GLPGP – Kenya Market Assessment

Final Report

Updated August 28, 2013

Dalberg

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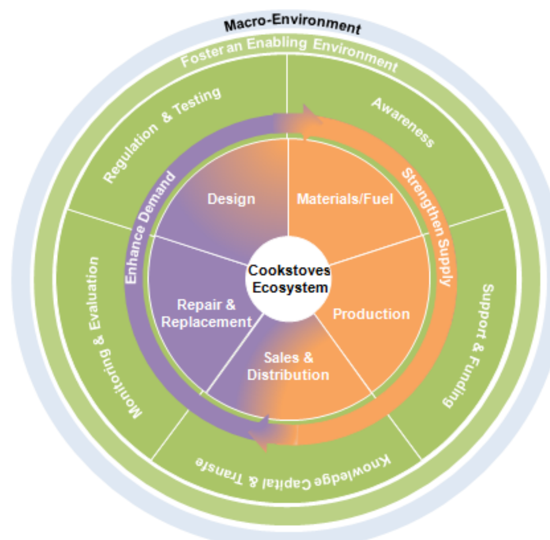
GACC is addressing issues that will enable 100 million homes to adopt clean and efficient stoves and fuels by 2020

- The Global Alliance for Clean Cookstoves (GACC) has been advancing clean cooking to **save lives, improve livelihoods, empower women, and protect the environment** by creating a thriving global market for clean and efficient household cooking solutions
- GACC plans to mobilize private and public sector to achieve its goal of fostering adoption of clean cookstoves and fuels in **100M households by 2020**
- The Alliance has developed a holistic framework for evaluating and addressing challenges in the uptake of clean cookstoves by addressing demand and supply side constraints and supporting an enabling environment for clean cooking
- A strong fact base is important for GACC in helping it identify opportunities and constraints in the uptake of clean fuels including LPG
- The Alliance seeks to better understand the role that LPG could play in the fuel mix for a clean cooking solution and provide critical data for building a broader policy and investment infrastructure under which LPG might grow as a major source of fuel for households in Africa and throughout the developing world
- This current assessment in Kenya will provide the Alliance with a perspective on the role that LPG can play in meeting the Alliance's goal of 100 million households adopting clean cookstoves and fuels by the year 2020



SOURCE: http://www.cleancookstoves.org/

* Countries that GLPGP will focus on in SSA are Cameroon, Ghana, Kenya, Tanzania, and Uganda

GLPGP aims to address key issues constraining LPG use in order to save lives, improve livelihoods and protect the environment

- The Global LPG Partnership (GLPGP) complements the work that is being done by GACC. With its initial focus on five countries* in SSA – GLPGP aims to transition **50-70M people to LPG for cooking, create 150,000+ new jobs, and offset more than 18M MT of wood used for cooking per year**
- In order to reach its objectives, GLPGP seeks to mobilize financial investments and policy reforms to support (i) Consumer finance and education, (ii) Supportive policy, regulatory and safety environment and (iii) LPG infrastructure and distribution development to meet consumer demand
- This report addresses the opportunity for LPG to be scaled up as a clean cooking fuel in Kenya – the first of the five SSA countries being analyzed. The two main areas of analysis include:
    - Demand Assessment: Understand baseline LPG demand, demand drivers, market segmentation for LPG and forecast future demand accounting for different scenarios
    - LPG Market Structure Assessment: Understand LPG value chain – players, types of investments etc., and prioritize key gaps to be addressed in the value chain including policy issues
- The goals of this market assessment are to:
    1. To estimate the total market potential for LPG usage for cooking by households in Kenya
    2. To develop a rich fact base around the opportunities and challenges related to accelerating the use of LPG for cooking in Kenya
    3. Provide an early assessment of the potential for investments or other interventions across the LPG value chain in Kenya to increase access to LPG cooking fuels and stoves
- This work complements the work of the GACC in Kenya and around the world

SOURCE: http://www.cleancookstoves.org/

* Countries that GLPGP will focus on in SSA are Cameroon, Ghana, Kenya, Tanzania, and Uganda

LPG is as a healthier modern alternative fuel for some of the 92% of Kenyans using harmful solid fuels and kerosene as the primary fuel for cooking

- 87% of Kenyans use solid fuels as their primary fuel source for cooking while 5% use kerosene as a primary fuel. The heavy reliance on inefficient traditional biomass sources exacerbates forest degradation and climate change, and has detrimental impacts on health and poverty in Kenya.
    - Over 15,000 Kenyans die annually due to exposure to household air pollution from burning solid fuels
    - >40% of childhood deaths are related to respiratory illness due to exposure to kerosene, wood and charcoal smoke
    - Average Kenyan household of 4 family members emits 1.2 tons of CO_2 per year
    - Kenya has experienced regional deforestation and degradation, with an overall 5% decline in its forest area since 1990
- There are a number of ways to reduce some or all of these negative impacts, including using improved biomass cookstoves and switching to modern fuels such as LPG. Different solutions will be appropriate for different user segments.
    - Less than 5% of Kenyans use LPG as their primary cooking fuel, with 5% is using kerosene and less than 1% using improved biomass cookstoves
- LPG represents a cleaner alternative to solid fuels and kerosene in the short-term, and a promising transition fuel for countries transitioning to more modern cooking technologies in the long-term[1].
- LPG is particularly attractive for urban and peri-urban households given the lower availability of firewood, the purchase of cooking fuels with cash, and the ease and efficiency of LPG distribution and retail due to the greater population density.
- While kerosene is considered a modern fuel used primarily in urban areas, recent evidence highlighting its carcinogenic characteristics make it less attractive. The new campaign in the country for a “Kerosene free Kenya” should speed up the momentum to move away from kerosene.
- Opportunities in the short-term to increase LPG use in rural areas are more limited. 87% of rural households use firewood as a primary fuel, and 75% of households using firewood in Kenya are collectors, acquiring the fuel at no direct cost.

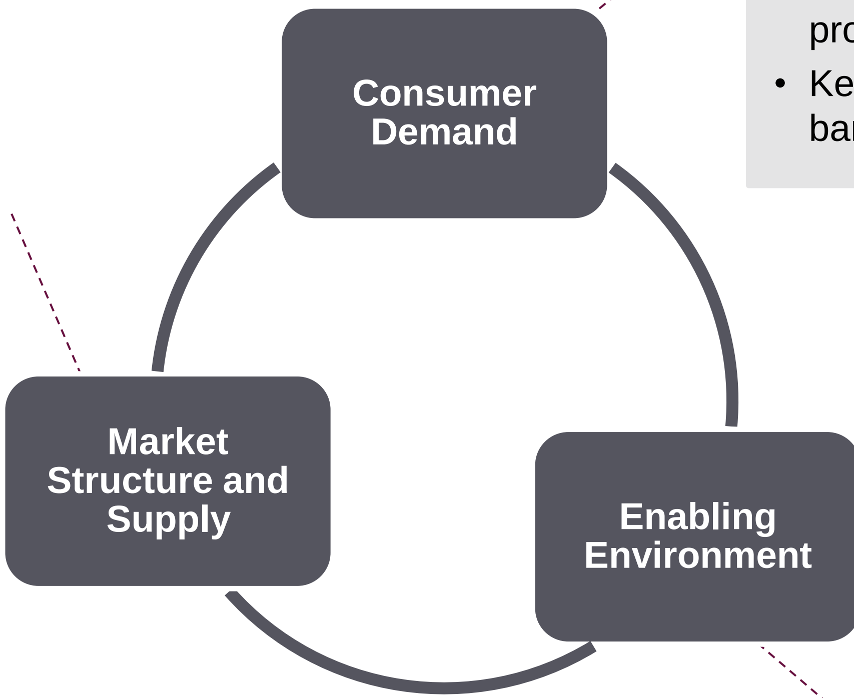
1) We characterize LPG as a short-term transition fuel because it is a proven technology that is commercially available now. Ultimately we expect that renewable energy and/or electricity will be the primary fuel available for most households

SOURCE: Global Alliance for Clean Cookstoves Country reports; WHO data; Company reports; Dalberg analysis

This assessment of Kenya's LPG market evaluates Market Structure and Supply, Consumer Demand, and the Enabling Environment

Market Structure and Supply

- Value chain overview – key players, distribution of value
- Industry coalescence/ existing momentum
- Key needs/gaps along supply chain (upstream and downstream) to ensure consistency of availability



Consumer Demand

- Current overview and projections of potential
- Key drivers of demand and barriers to adoption

Enabling Environment

- Regulation and policy
- Political risks
- Sector support (donor and NGO actors providing additional funding, consumer education, advocacy)

SOURCE: Dalberg analysis

Key stakeholders across the value chain were interviewed as part of the study to inform analysis of supply, demand, and regulatory constraints (1/2)

Name	Organization	Category	Role in Value Chain
Patrick Nyoike	Ministry of Energy and Petroleum	Government	Regulation
Joseph Wafula		Government	Regulation
Faith Odongo		Government	Regulation
Jane Njoroge	National Oil Corporation of Kenya	Government	Filling, Wholesale, Retail, Distribution
Sumayya Hassan-Athmani		Government	Filling, Wholesale, Retail, Distribution
Ken Mugambi		Government	Filling, Wholesale, Retail, Distribution
Kamau Mugenda		Government	Filling, Wholesale, Retail, Distribution
Eng.Linus Muthui Gitonga	Energy Regulatory Commission Kenya	Government	Regulation
Elizabeth J. Akinyi	Kenya Pipeline Company Ltd	Government	Bulk Transport
Eng. Elias Karumi		Government	Bulk Transport
Selest N. Kilinda		Government	Bulk Transport
Tom K. Mailu		Government	Bulk Transport

Key stakeholders across the value chain were interviewed as part of the study to inform analysis of supply, demand, and regulatory constraints (2/2)

Name	Organization	Category	Role in Value Chain
Joster Imbuchi	Kenya Railways	Government	Bulk Transport
Nduva Muli		Government	Bulk Transport
Wanjiku Manyara	Petroleum Institute of East Africa (PIEA)	Private Sector	Industry; Regulatory Environment
Alexis Vovk	Total Kenya	Private Sector	Storage, Filling, Wholesale, Retail, Distribution
Elizabeth Muchiri	Prestige Gas Solutions	Private Sector	Retail
David Ohana	KenolKobil	Private Sector	Filling, Wholesale, Retail, Distribution
Alex Evans	GLPGP	Public-Private Partnership	Capacity Building
Renzo Bee	GLPGP	Public-Private Partnership	Capacity Building

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While only 5-7% of the population currently uses LPG as a primary fuel, consumption has been growing strongly and we see future growth potential

- The current market for LPG in Kenya is underdeveloped, with 5-7% of households relying on LPG as a primary cooking fuel
  - LPG penetration is much higher in urban areas at 21%; Only 1% of rural households use LPG as a primary fuel
  - As it is common for some households to use multiple fuels ("fuel stacking"), total LPG penetration may be closer to 7%-10% nationally
  - The greater Nairobi region accounts for 60% of the market, where penetration rates for LPG are estimated to be as high as 40%. Mombasa makes up 15% of the market, with the remaining market scattered throughout other growing urban centers, especially in Western Kenya

- Key barriers to LPG adoption include cost – both initial cost of equipment and the cost of the fuel—and accessibility
  - The price of LPG in Kenya is among the highest in the world. The availability of very low cost charcoal in Kenya further limits the adoption of LPG. Experimental business models in Kenya to reduce the cost for poor consumers are in early stages
  - Limited storage, distribution and retail capacity across the country limit access outside the core markets of Nairobi and Mombasa. Due to historically weaknesses in supply and importing capability, shortages have been common in recent years. Access in rural areas is extremely low

- Despite challenging local conditions, the LPG market in Kenya has grown significantly in recent years, and we expect this growth to continue through 2020
  - The existence of relatively large consumer segments who currently pay for other fuels (including wood, charcoal and kerosene) provides a potential market for LPG of 14.5 million Kenyans, though high LPG prices compared to other fuels are a key barrier making LPG not immediately affordable for all households in this segment
  - Dalberg estimates that absent any significant incremental investments in the market, penetration rates for LPG will reach 8%-12% by 2020.[1] With aggressive investments and interventions across the value chain to improve access and lower prices, Dalberg estimates that penetration can reach up to 18% nationally by 2020.[2] Achieving this potential will require LPG prices to decline significantly, reflecting similar cost structures in more developed markets, in order to be compete with current low-cost domestic charcoal prices, which are expected to rise at 16% annually

