs arrange supply agreements with international traders directly. The market is highly competitive, with traders and BDCs jostling for optimal financing terms.



Ghana LPG receivers 2021



Source: CITAC

Figure 38: Ghana LPG receivers

### 2.3.2 From bulk storage to filling

Ghana has a less fragmented value chain than Nigeria. From the import terminals, LPG is transported in bulk to a network of over 700 skids (also called 'microstations') where consumers come to fill their cylinders. The skids also serve a large number of taxis/cars with Autogas. Some of these vehicles are dedicated LPG vehicles but others have undergone makeshift conversions. Nationally, demand at the skids is split 60:40 between residential demand and Autogas.

### 2.3.3 Last mile distribution

In the vast majority of cases, 'last mile' distribution in Ghana currently involves consumers (or their drivers/house boys) travelling to a skid with a cylinder and waiting while it is filled. Part-filling is common: the LPGMC Association estimates that 'tot filling' accounts for 50% of all residential skid sales.

Some skids offer home delivery services, visiting particular areas on certain days of the week for example, but these services are not widely available.

Some skids also offer basic cylinder maintenance, for example:

- Replacement rubbers at around 7 cedis (1 USD)
- Replacement ball valves at around 35 cedis (5 USD)
- Removal of sand from the ball valve
- Checking for leaks (soap and water test)

CITAC understands that this work is often carried out off site.

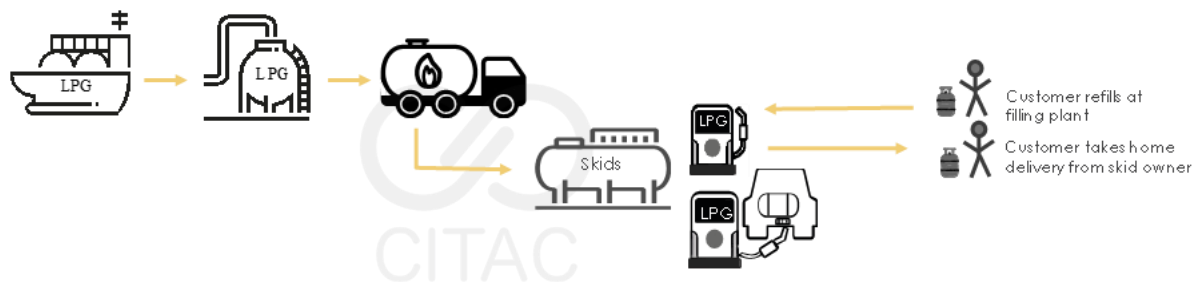


Figure 39: Ghana LPG value chain (for residential sales), source: CITAC

## 2.3.4 Cylinder Recirculation Model

Following a major explosion which killed 7 people and injured over 100 more at a skid near Atomic Junction in Accra, in October 2017, the National Petroleum Authority (NPA) has been formally seeking to overhaul the current value chain in favour of a more conventional Cylinder Recirculation Model. This CRM has the following key characteristics:

- Marketer, not customer, to own the cylinder\*
- Two new value chain activities to be created: 1) bottling (at large automated plants with carousel filling); 2) bottle transport
- Skids to be prohibited from serving residential customers
- Skids to serve Autogas customers only
- Creation of Cylinder Exchange Points where customers swap empty cylinders for full ones (part-filling no longer possible)

\*In early March 2022, NPA and the Ministry of Energy were also exploring an alternative model under which the bottling plants would acquire the cylinders. This potential deviation from the original CRM blueprint has been motivated by concerns that the LPGMCs do not have strong enough balance sheets to import large quantities of cylinders.