- Awareness of LPG as an alternative fuel is high among Kenyan consumers, and it is seen as an aspirational fuel. Although safety concerns do exist, surveys suggest that safety concerns are not a key barrier to adoption
  - Mistrust in the market due to perceptions/realities related to partial filling, contamination of fuel, and other deceptive practices by grey/black market players are seen as greatly limiting the sustained growth of the market

[1,2] Details on projections are provided in the slides to follow

SOURCE: Dalberg research and analysis

Key value chain constraints must be removed to enable lower LPG prices for consumers and to promote private investment to grow the market

- Relatively high LPG prices in Kenya reflect an under-developed market that constrains investment across the value chain and keeps retail prices high for end users
  - Unusually high margins for importers, marketers and distributors drive up to 90% of the final retail cost for consumers
  - Key steps are being made to address upstream constraints through large investment in increased storage capacity in Mombasa through off-shore floating ship storage; However, costs remain very high due to benchmarking to previous cost levels as opposed to aligning to international or regional pricing benchmarks
  - Limited government regulatory enforcement capacity enables gray/black market for illegal cross-filling and cylinder theft to thrive, discouraging investment by the private sector to grow the market

- Although some investments are underway to strengthen the market, key constraints remain across four dimensions:
  1. Low consumer affordability due to high initial costs for cylinders and high LPG fuel costs relative to charcoal and wood
  2. Supply constraints resulting from limited bulk storage and filling capacity for large demand centers
  3. High upstream costs related to importing and port storage
  4. Low enforcement capacity for existing regulations to protect investments

- Addressing these remaining constraints effectively through appropriate interventions and investments can unlock significant potential in Kenya to help accelerate growth of the domestic LPG market

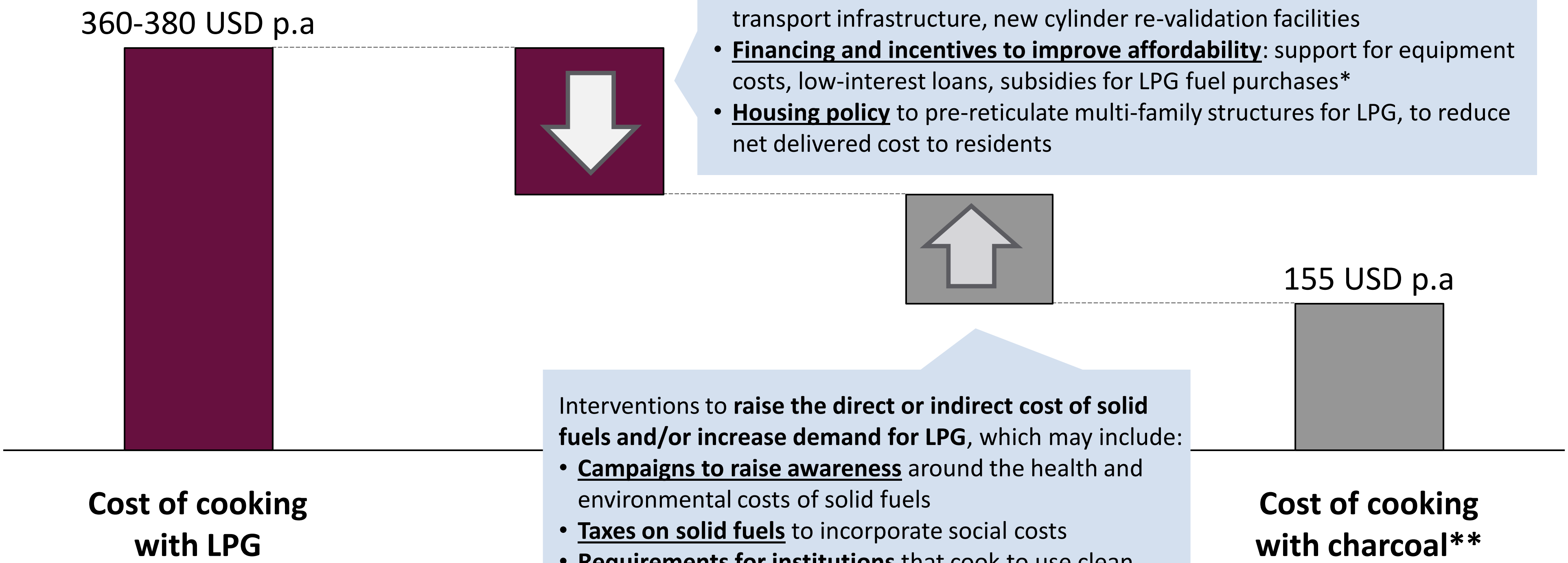
- Interventions will need to align local (currently higher) LPG costs with costs of alternative domestic fuel sources such as charcoal, and ideally also wood, which currently cost significantly less than LPG on an annual basis
  - E.g., current annual costs for HHs cooking with LPG is 2.3x of HHs using charcoal

SOURCE: Dalberg research and analysis

Interventions and investments to make LPG more cost-competitive with harmful traditional fuels are needed to accelerate adoption of LPG in Kenya

Interventions are illustrative and represent a range of potential investments and policy reforms

- Annual fuel **costs for LPG in Kenya are 2-3 times higher** than equivalent annual fuel costs for purchased charcoal or kerosene
- Large scale adoption of LPG will be limited until the gap in relative prices is reduced



Interventions are needed to **reduce the retail price of LPG**, and may include:
- **Policy and regulatory capacity** to enforce property rights (e.g., over cylinders) and/or stabilize import prices to align with cost benchmarks
- **Investments across the LPG value chain to improve its efficiency**: expanded import capacity, new bulk storage and filling plants, improved transport infrastructure, new cylinder re-validation facilities
- **Financing and incentives to improve affordability**: support for equipment costs, low-interest loans, subsidies for LPG fuel purchases*
- **Housing policy** to pre-reticulate multi-family structures for LPG, to reduce net delivered cost to residents

Interventions to **raise the direct or indirect cost of solid fuels and/or increase demand for LPG**, which may include:
- **Campaigns to raise awareness** around the health and environmental costs of solid fuels
- **Taxes on solid fuels** to incorporate social costs
- **Requirements for institutions** that cook to use clean fuels such as LPG over solid fuels and kerosene

* Fuel subsidies are generally not recommended by the Global LPG Partnership or most stakeholders in Kenya. ** Average cost of cooking with kerosene was 200 USD p.a for 2013. SOURCE: Dalberg research and analysis; Timetric price data.

Implications for action: Potential next steps by key stakeholder groups

	Possible next steps/considerations
Private sector/ Energy Industry players	• Share any pre-prepared feasibility studies or business plans for potential/proposed interventions • Engage with partners to explore possible co-investment opportunities • Continue to provide local-level guidance and input into development of country-level strategies and investment plans
Donors/Funders	• Support further investigation and validation of intervention options, to identify appropriate mechanisms and prioritise against country needs preferences • Develop funding mechanism or pool funding where instrument exists to support infrastructure investments and support to financial services providers
Sector support coalitions / Others	• Identify core areas of focus/priority areas to ensure maximisation of support resources rather than duplication • Engage particularly on consumer education and finance side as private sector/donors likely better places to support infrastructure investment and development

Summary of Key Findings (1/2)

• Kenya's population today is	2.4 M urban HH	7.5 M rural HH
• Kenya's population in 2020 will be	4.0 M urban HH	8.4 M rural HH
• LPG is used today by	0.6 M urban HH (25% of HHs)	0.1 M rural HH (1% of HH)
at an average price of	$2.50 / kg (significantly higher than regional averages)	

- The average cash outlay for equipment and fuel needed to become an LPG user is $50-$90 depending on cylinder size and stove quality
- LPG end-user cost can be reduced by at least 20% in Kenya to $2/kg
  - Through realization of economies of scale, optimization and increased efficiency in the supply chain, other effects of coordinated investment and intervention along the value chain, and effective regulatory reform and enforcement to remedy a number of serious but solvable market dysfunctions

- <u>Base Case Projection:</u> Based on the existing growth trajectories in Kenya, LPG adoption by 2020:
  - 1.3 million HH (11% of projected households)
  - Total market size of 160 tonnes/year

- <u>Target Intervention Case:</u> If envisioned investments are realized 2014-2016, LPG adoption by 2020
  - 2.3 million HH (18% of projected households)
  - Total market size of 260-330 tonnes/year

Potential role for consumer finance in Kenya:

- The initial out-of-pocket cost for LPG equipment (primarily the cylinder deposit and related stove equipment purchase) reduces the affordability of switching to LPG for a portion of Kenyan households
- It is expected that a comprehensive consumer LPG switching programme that includes financing for initial equipment costs, education, awareness-raising, and catalysts for behavior change will increase adoption of LPG, especially if coordinated with investments that strengthen and improve the efficiency of the LPG supply chain in Kenya
- As a follow-on step, the incremental impact of such a consumer programme on LPG adoption and penetration in Kenya must be assessed and quantified, as it was beyond the scope of this current study

Summary of Key Findings (2/2)

- The estimated investment needed to achieve the Target Intervention Case would be approximately

• Import terminal capability and storage	US $14M
• Expansion of bulk tanks	US $1M
• Additional bulk depots and filling plant capacity	US $42M
(The above three sets of assets should be structured on a public utility model so that economies of scale will directly benefit end-consumers)	
• Tankers for primary transport	US $10 M
• Trucks for cylinder transport	US $ 18M
• Approximately 3M additional cylinders	US $65M
• Consumer finance (revolving)	up to US $25M
(funded from a combination of local and foreign sources)	
• Total	up to US $175M

• On a 2020 per-household basis, the investment is	US $14
• Estimated lives saved annually from reduced exposure to IAP would be[1]	1,400
• Estimated forest area saved annually would be[2]	20,400 hectares
• Estimated reduction in carbon emissions annually would be[3]	1.04 million tons

1) Current deaths from IAP in Kenya reflect 0.16% of the population. Interventions expected to reduce households exposed by nearly 1M, resulting in ~1,400 lives saved. 2) Estimates from GLPGP model, assumes one-half of converted HH were previously using advanced charcoal cookstoves, with the other one-half using charcoal with traditional stoves. 3) Typical HH in Kenya releases 1.2 tons of carbon per year due to cooking fuel

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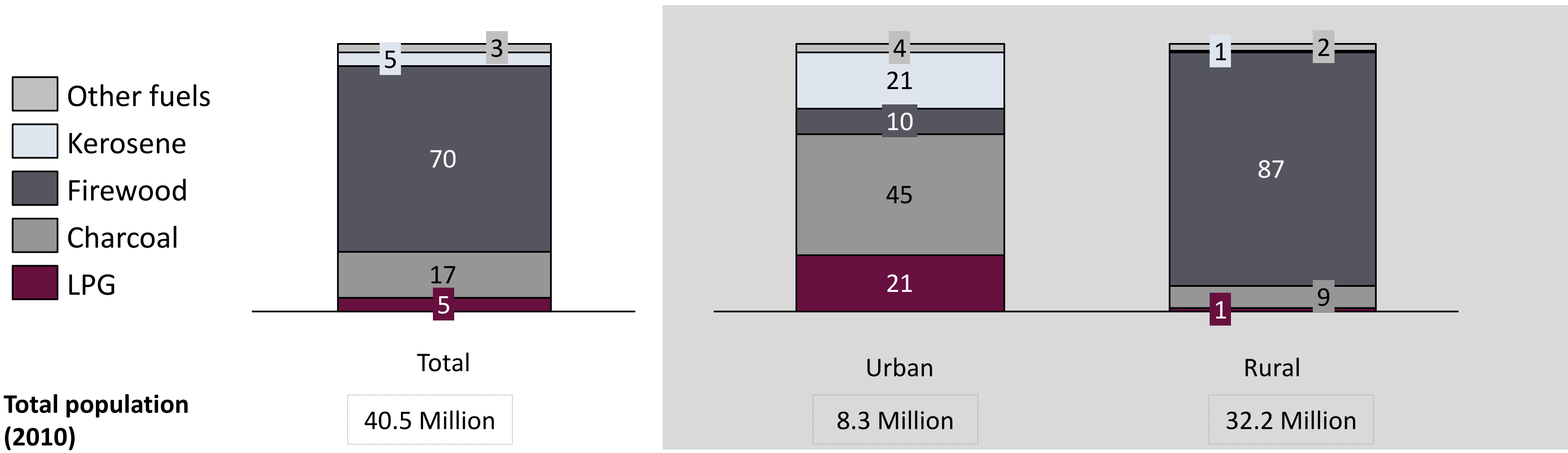
Kenya's fuel mix shows low penetration of LPG nationally (~5% of population using as primary fuel) but much higher in urban areas (~21%)