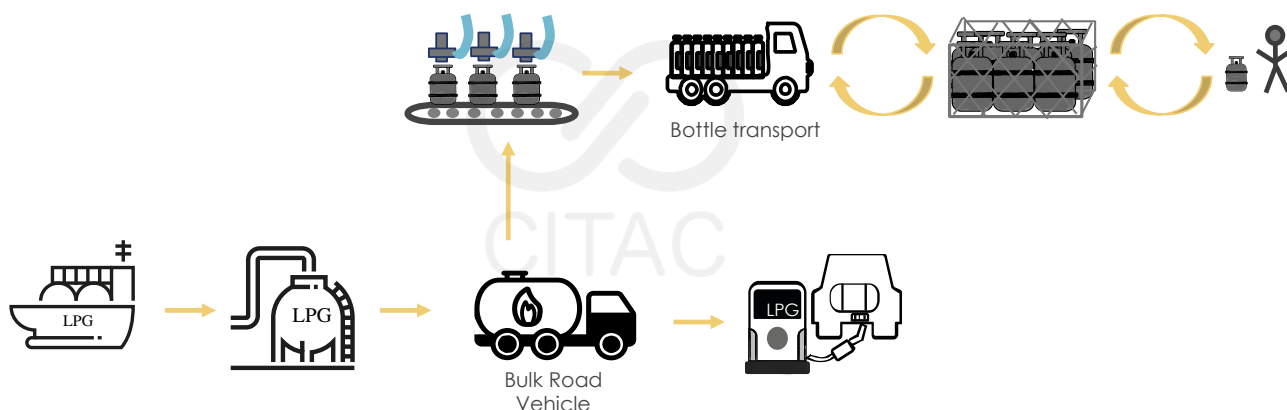


Figure 40: CRM blueprint (source: CITAC)

## 2.3.5 CRM implementation barriers

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### 2.3.5.1 Resistance from LPGMCs

Under the CRM, ex-skids sales to residential customers would no longer be allowed. This has led to resistance from the LPGMC Association.

Since the Atomic Junction explosion, no new skid construction licences have been issued. In addition, skids that were midway through construction have largely been prevented from completing those projects.

The LPGMC Association has also expressed concern that the CRM could reduce consumer demand, as part-filling would no longer be possible.

### 2.3.5.2 Cylinder disappearance

NPA has conducted various CRM Pilots under which branded cylinders were gifted to customers (in collaboration with specific LPGMCs) and branded cylinder exchange points were established. Some of these exchange points were also equipped with weighing scales.

The LPGMC Association provided the following feedback in relation to a pilot carried out in Kade, Eastern Region:

- 3,000-4,000 free, branded cylinders were injected into the community, along with several exchange point cages.
- After one year, most of the cylinders had disappeared.
- Customers had a cultural preference for filling at local skids, where the filling could be observed. The presence of weighing scales at the cages did nothing to overcome this.

Mini commercial pilots carried out by LPGMCs have yielded similar results.

NPA will be conducting further CRM pilots over the course of 2022.

### 2.3.5.3 Culture of ownership

Owing to a 'culture of ownership', it is difficult to convince consumers who already own a bottle to relinquish ownership of that bottle under a deposit scheme.

## 2.4 Pricing, inter-fuel competition and fuel stacking

### 2.4.1 Refill pricing and taxation

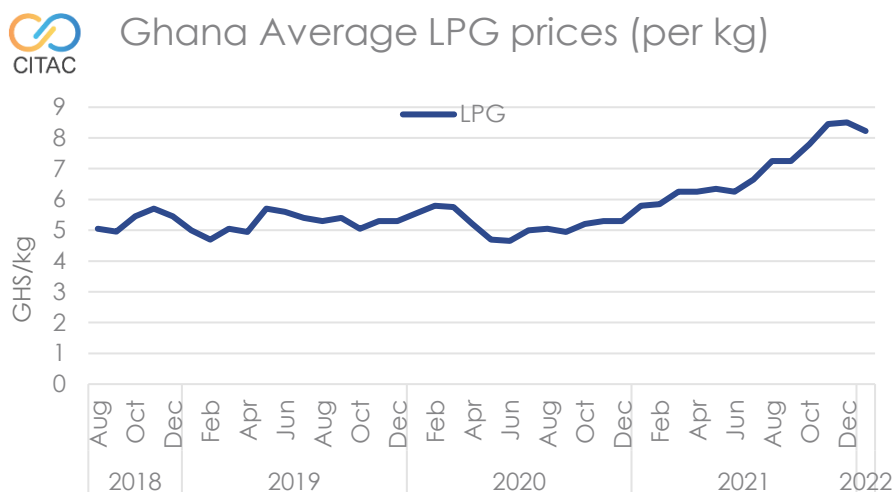
#### 2.4.1.1 'Guided' pricing

As with prices of other petroleum products, LPG retail prices in Ghana are broadly liberalised, with wholesalers and retailers free to set their own margins. However, three significant restrictions on pricing practice are in place:

- Firstly, every retailer must ensure that petroleum products are available at the same price throughout its network, irrespective of location and distance from the primary point of supply. This is enabled through the use of the Unified Petroleum Pricing Fund (UPPF), which on 7 February 2022 stood at 0.27 GHS/kg (4.2 ¢/kg).
- Secondly, every two weeks each retailer must submit an indicative retail price to the National Petroleum Authority. These indicative retail prices, which are publicised through the NPA website, then act as a maximum price to be charged across that retailer's network. LPGMCs are free to charge below or up to their posted indicative price, but not above. The two pricing window periods run from 1st to 15th and from the 16th to the last day of each month.
- Thirdly, as with gasoline and gasoil, the build-up of LPG prices includes a Price Stabilisation & Recovery Levy, presently fixed at 0.14 GHS/kg. The PRSL has two functions: to support the policy of constant pump prices during each two-week pricing window, and to contribute towards a cross-subsidy paid on fuel oil and on premix gasoline used in two-stroke engines.

#### 2.4.1.2 Historical LPG prices in Ghana

Posted LPG prices for each two-week pricing window are given on a strictly per-kg basis, but marketers are free to discount below their official posted price if they so wish. The price chart below gives the average of all LPGMCs' posted prices as published by the NPA. Prices rose by around 80% from 2019 to March 2022 when they hit 9 cedis/kg.



Source: NPA

Figure 41: Ghana average LPG prices (per kg)

#### 2.4.1.3 LPG taxation

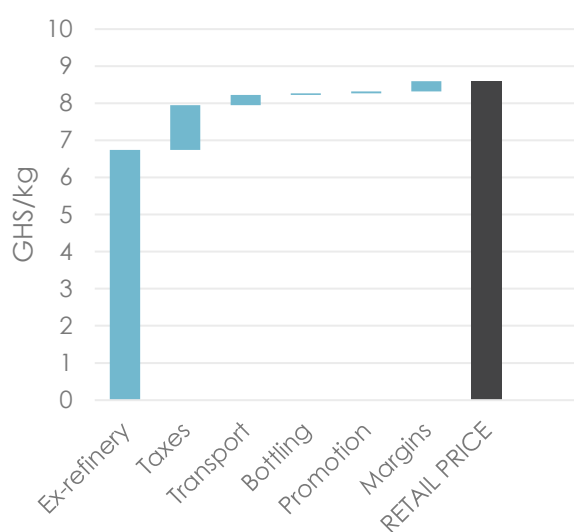
As with all petroleum products, LPG is exempt from VAT in Ghana. However, it is subject to petroleum-specific taxes:

Name	GHS/kg	¢/kg
Energy Debt Recovery Levy	0.41	6.32
Price Stabilisation and Recovery Levy	0.14	2.16
ENERGY SECTOR RECOVERY LEVY	0.18	2.77
Special Petroleum Tax	0.48	7.40

Table 4: Ghana LPG taxes

As of February 2022, taxation accounted for around 20% of the LPG build-up. There have been repeated calls by the LPGMC Association to make LPG a tax-free product.

### Ghana: LPG price buildup 1-15 Feb 2022



Source: NPA

Figure 42: Ghana LPG price build-up 1-15 Feb 2022

#### 2.4.1.4 Effect of FX rates on LPG prices

The exchange rate of the Ghanaian Cedi (GHS) is fully liberalised. Over the past five years it has lost approximately 30% of its value against the US Dollar, falling from 4.5 to 6.4 cedis to the dollar. By March 2022, the Cedi had weakened further, reaching 7 cedis to the dollar.

## 2.4.2 Cylinder prices

As in Nigeria, cylinder prices have risen in local terms over the past year.

CITAC noted the following cylinder prices in the Ayikuma area in February 2022:

Greater Accra cylinder prices (February 2022)		
Product	Price (Cedis)	Price (USD)
6kg cylinder (empty) + grate	180	26
14kg cylinder (empty)	250	36

Source: CITAC

Table 5: Greater Accra cylinder prices (Feb 2022)

### 2.4.3 Price of competing fuels

The price of charcoal varies significantly depending on distance from source of production. A large sack of locally-produced charcoal in Ayikuma (on the border of the Greater Accra and Eastern Regions) was retailing for around 80 cedis (11 USD) in February 2022. Charcoal is generally sold by size, rather than weight and CITAC had no means of weighing the bag. We would estimate its weight at 25kg.