Kenya fuel mix - % population using primary fuel
National, Urban, Rural

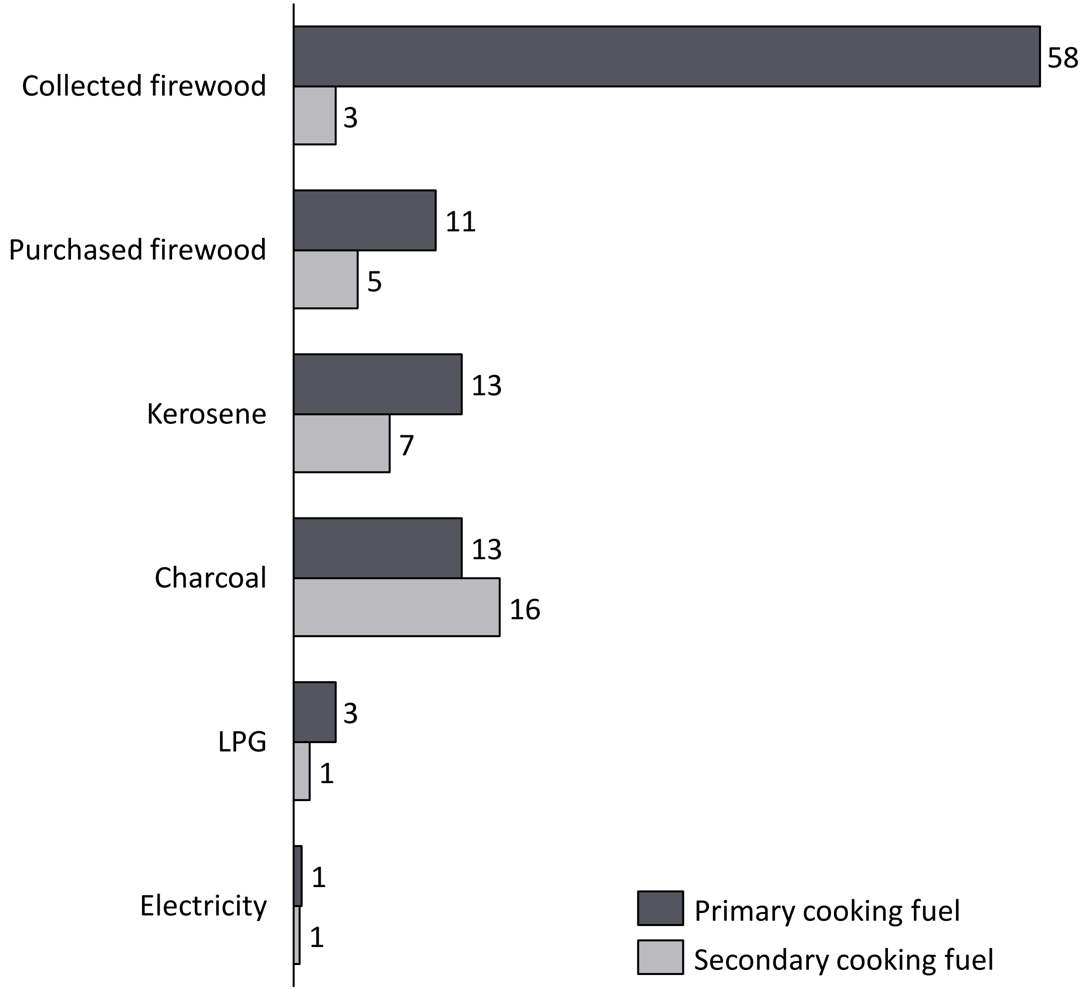


- Relatively low LPG adoption nationally due to low rural penetration – high level of use in urban areas (21% of population using as primary fuel
    - This likely underestimates use in Nairobi as the capital city, with primary use being potentially ~50% higher at ~30% primary use
- Fuelwood still dominant national fuel, though low levels of use in urban areas – partly due to relatively low charcoal prices and lack of geographic proximity to wood source
    - Most fuelwood used in rural areas is collected; ~75% of HH collect rather than buy
- Low use of "other fuels"; electricity use still low and restricted to highest income brackets

SOURCE: Fuel use databases collected by DHS, WB, etc. and maintained by WHO; Data reflects 2009 estimates, though likely to remain stable through 2011/2012. Dalberg analysis

Despite a gradual trend towards cleaner modern fuels as incomes rise, high rates of fuel stacking occur in Kenya – an estimated ~54% use multiple fuels*

Household use of cooking fuel, primary and secondary
(% of HH)



- In practice, many households use multiple fuel sources; they do not simply substitute fuels as income rises but "stack" fuels – using modern fuels sparingly at first in a supplementary manner
  - This behavior tends to reduce the impact of fuel price volatility and fuel shortages
- **In Kenya, surveys suggest that 54% of HH use multiple fuels**
- For example: Data show that use of LPG as a secondary fuel in 2005/2006 was 30% of LPG primary use, adding an additional 1% of HH using any LPG
- Similarly, use of charcoal as a secondary fuel is actually higher than that as a primary fuel, illustrating high use of charcoal as a supplement

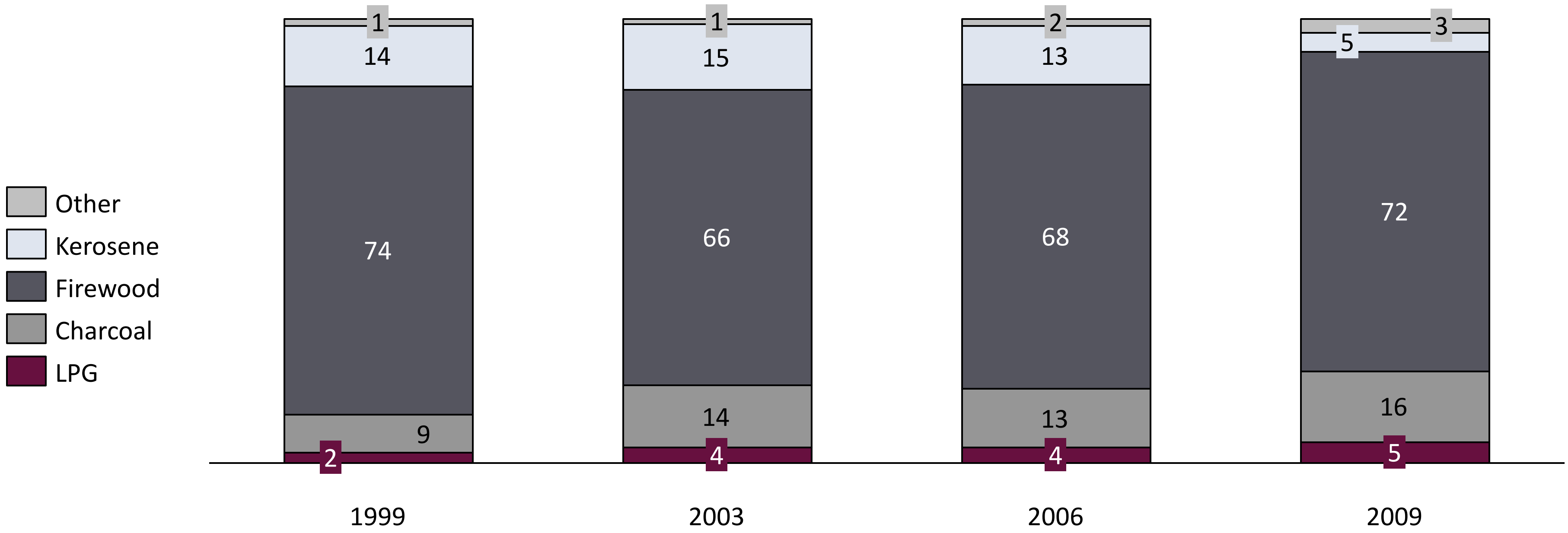
**NB: Rate of fuel stacking to be confirmed*

Note: Fuel stacking tends to decline in countries as domestic fuel markets evolve and the availability and affordability of modern fuels increases

SOURCE: WB Who Uses Bottled Gas? Evidence from Households in Developing Countries, 2011; KIPPRA survey 2010; WB and DHS data; Dalberg analysis

This fuel mix has changed overtime, with charcoal remaining dominant, but significant decline in kerosene use and increase in charcoal and LPG

Primary fuel source for Kenyan households
(% of population)

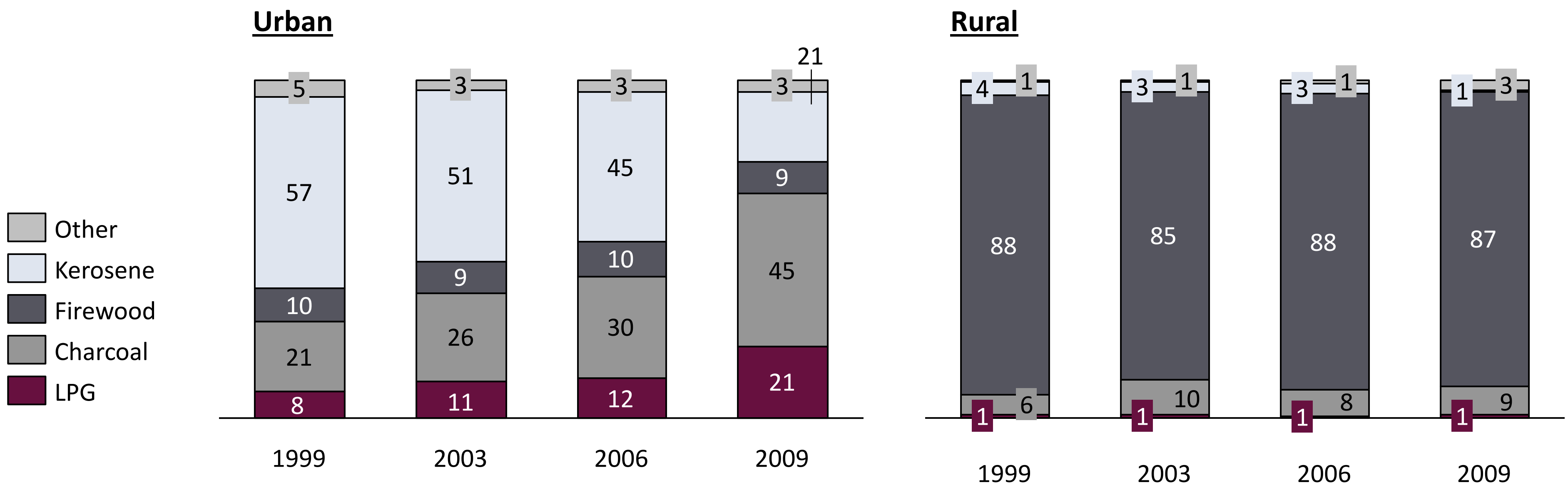


- Firewood remains the dominant fuel used in Kenya, remaining between 65%-75% of primary fuel used by households between 1999-2009
- LPG use nationally has grown significantly – 150% increase in 10 years between 1999 – 2009, with a rapid increase of ~25% between 2006-2009.
- This recent increase in LPG use appears to be driven primarily by a switch away from kerosene
  - Kerosene use declined from 57% in 1999 to 21% in 2009

SOURCE: Primarily from Kenya National Bureau of Statistics Household Surveys and WHO World Health Surveys (WHS); Timetric price data

This trend has primarily been driven by urban populations; rural populations continue to rely on firewood although with some increase in charcoal use

Primary fuel source for Kenyan households
(% of urban and rural populations)

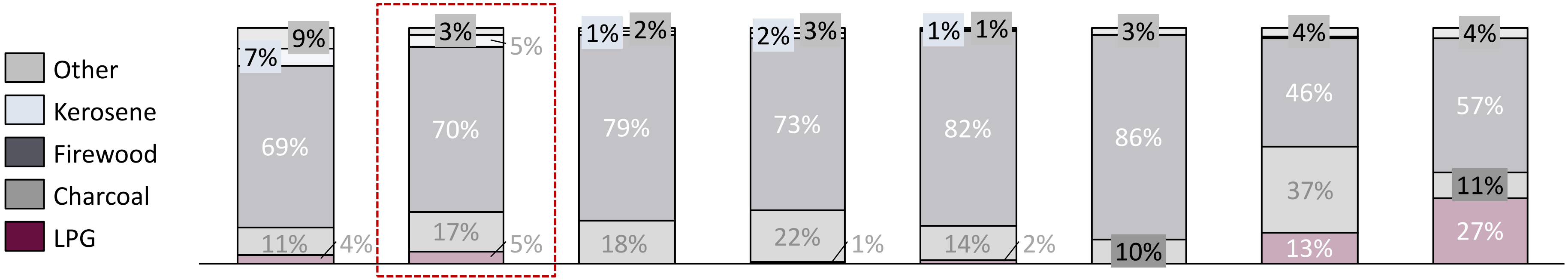


- LPG use has close to tripled in urban areas from 1999 to 2009
- Charcoal has become increasingly used in urban areas - more than doubling from 21% use in 1999 to 45% in 2009. Increase has been driven by its low relative costs
- In rural areas, firewood constitutes main fuel used and has remained consistently so over time with ~75% of rural households exclusively gathering it rather than buying it
- LPG use in rural areas has been consistently low, at under 1%, because of inadequate LPG distribution and retail networks in rural areas and the high availability of cheap firewood

SOURCE: Primarily from Kenya National Bureau of Statistics Household Surveys and WHO World Health Surveys (WHS)

If compared to the rest of SSA, Kenya shows higher LPG use than the average, but lower than countries in which government intervention has been strong

Percentage of population using different fuel sources for cooking
(%, Kenya vs. region and regional benchmarks)



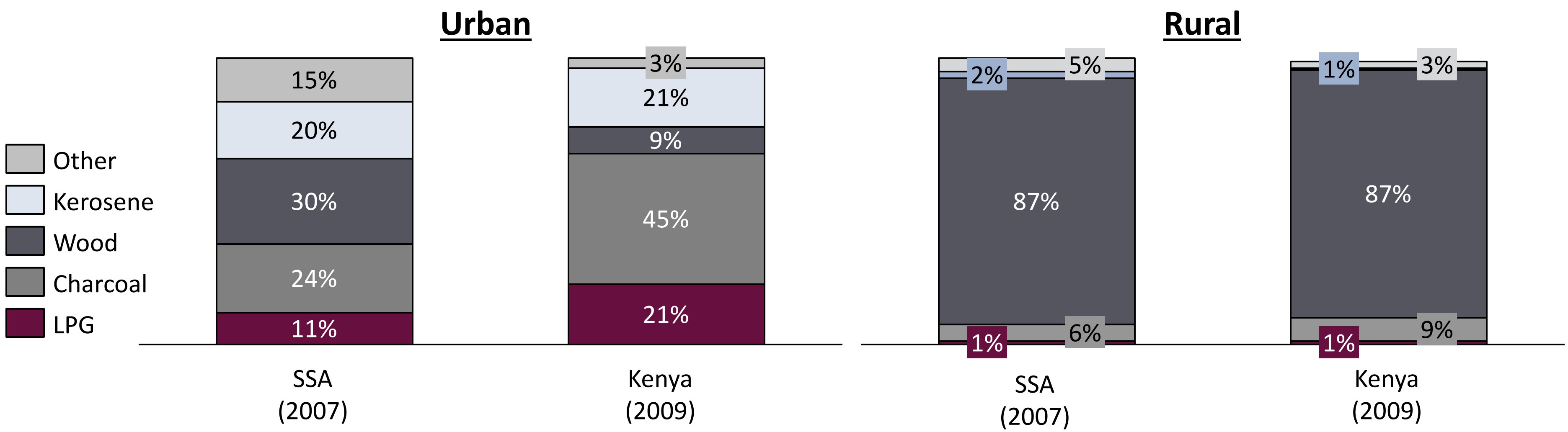
	SSA	**Kenya**	Tanzania	Uganda	Mozambique	Malawi	Ghana	Senegal
Data year for fuel data	(2010)	**(2009)**	(2010)	(2010)	(2009)	(2010)	(2008)	(2011)
GDP per capita	$2,061	**$1,510**	$1,336	$1,188	$861	$789	$1,652	$1,737
Urban population	37%	**24%**	27%	16%	31%	16%	52%	43%
Urbanization rate	37%	**4.36%**	4.77%	5.74%	3.05%	4.2%	3.5%	3.32%

- **Kenya LPG penetration slightly higher than SSA average (5% vs. 4%)**
- Senegal shows higher LPG penetration due to its longstanding efforts to create and sustain an effective and modern policy, regulatory, and safety environment for LPG, and also in part due to an LPG subsidy from the 1970s-1990s. Ghana also subsidized LPG until 2013. Both countries have a higher percentage of urban populations, which increases ease of LPG distribution and speeds up penetration
- Greater share of woodfuel use in Tanzania than Kenya given abundance of wood resource – Kenya's forest resources somewhat degraded and regulation increasing in effort to increase charcoal sustainability
- "Other fuels" include electricity (very small share across the region) – users of which could be targeted for LPG use, as well as crop and animal waste and other biomass typically used by lower income populations

SOURCE: WB and DHS data; Dalberg analysis. GDP and urbanization data from WDI database. Urbanization rate from CIA World Factbook, for 2010-2015. GDP per capita data from 2011 at PPP (constant 2005 international $) while urbanization data is from 2011

When comparing urban and rural separately, primary LPG use in urban Kenya is nearly double SSA average at 21%; Nairobi alone is estimated at ~40%

Percentage of population using different fuel sources for cooking
(%, Kenya and SSA urban vs. rural)



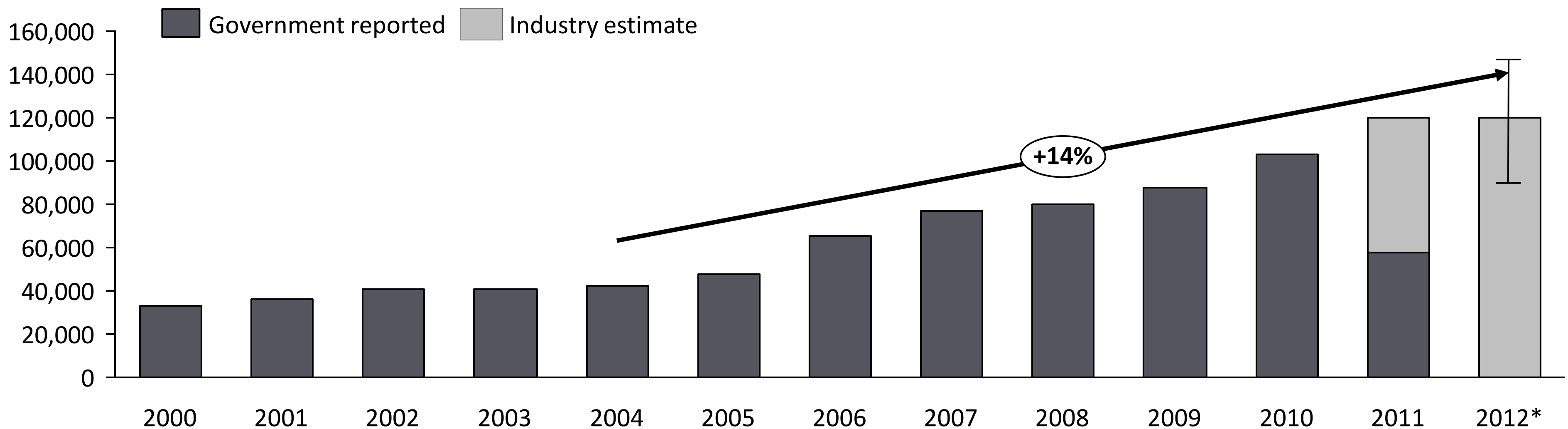
- **Urban LPG use as a primary fuel in Kenya already at 21% compared to SSA average of 11%**
  - 60% of LPG market estimated to be in Nairobi and surrounding areas (with 15% in Mombasa and the remaining 25% in other growing urban centres, especially in Western Kenya – Kisumu, Kisii, etc.)
  - Primary use of LPG estimated to be double in Nairobi compared to other urban centers (i.e. close to 40% based on interviews with local LPG industry players)
- However, urban charcoal consumption in Kenya is much higher than the SSA average (45% vs. 24%) and fuelwood is correspondingly lower (9% vs. 30%)
  - This is likely due to the low cost of charcoal in Kenya relative to other countries, due to well-established formal and informal supply chains, as well as the relative lack of geographic proximity to fuelwood sources
- Rural LPG use very low across the continent – likely due to lower average incomes and limited rural LPG distribution and retail networks

Source: Dalberg research and analysis

LPG consumption in Kenya has increased dramatically since 2005; data indicate a decline in recent years, although industry interviews dispute it

Total volume of LPG consumed, Kenya

MT, *[note total consumption volume, not just household]*

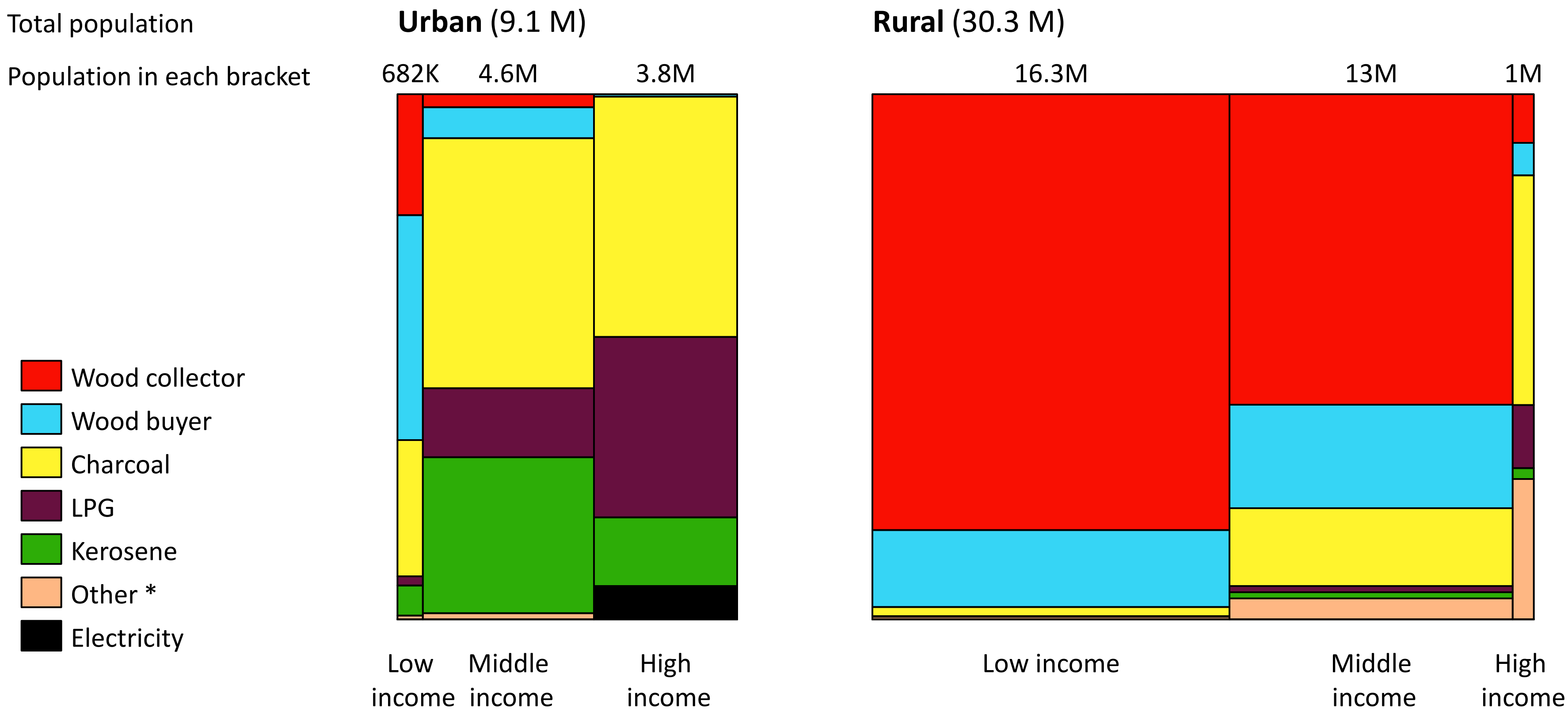


- According to official government data, at peak consumption, Kenya was using almost 90K MT (2009-10)
- **Import data suggest consumption has since dropped to ~65KMT, though this is doubted by industry players and experts, who suggest growth has continued its upward trend**
- Although there was a supply shortage in 2011 and related price spike, industry suggests the decline reported is due to poor data collection:
  - Statistics regulations do not specify/clarify reporting requirements for LPG, so while some LPG fuel volumes are reported (imports by sea and most white-market sales), not all LPG is tracked
  - Additional imports enter Kenya overland from Zambia/Tanzania, which may not be counted
- Industry estimates place the current market at 90 -150K MT p.a, and likely around 120MT