Figure 43: Charcoal production (left) and storage (right) in Ayenyah (source: CITAC)

Charcoal and LPG refill prices in the Ayikuma area in February 2022 are shown in the table below. The Cedi/MJ values are not adjusted for stove efficiency.

Greater Accra domestic fuel prices (February 2022)		
Product	Price (Cedis)	Cedis/100MJ
Per-kg refill	9	18
6kg refill	54	18
14kg refill	126	18
Charcoal (25kg)	8,000	12

Source: CITAC

Table 6: Greater Accra domestic fuel prices (Feb 2022)

### 2.4.4 Stove prices

Stove prices have risen in local terms over the past year. Exact prices vary by location and model but two-burner stoves are generally in the \$40-80 range.

### 2.4.5 Fuel stacking

Fuel stacking is the norm in Ghana. In urban areas, the stack generally comprises LPG plus some charcoal. In peri-urban and rural areas, the stack is dominated by charcoal and firewood. Kerosene is no longer used in most areas.





Figure 44: Kordiabe household using charcoal stove alongside LPG (source: CITAC)

## 2.4.6 Credit offerings and PAYG

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While it is very rare for skid owners to offer credit to clients, more tech-centric credit solutions are emerging. Smartphone penetration is low in rural areas but access to Mobile Money (at a household level) is almost universal, with MTN's MoMo the market leader by far.



Figure 45: Households with access to mobile money in Ayenyah (source: CITAC)

Loan services are available via the platforms of the main Mobile Money providers (MTN, Vodaphone, Tigo). MTN uses the JUMO platform, offering loans provided by ABSA, Ecobank and Letshego. In theory, credit is therefore readily available to households wishing to purchase an LPG starter pack but in reality new customers are only able to borrow small amounts repayable within one month at high interest rates—until creditworthiness has been demonstrated over time.

There are various other tech-focussed money lending solutions on the market. Fido, for instance, offers an Android app-based digital money lending service based on a risk-based algorithm that profiles users based on age, gender, address and messaging traffic among other 'tags'. The profiling does not use financial data. As with loans offered via mobile money providers, loan amounts are small, interest rates high and tenors short.

## 2.5 Regulation

### 2.5.1 Regulatory bodies

#### 2.5.1.1 National Petroleum Authority

Since 2005 regulation of the LPG sector in Ghana has been the responsibility of the National Petroleum Authority (NPA). NPA has the task of implementing the policies devised by the Energy Ministry.

NPA has responsibility for all regulated areas of the LPG sector in Ghana, with the exception of setting specifications of LPG and associated equipment such as cylinders, valves, burners, stoves, gauges etc., which is the responsibility of the Ghana Standards Authority.

Marketers (skid owners) operating in the sector are represented by their lobbying body, the LPG Marketers Association of Ghana.



Figure 46: NPA areas of regulation (source: NPA)

#### 2.5.1.2 Charcoal and firewood regulation

Three bodies have regulatory oversight over the charcoal and firewood industries in Ghana: The Energy Commission, the Environmental Protection Agency and the Forestry Commission.

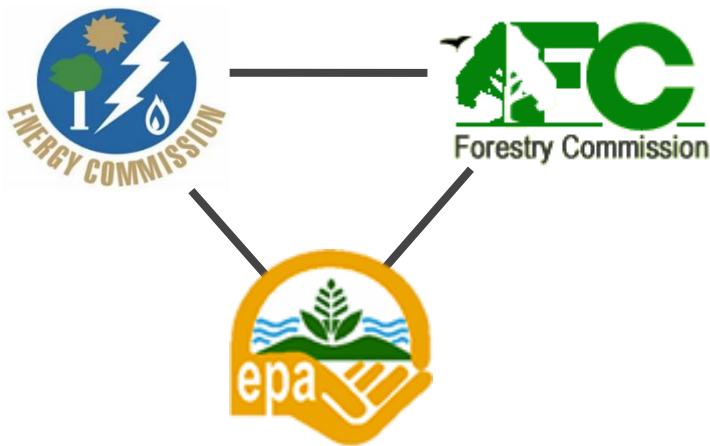


Figure 47: Charcoal regulatory bodies

Licences to product charcoal are issued by the Energy Commission but applicants for a permit must first obtain an Environmental Certificate issued by the EPA and a certification letter from the Forestry Commission indicating that the licensee has the right to use the wood destined for use as fuel.