SOURCE: 2011 LPG Association report; Press releases; Company and industry reports; :Stakeholder interviews ; Dalberg analysis

77% of the population is rural and 43% low income. Wood, mostly gathered, dominates their fuel use. Only 55% of Kenyans now pay for fuel of any kind

Fuel market segmentation for Kenya
(% of people by income bracket)



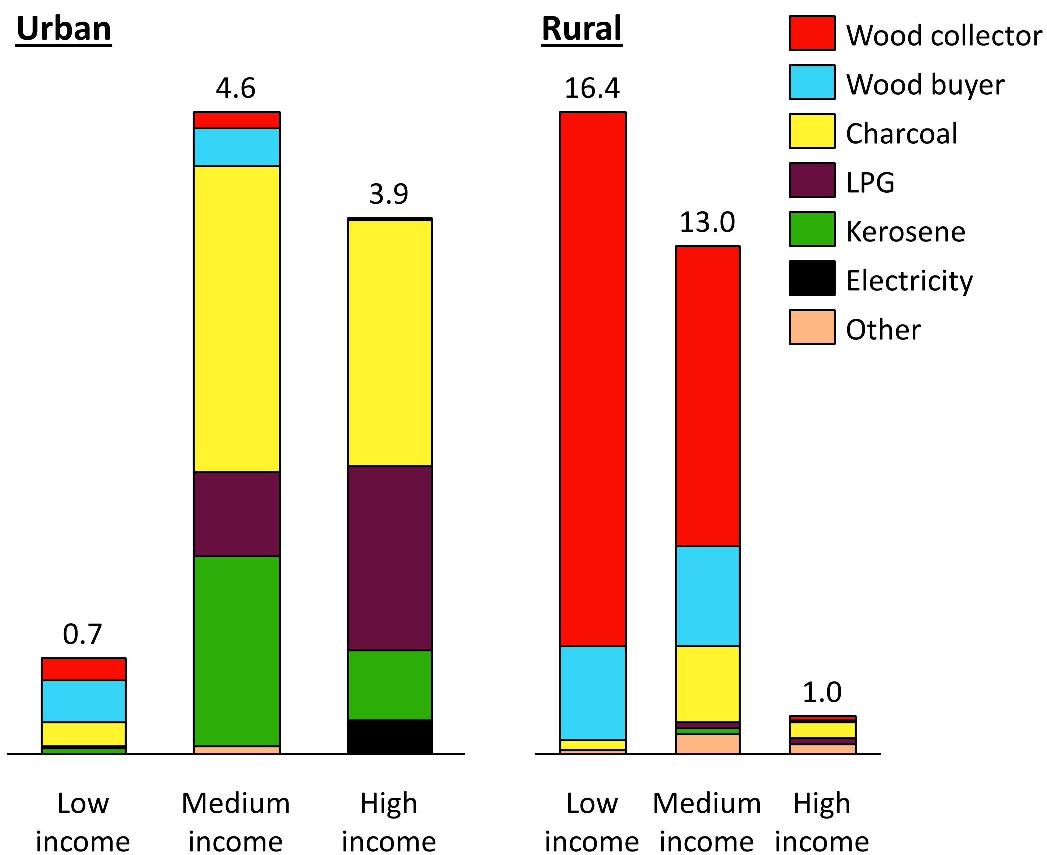
Key assumptions: Low (HH under KES 10k/month), Medium (HHs between 10k-40k/month) and High (HHs > KES 40k/month). Kenyan data used for urban-rural totals, fuel mix in urban and rural areas; SSA average data is used to extrapolate likelihoods of people using different fuel types based on their income

Note: "Other" in low income group is mostly biomass while in medium income group it could be a mix of electricity and biomass.

SOURCE: Raw Data from KNBS Energy Penetration 2007 and Census 2009. FSD FinAccess 2009; Fuel use databases collected by DHS, WB, etc. and maintained by WHO; Dalberg analysis

57% of urban residents and 22% of rural residents currently pay for non-LPG fuel, suggesting an upper bound of ~14.5M as the addressable market for LPG

Fuel use by income level and location
(Million people)



- Largest segment of urban market using LPG are high income (1.3 million people) followed by middle income urban (0.6 million)
- **In urban areas, an additional 2.3 million high income residents and 3.8 million middle income residents use purchased fuel,** suggesting a large potential additional market for LPG, albeit with competition from lower-cost fuels
- Kenya's population is 76% rural as of 2009. However, rural residents are less of a viable market segment for LPG, because **only 8 million (or 22%) of the 35 million rural residents currently purchase fuel** (excluding existing LPG users)

Key assumptions: Low (HH under KES 10k/month), Medium (HHs between 10k-40k/month) and High (HHs > KES 40k/month). Kenyan data used for urban-rural totals, fuel mix in urban and rural areas while SSA data is only used to extrapolate likelihoods of people using different fuel types based on their income

SOURCE: Raw Data from KNBS Energy Penetration 2007 and Census 2009. FSD FinAccess 2009; Fuel use databases collected by DHS, WB, etc. and maintained by WHO; Dalberg analysis

Interventions should target the ~9 M Kenyans buying charcoal or kerosene; wood collectors and other rural consumers likely to remain biomass dependent

	Size	Segment profile	Segment challenges	
Wood collectors	21.6 mil (55%)	• Predominantly lower income rural HHs • 99% rural, 1% urban	• Lack of disposable income to move up energy ladder • Long collection times/biomass scarcity • High harm to health, but minimal awareness of it	• Low likelihood of switching to LPG • Likely to remain biomass dependent
Low income wood purchasers	2.7 mil (7%)	• Low income (HHs under KES 10k/mth) • 89% rural, 11% urban	• High fuel expenditures relative to income • Lack of awareness of harms • Modern energy is deemed unaffordable/inaccessible	
Mid-high income wood purchasers	2.9 mil (7%)	• Medium – High income (HHs above 10k/mth) • 90% rural, 10% urban	• Lack of awareness of harm, but more sensitive to time burden of fuel-gathering/cooking • Modern energy is deemed inaccessible	
Rural charcoal users	2.6 mil (7%)	• 11% low income, 73% middle income and 16% high income	• Lower income still mostly relying on firewood (gathered or purchased)	
Urban charcoal users	4.1mil (11%)	• 4% low income, 53% middle income, 43% high income	• High premiums paid by low income (esp. in slums), and fuel consumes a very large income share • High share of income for mid-income urban buyers, but financially challenging to move up energy ladder	• Higher likelihood of switching to LPG
Kerosene users	2.1 mil (5%)	• 91% urban, 9% rural • 2% low income, 73% middle income and 25% high income	• Adverse health effects, but minimal awareness given kerosene is seen as a “cleaner” fuel for those moving up the energy ladder	
LPG	2.2 mil (6%)	• 88% urban, 12% rural • 1% low income, 34% middle income and 65% high income	• Low availability of LPG in rural areas • High relative cost of LPG fuel and equipment (cylinders/stoves) limit use to higher income HHs	

To note: Fuel penetration rates vary slightly from actuals given that urban-rural populations used might differ slightly from data used in the fuel use databases, thus slightly skewing numbers when aggregated up from percentages to absolutes.

SOURCE: Fuel use databases collected by DHS, WB, etc. and maintained by WHO; Dalberg analysis

The growth of LPG adoption in Kenya is critically shaped by investments and interventions that address affordability, awareness, and accessibility

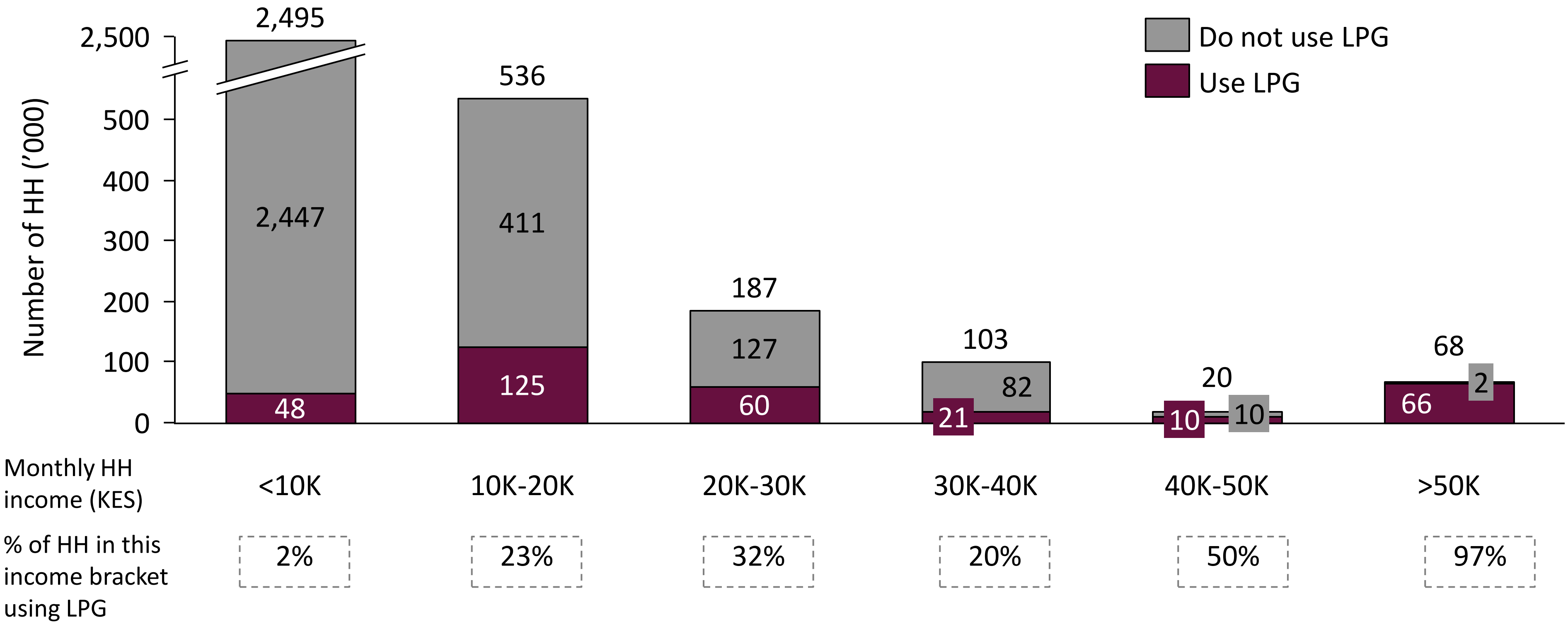
	Key drivers	Notes
Affordability	• Price of LPG and substitutes • Household income • Minimum purchase volume • Supply and distribution efficiency	• As the prices of charcoal and kerosene increase, people may be more willing to spend more on LPG as the opportunity cost or cost differential decreases • The impact of substitute fuel prices is higher on urban populations, as rural populations may be gathering fuel for "free" • LPG use increases with income as charcoal, kerosene, and fuel wood use decreases with income • Charcoal/kerosene sold in smaller units are convenient to daily purchasing – LPG's larger unit size (weekly or larger amounts) requires cash accumulation, which is difficult for some wage earners • Distribution infrastructure – e.g. optimized sizing and location of storage and filling depots, combined with scale economies – reduces overall supply chain costs
Awareness	• Prevalence of marketing/ education campaigns • Demographics – gender, level of education, etc.	• Awareness includes issues of continuous availability of fuel, perceived safety, possible cheating of consumers by illegal vendors, appreciation of health/environmental benefits • Education campaigns increase LPG use as long as LPG is also affordable – knowledge of benefits alone does not sufficiently incentivize switching • Demographics are important in their link to household income (i.e. more educated people more likely to have a higher income). Normalizing for income, such demographics are less important
Accessibility	• Strength of distribution and retail networks • Urban/peri-urban/ rural location	• Distribution and retail networks for LPG more advanced in urban areas than in rural areas, making LPG easier to access in urban areas • In addition to challenges in distributing LPG in rural areas, wood fuel is more available in rural areas. 75% of households in Kenya that use wood fuel gather it rather than purchase it

Source: ERC Study on Energy Consumption Patterns in Kenya, 2010 and PIEA Q1 2013 report.

Income: Share of households using LPG increases with income, although 60% of all HH using any LPG earn less than 20K KES p.m

Affordability

Income distribution and LPG use by urban households (reflects both primary and secondary users)



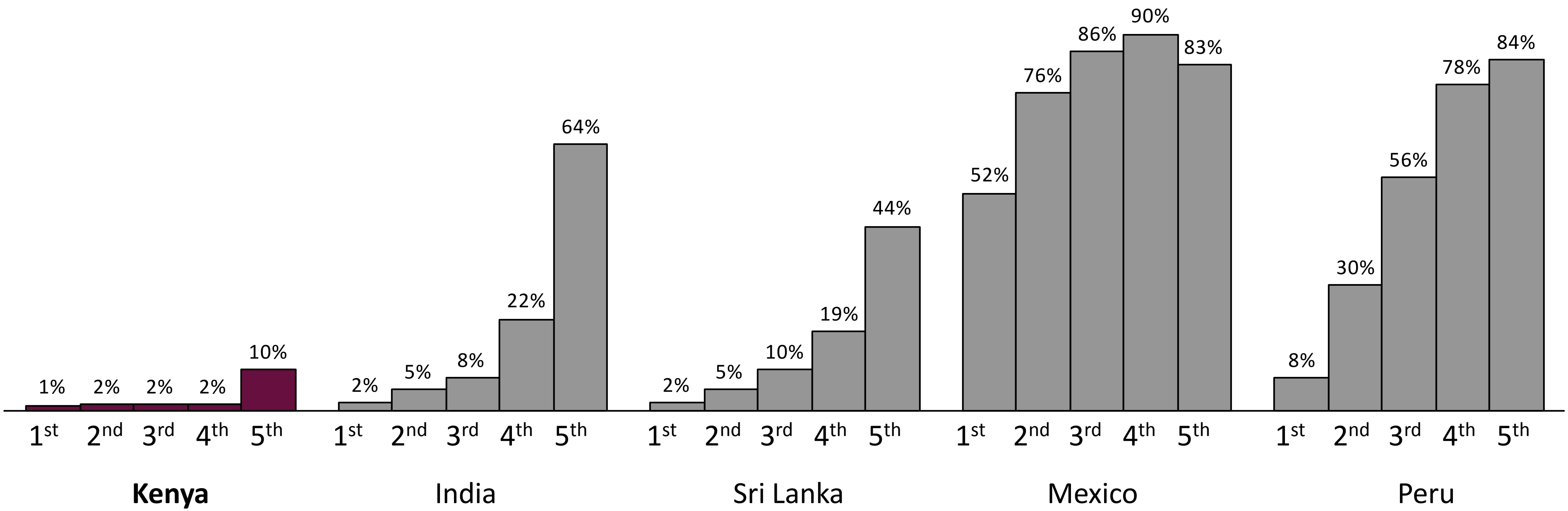
- Nearly all HH in the highest income bracket use LPG compared to almost none in the lowest
- While LPG use does in general increase with income, there is a significant share of households earning under 30K KES per month that use LPG
- These lower income HH may be using smaller quantities of LPG and only for non-energy-intensive cooking e.g. tea, breakfast, or when cooking for guests

Source: Dalberg Analysis. Raw Data from KNBS Energy Penetration 2007 and Census 2009. FSD FinAccess 2009.

Income: However, even when comparing primary income use of the highest quintile, Kenya lags behind other developing countries

Affordability

Percentage using LPG as primary cooking fuel by income quintile
(%, Kenya vs. benchmark countries)



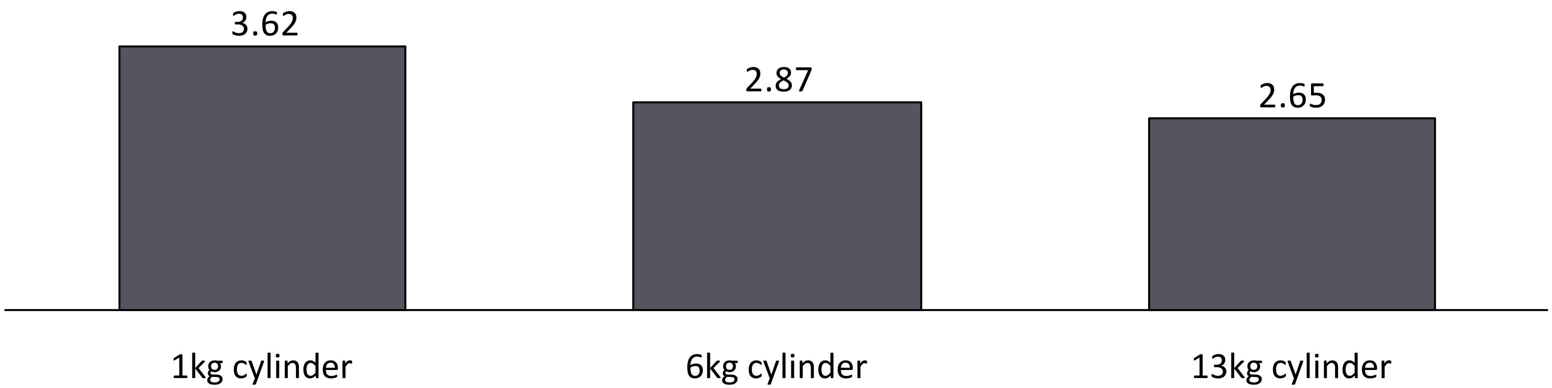
- **Across all income quintiles, Kenya HH LPG use is very low compared to other fast growing economies.**
- Even in the highest quintile, where modern fuels should be dominant, LPG use as a primary fuel in Kenya is only by 10% of that quintile compared to 45%-85% in other countries
- In other countries, LPG use by the 2nd and 3rd quintiles is also relatively high – the lower 2 quintiles are often hard to reach without large subsidies and supply side interventions – but the disproportionately low primary LPG use by the 3rd and 4th quintiles in Kenya is telling

Note: Study data comes from latest national household surveys for the different countries. The data for Kenya is from the Integrated Household Budget Survey (KIHBS) administered by the Kenya National Bureau of Statistics. The fieldwork for this survey was carried out between May 2005 and April 2006

Source: World Bank, 2011 report "Who Uses Bottled Gas?"

Purchase volume: Unit cost of LPG decreases with purchase volume but given low incomes, bulk purchase difficult

Per unit cost of LPG by cylinder size
(USD/KG)



	1kg cylinder	6kg cylinder	13kg cylinder
Total cost of LPG per cylinder (USD)	4	17	34

- LPG prices have been on the decline in 2013, with 6KG and 13KG retailing at approximately $14 and $31 respectively, bringing average cost to $2.4/KG
- HHs that can only afford the smallest cylinder are paying 37% more per kg than households that can afford the 13kg cylinder
- However, total cylinder cost of the large cylinders is often out of reach for low-income households as a single purchase – smaller cylinders are addressing access despite the higher per unit cost presently charged for them

* Today, only one vendor (i.e., with no LPG competition) is offering 1kg cylinders

SOURCE: World Bank (2011), FSD FinAccess (2009); Dalberg data (2012) and analysis

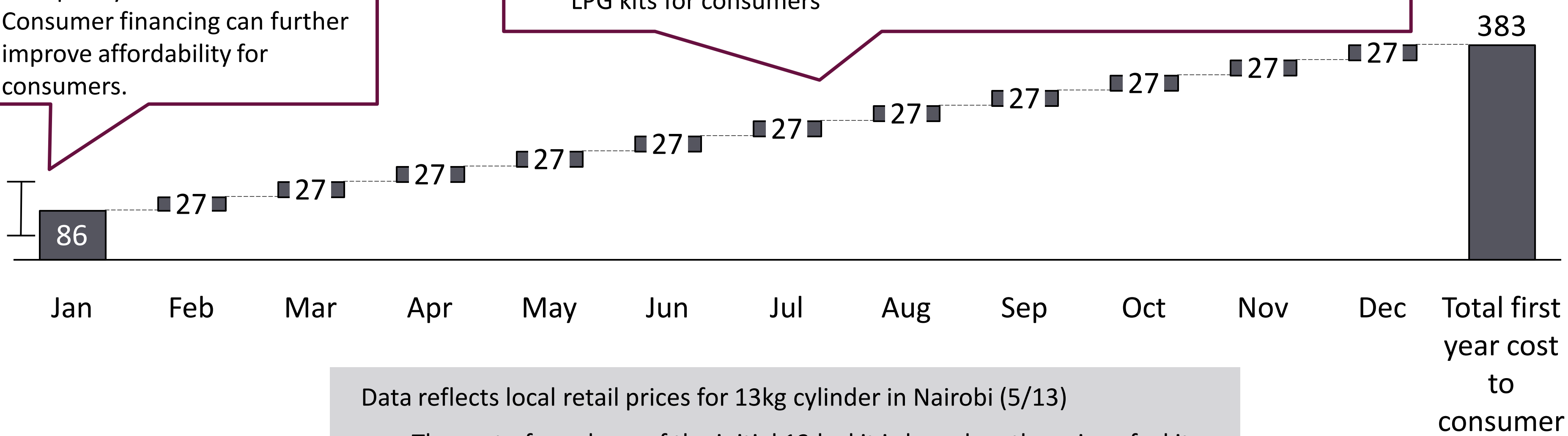
Annual HH cost of cooking with LPG requires a high upfront cost and regular fuel purchases; appropriate interventions can decrease fuel costs by 20% by 2020

Estimated annual cost of LPG per household, Kenya
(USD; Primary LPG user)

Initial purchase price for cylinder and fuel can vary significantly based on retail business model, size of cylinder, and quality of the stove. Consumer financing can further improve affordability for consumers.

Potential for interventions to drive down the cost of fuel for households

- Increasing the efficiency in the Kenya LPG supply chain can reduce fuel costs by up to 20%; Declines in regional prices for imported LPG expected through 2016 (IHS forecasts)
- Consumer financing for cylinders can further increase the affordability of LPG kits for consumers



Data reflects local retail prices for 13kg cylinder in Nairobi (5/13)

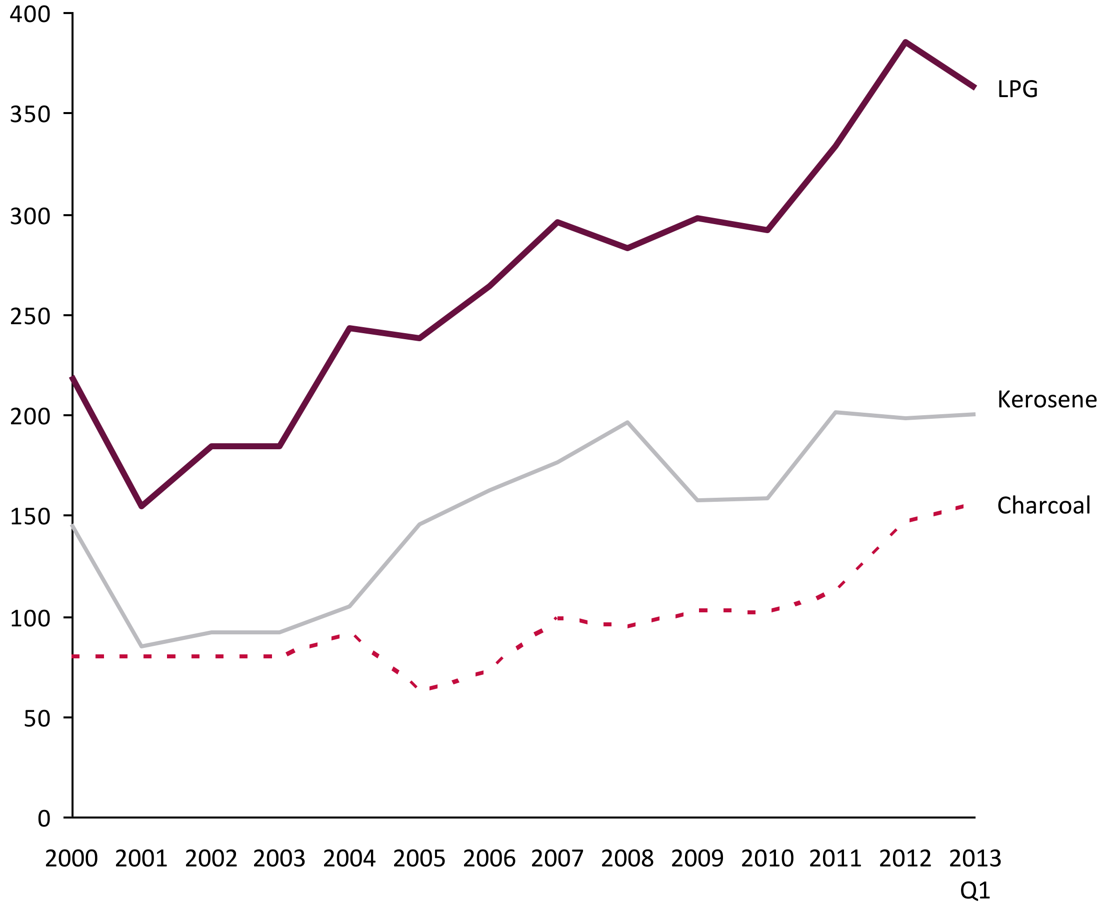
- The cost of purchase of the initial 13 kg kit is based on the price of a kit that includes cylinder, 13 kg of fuel, and basic stove
- Assumes 11 additional monthly refills at $27 per 13 kg cylinder, totaling $297 for refills