The Ministry of Energy is also working with the Energy Commission to formulate policies on the promotion of efficient charcoal kilns and establishment of nominated woodlots for growing trees to be felled for use as fuel. The Ministry of Energy and the Energy Commission are also working with the ECOWAS Centre for Renewable Energy and Energy Efficiency on development of National Wood-Energy Regulations, to support the implementation of a sustainable and efficient charcoal production on local and national level.

## 2.6 Barrier analysis and uptake solutions

### 2.6.1 Barrier analysis

The barriers to LPG uptake in Ghana are similar to those at play in Nigeria i.e. heavily focussed on affordability.

CITAC's field work in Ayenyah/Kordiabe is instructive here:

- Despite the presence of two skids, within a short taxi ride of both locations, around 90% of households did not use LPG because they could simply not afford the upfront cost of the cylinder/stove, subsequent refills, or both. This was a recurring theme.
- Firewood was readily available in both locations though charcoal was the preferred fuel for many households, even in the dry season, owing to its superior heat value and convenience. The average daily spend on charcoal was 3-5 Cedis (\$0.43-\$0.71). CITAC witnessed charcoal production taking place on the outskirts of Ayenyah.
- Where respondents did have experience of using LPG, if only occasional, they identified fast cooking/re-heating as a key benefit of the product and one that would always make it the preferred option in specific cooking applications. Several respondents also commented that LPG was cheaper than charcoal on a daily basis.
- If successful, greater LPG penetration in rural and peri-urban areas would therefore increase LPG's presence in the fuel stack, rather than completely replace charcoal and firewood.



Figure 48: Skid near Ayenyah/Kordiabe (source: CITAC)

### 2.6.2 Towards a Ghana Pilot

Designing an uptake pilot in Ghana is complicated, at present, by the transition to the CRM system. If implemented, this will fundamentally change the way the country's LPG sector operates.

CITAC believes the CRM and the existing skids-based distribution system will run in parallel for many years, with new bottling plants (Puma, Goil, NewGas) likely to focus on Accra/Tema and Kumasi. It remains to be seen exactly how the different value chain activities will be organised.

Faced with this hybrid regulatory environment, CITAC proposes two pilot models. The first is targeted at rural environments, using a 'village by village' approach, and assumes supply will come from skids. The second is targeted at peri-urban environments and assumes supply will come from either large bottling plants OR skids OR both.

### 2.6.2.1 Ghana: Pilot 1 Rural PAYG using microstation supply

As noted under 2.6.1 *Barrier analysis* above, the key hurdle to LPG's entry into the fuel stack is affordability: a 6kg plug and play cylinder (including grate) costs around \$26 with subsequent refills currently costing close to \$8. These large one-off costs are beyond the means of most rural households which tend to satisfy their cooking needs on a PAYG basis, purchasing small quantities of charcoal daily.

In theory, the almost universal household penetration of mobile money provides the infrastructure basis for credit to be extended to low-income customers. That infrastructure needs to be adapted, however, if low-income households are to be able to afford the up-front starter pack costs.

At present, mobile money loans are only available to people who have demonstrated extensive use of mobile wallets over time. New customers with the appropriate mobile wallet history are only able to borrow small amounts to begin with e.g. 50 Cedis (\$7). Over time, available loan amounts grow, and interest rates fall, as creditworthiness is built up but even preferential interest remain high (at 8-10% per month) and the majority of loans have to be paid back within one month. These constraints mean that for many low-income consumers, mobile money does not currently offer a rapid or realistic means of acquiring a cylinder.

At the same time, part-filling is not readily accessible to all: in theory, consumers can purchase any amount of LPG they can afford, as all skids offer part-filling. In reality, travel costs to/from the skid mean that many consumers prefer to wait until they have enough cash to purchase a full refill.

CITAC sees a gap in the market for longer-term credit to combine with smart metering solutions such that the cost of both the cylinder (whether acquired outright or via a deposit scheme) and the gas inside it can be spread over a much longer period than one month. The natural cost comparison benchmark is the daily cost of charcoal acquisition, which CITAC has assumed at 4 cedis/day.