Note: LPG costs are based on a user with a traditional stove, who only uses LPG (no fuel stacking); such a user would require ~13 kgs of LPG per month (annual consumption of 154 kgs) at 2,350 KES (or $27) per 13 kg refill. An occasional user (50% LPG use) would spend $14 per month for an annual cost of $170 for refills. A 13 kg package including cylinder, gas, hose, and regulator costs 7420 KES (or $86). Source: Prices reflect field visits in Nairobi in May 2013; Dalberg analysis

Price: LPG is significantly more expensive than other fuels, but the price gap is shrinking

Affordability

Cost of one year of cooking in Kenya using LPG, Kerosene, and Charcoal (USD)



Annual cost of LPG is 2.3x higher than that of charcoal and 1.8x than kerosene in 2013

- Efficiency of LPG significantly higher than that of kerosene and charcoal, but kerosene subsidies and low charcoal costs increase the relative cost of LPG vs. other fuels

Cost trends expected to decrease the gap between costs of LPG and other fuels

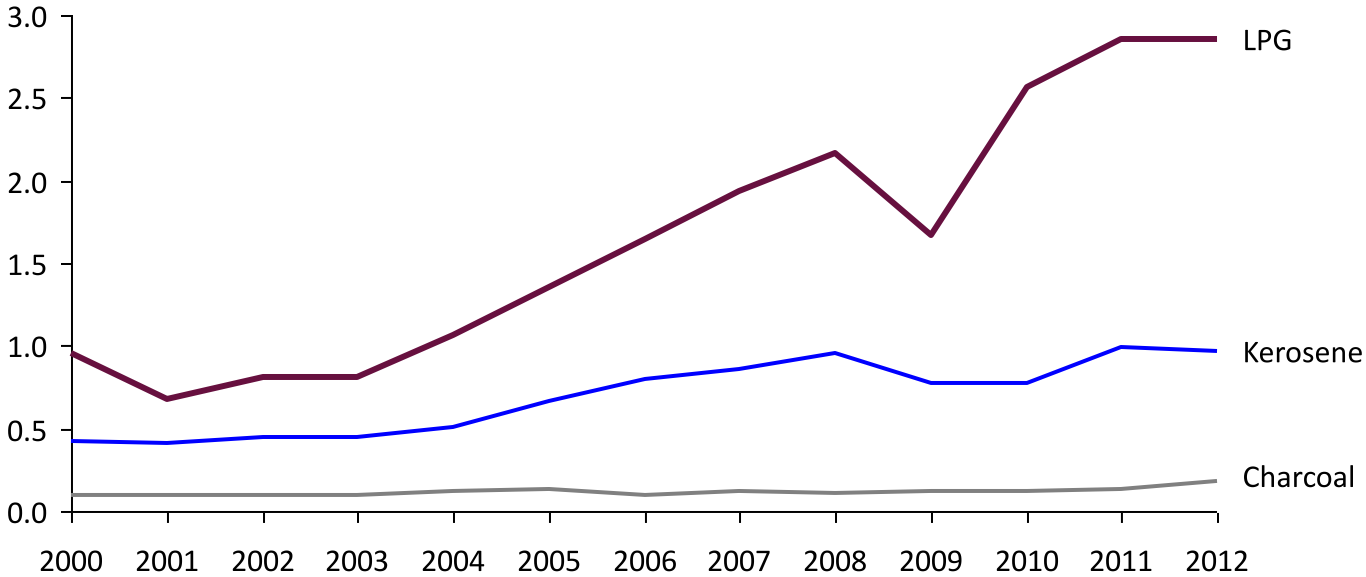
- "Kerosene free Kenya" expected to reduce kerosene subsidies, thus increasing the relative price of kerosene
- Charcoal prices are expected to increase as well, due to the government's planned measures to regulate the charcoal industry; e.g., dealers would require permits from the Kenya Forestry Service (KFS) to burn and supply charcoal

Assumptions: Annual consumption of LPG assumed to be 154.3 (GLPGP analysis), kerosene consumption is 204, while charcoal consumption is 794, assuming 50% of population use Kenya Ceramic Jiko stoves since 2005, with a previously graduated increase in use from 2000-2005.

SOURCE: LPG Global prices are from 2011 LPG Association Report (calculated as avg. of butane and propane prices for Saudi Oil); Kenya LPG (13 KG), kerosene, and charcoal (4 KG) prices from 2005 to 2013 Q1 obtained from Timetric, data as of Apr. 2013. Fuel use databases collected by DHS, WB, etc. and maintained by WHO; Dalberg analysis

Price: LPG prices in Kenya are volatile and much higher than average SSA prices, as well as an equal unit of substitute fuel

End-user costs of LPG, Kerosene, and Charcoal in Kenya
(USD, 1 liter LPG, 1kg kerosene and charcoal)



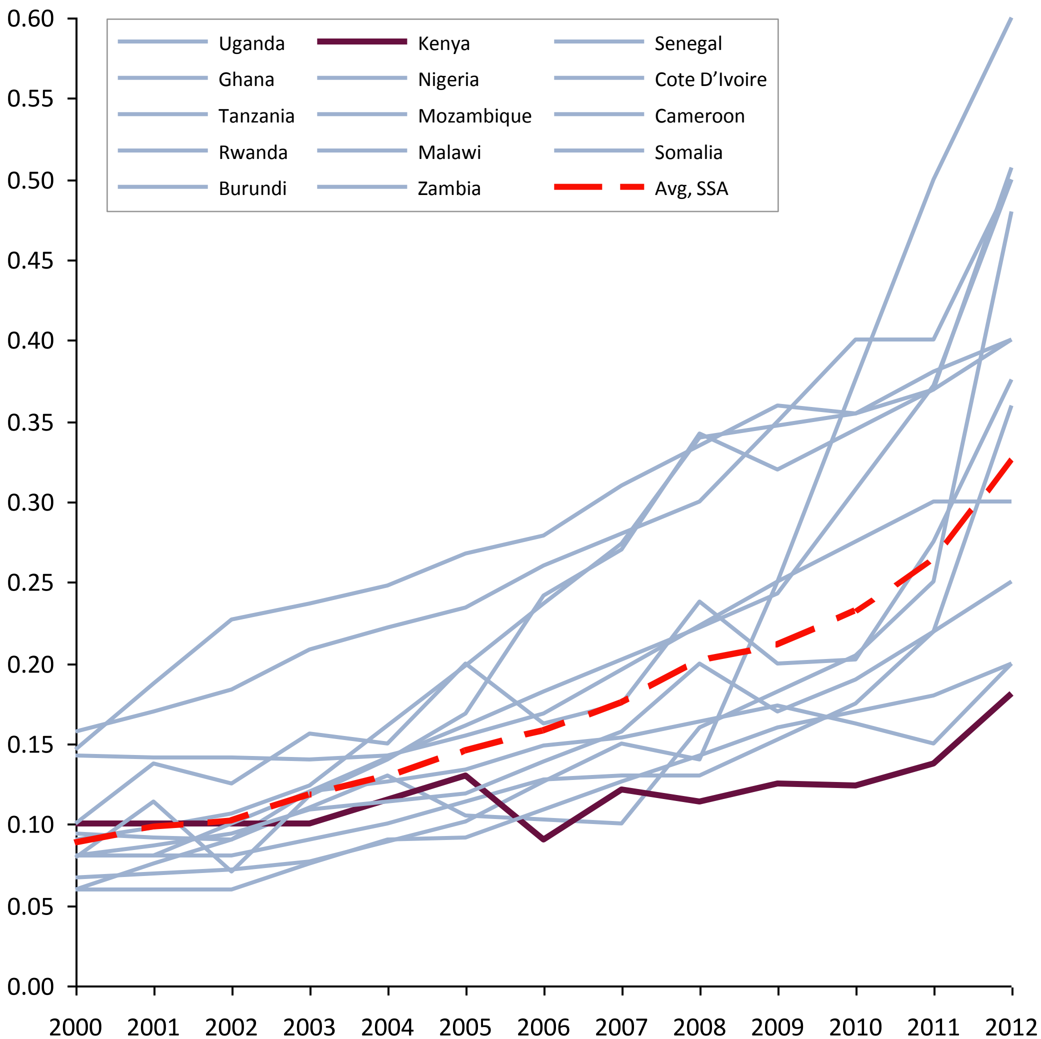
	CAGR ('06-'12)	CAGR ('00-'12)
LPG	7%	8%
Kerosene	3%	7%
Charcoal	12%	5%

- Kenya LPG prices significantly higher than global prices; WB (2011) est. 2-3x higher in Kenya than other developing countries
- Kenya LPG costs track to global though spikes and dips are more pronounced (greater volatility) and overall price much higher
    - High volatility of LPG price in Kenya, driven by erratic supply and inadequate storage in the country
- Kerosene prices have been increasing since 2004, but are still lower than LPG prices. The relatively lower volatility and insulation from global crude oil price may be due to government regulation of kerosene prices and subsidies
- Charcoal prices also quite volatile on a seasonal/month-to-month basis, though annual average is relatively stable and low

SOURCE: Crude oil prices from IndexMundi; LPG Global prices are from 2011 LPG Association Report (calculated as avg. of butane and propane prices for Saudi Oil); WB 2011 Study on Residential Prices of LPG; Dalberg analysis. Price data beginning 2005 obtained from Timetric, data as of Apr. 2013.

Price: Kenya has one of the lowest charcoal prices in SSA; several factors lead to Kenya having an artificially low charcoal price

Costs of Charcoal, Kenya vs. other SSA countries
(USD, 1kg of charcoal)



High supply of charcoal in the region due to low regulation

- Charcoal production is currently illegal, though there are talks about legalizing and regulating the sector
- Given a logging ban in place since the late 1990s, the source wood for charcoal in Kenya is unclear

Though average charcoal costs are low, there are high seasonal variations in charcoal costs

- In the rainy season, charcoal costs can double, which particularly impacts urban populations where almost 50% use charcoal as the primary fuel
- Further, when oil prices rise, people increase charcoal use and reduce kerosene use, so the impact of charcoal price increase is greater

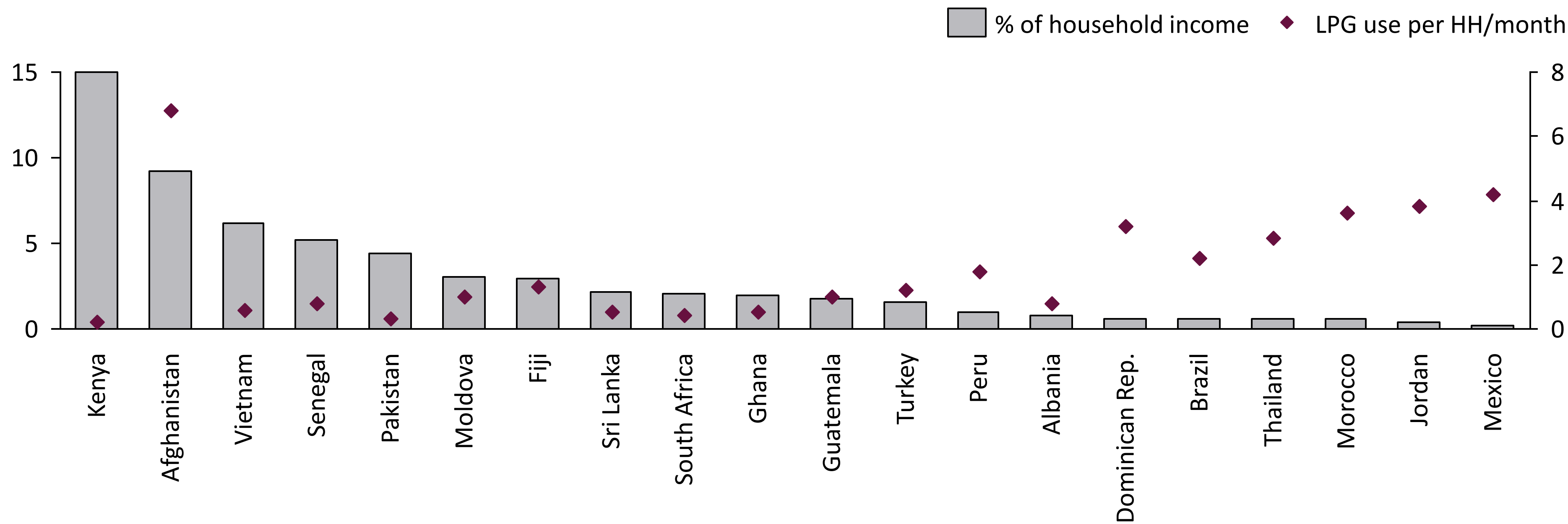
Turning point in charcoal prices in last few years