For both the cylinder cost AND the gas to be spread, a PAYG solution such as smart metering is required. Each customer will therefore require the following hardware (approximate retail prices in brackets):

- 6kg cylinder - \$25
- Two-burner stove - \$60 (this has to be acquired as plug and play grates cannot be affixed to cylinders with smart meters)
- Smart meter - \$90

Total hardware cost: \$175

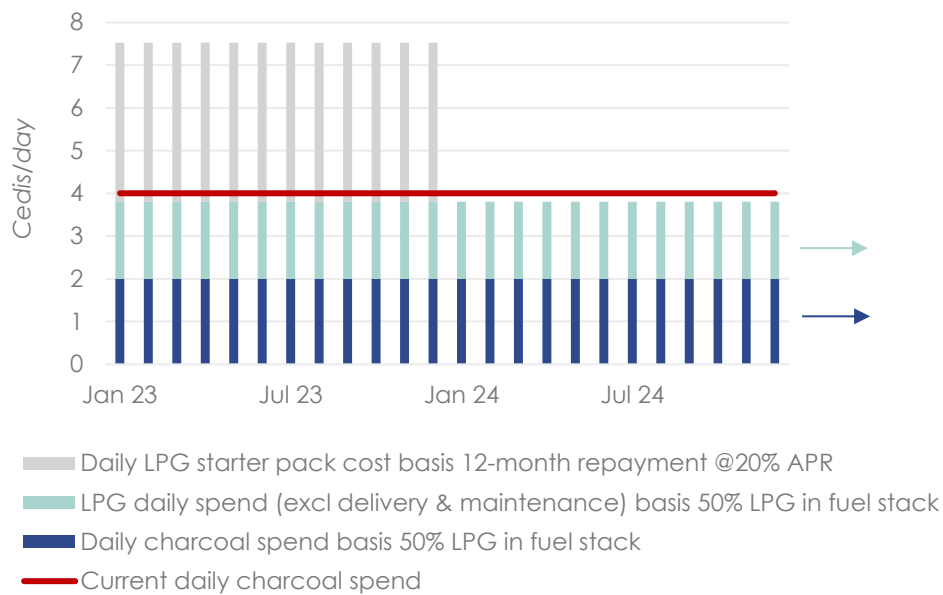
Customers will have a strong preference for the cylinder financing and PAYG purchases to be clearly unbundled as they will invariably seek to benchmark the cost of the gas itself with the price available at the local skid.

The graph below shows the daily cost of administering the PAYG solution. Key assumptions are as follows:

- Total hardware cost is \$175. The customer is assumed to obtain a 12-month loan at 20% APR, making 12 monthly repayments. The daily equivalent repayment cost the consumer is therefore just under 4 cedis/day. To CITAC's knowledge no such loan facility currently exists for the targeted consumer profile.
- The hardware can be acquired by the consumer under a mini deposit scheme or as an outright purchase.
- After acquiring the LPG cylinder and smart meter, the customer replaces 50% of their existing charcoal consumption with LPG.
- Monthly consumption of LPG per household is 1 x 6kg refill.
- The daily cost of LPG, paid for via mobile money top-ups to the Smart meter, is 1.8 Cedis/day (based on February 2022 prices). This figure excludes the operating costs, including delivery and maintenance, of the scheme operator. The scheme operator's unit costs will be very heavily influenced by the size of the ultimate customer base, so they have not been modelled here but they would add several cedis to the daily LPG price.
- Charcoal continues to account for the other 50% of the fuel stack at a cost of 2 Cedis/day.



## Daily fuel spend modelling (Pilot 1)



Source: CITAC

Figure 49: Daily fuel spend modelling (Pilot 1)

This basic modelling shows that, if the refill cost is spread such that it is incurred daily rather than in the form of one-off purchases then the daily fuel cost (50% charcoal, 50% LPG) to the household (excluding scheme administrator opex) is similar to the current 4 cedis/day spent on charcoal. But once hardware amortisation (and scheme operator opex) are added, the daily cost quickly becomes untenable for the target customer base.

For a smart meter solution to be more accessible and scalable, it is clear that additional price support is required. This could take the following form:

- Government or scheme operator to purchase and retain ownership of smart meter and two-burner stove, making them available to customer free of charge. This would reduce hardware costs to the consumer by 85%.
- Government or scheme to finance 'free' smart meters and stove via the generation and sale of carbon credits.

CITAC notes that this first Pilot will be difficult to implement if residential ex skids filling is banned across the country. This is because refilling cylinders with smart meters requires agents to physically enter people's homes and unlock the meter, making the system human resource intensive and better suited to small batch filling from skids.

### 2.6.2.2 Pilot 2: 3kg format targeting peri-urban areas

The second proposed pilot has a different focus, targeting households with more predictable/formal income in peri-urban areas. The second pilot is centered on making 3kg cylinders and refills available to consumers on an in-community basis. The rationale behind this pilot is as follows:

- The 5kg cylinder is currently the smallest format on the Ghana market, though the 6kg format is far more common.
- From an affordability perspective, this creates cylinder acquisition and refill challenges.
- The introduction of a 3kg format can be administered either via the current skids system OR the CRM OR both, depending on location, giving it significant regulatory resilience.

Key characteristics of Pilot 2 are as follows:

- LPGMCs to work with microfinance banks or mobile money platforms to offer in-community sales kiosks for 3kg cylinders. The cylinder can be made available as an outright sale or under a deposit scheme arrangement. Either

way, the credit needs to be more accessible, in terms of tenor and interest rates, than the current mobile money loan offerings.

- Scenario 1: If the customer acquires the cylinder outright (something that would not be possible if the CRM is universally enforced), he/she can decide to refill by either travelling to the skid or by taking a delivery option from the skid operator.
- Scenario 2: If the customer acquires the cylinder under a deposit arrangement (whether with a CRM operator or a skid owner), he/she will exchange the empty cylinder for a full one at an in-community exchange point. The empty cylinders will be refilled either at the local skid (if this model is allowed to continue) or at a centralised CRM bottling plant.
- As the cost of centralised bottling and cylinder exchange points is generally higher than skid-filling, particularly for small 3kg cylinders, it is important that skid filling and the CRM do not co-exist in the same location, as customers will always be drawn to the cheaper prices offered by the skid.

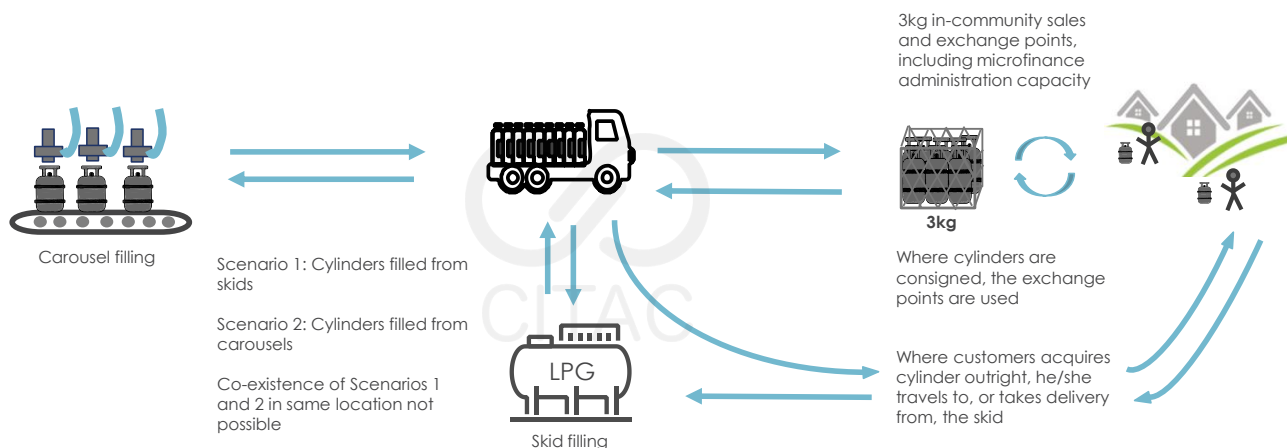


Figure 50: Pilot 2 summary schematic (source: CITAC)

### 2.6.2.3 Advocacy

The development of these pilots would be supported by the removal of all taxes on LPG: such a move would likely have the unintended consequence of boosting demand for Autogas (thereby reducing tax receipts on gasoline sales). This gradual move from gasoline to LPG can nevertheless be considered a de facto first step on Ghana's path to decarbonising road transport.

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