- After 2006-07, and even more dramatically since 2009, charcoal prices have risen quickly due to policy changes and exogenous factors
- Decrease in illegal imports from multiple source countries, including South Sudan, Ethiopia, and Somalia, e.g., a 2012 export ban from S. Somalia by UN Security Council

SOURCE: KIPPRA (2010); News reports; Energy Access for the Urban Poor (2008); Timetric (Apr. 2013). Dalberg analysis

Comparing this share of income required for regular LPG use, the cost in Kenya is much higher than in most of the developing world

Share of household income required to be spent on LPG for regular use and per HH consumption*
(% and KG/month, Kenya vs. benchmark countries)



- **Required share of income for regular LPG use in Kenya is 2-5x more than in other developing countries resulting in very low per capita use in the country**
    - As expected, lower share of required income expenditure on LPG correlate to higher use except in some outlier countries where external factors might be at play (e.g., Afghanistan, Albania)
- High costs in Kenya due to value chain constraints (*see next section*) and low consumer affordability (*see previous slides*)
- Lower costs in other countries sometimes a result of public action that lowered barriers to adoption (e.g., Senegal)

SOURCE: World Bank 2011 report, “The Role of Liquefied Petroleum Gas in Reducing Energy Poverty”

*LPG consumption estimated at 3kg/month/person. Income derived from HH total final expenditure as the share of GDP in 2010. Consumption data from 2009

Awareness: While LPG is a clean and efficient fuel, it is perceived to be less economical and not as readily available as substitutes

% HH citing reason as primary for use of different fuel
(113 HH surveyed in Kibera)

Reason for use	LPG	Kerosene	Charcoal	Wood	Elect.
Cheap/affordable	**1%**	51%	49%	19%	0%
Fast and efficient	**41%**	29%	12%	12%	33%
Always available	**7%**	14%	3%	4%	0%
Easy to use	**17%**	9%	2%	8%	33%
Economical	**7%**	8%	9%	1%	0%
Convenient	**1%**	8%	7%	4%	67%
Clean	**17%**	3%	2%	0%	0%
Does not smoke	**17%**	2%	2%	0%	0%
Lasts longer	**3%**	3%	5%	4%	0%
Keeps cooking pots clean	**1%**	0%	2%	0%	33%

Key: Significance in driving use

Major deterrent

Moderate importance

Major incentive

Role unclear

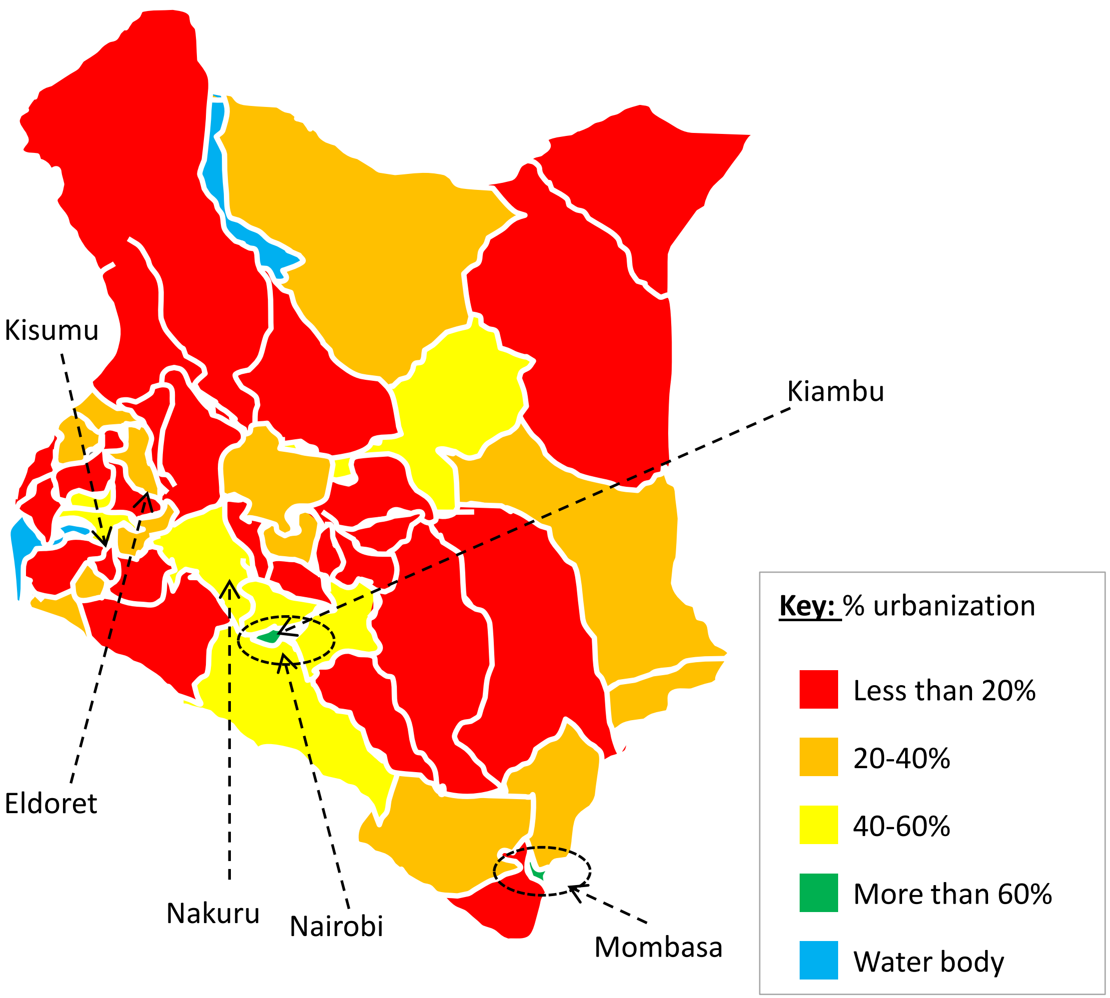
- **Deterrents to LPG use include high upfront costs, fluctuating fuel prices and sporadic availability.** Safety concerns were raised by HH though not covered in survey
- LPG users consider it efficient, easy to use and clean
- Kerosene use primarily driven by affordability and ease of use. However, data are from 2008, before kerosene prices reached parity with LPG prices and when availability was not an issue
- Charcoal use primarily driven by low cost, though there were some issues cited on ensuring a steady supply given the challenges in local charcoal production in Kenya
- Most HH did not use electricity for cooking, but expressed their perceptions on the benefits of using it
- Some reasons such as "keeps cooking pots clean" are considered "bonuses," but would not necessarily lead to a fuel switch if other factors such as cost and availability were not also conducive
- Worth noting that HH were surveyed on fuels being used, i.e. those who consider firewood easy to use, might not have another fuel to compare it to
- *Note: unclear whether "convenient" means convenient to use or convenient to switch to e.g., low upfront costs, ease of access, etc.*

SOURCE: Kibera HH survey (2013, data collected in 2008); Dalberg analysis

Note: Total number of respondents does not add up to 100% because respondents gave more than one reason

Access: Devolution has given counties responsibility for energy access; counties have different levels of urbanisation and income

Urban population by county
(% of total)



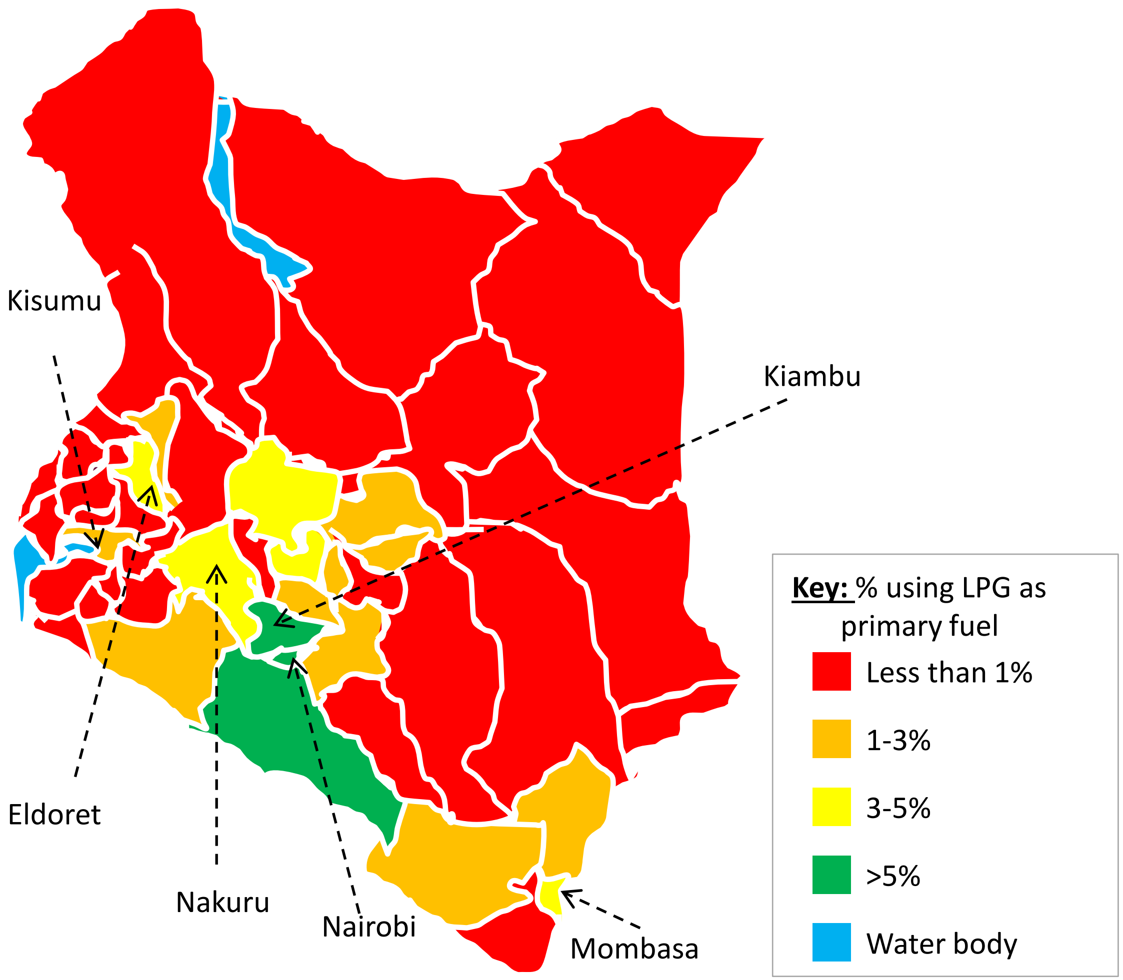
- Under the new constitution of Kenya, the country is divided into 47 counties, with many key functions and powers devolved to county governments instead of being centralised nationally
- In energy, the national government is responsible for energy policy whereas the county government is responsible for planning and development within its jurisdiction*
- Key county functions include electricity and gas reticulation and energy regulation
- Only 5 counties are more than 50% urban; most have 80%+ of their populations living in rural areas
- **Because level of urbanization is correlated with income levels and strength of infrastructure, LPG uptake in counties with low urbanisations is difficult due to both lack of purchasing power and accessibility**

*Although the Constitution allows for the roles of the two levels of government to overlap, uncertainty may develop operationally in terms of extent of responsibility

SOURCE: Government of Kenya data (2013); Dalberg analysis

Access: LPG access in Kenya is very geographically concentrated today, with limited use outside the more urbanised counties

HH using LPG as primary cooking fuel
(% of total)

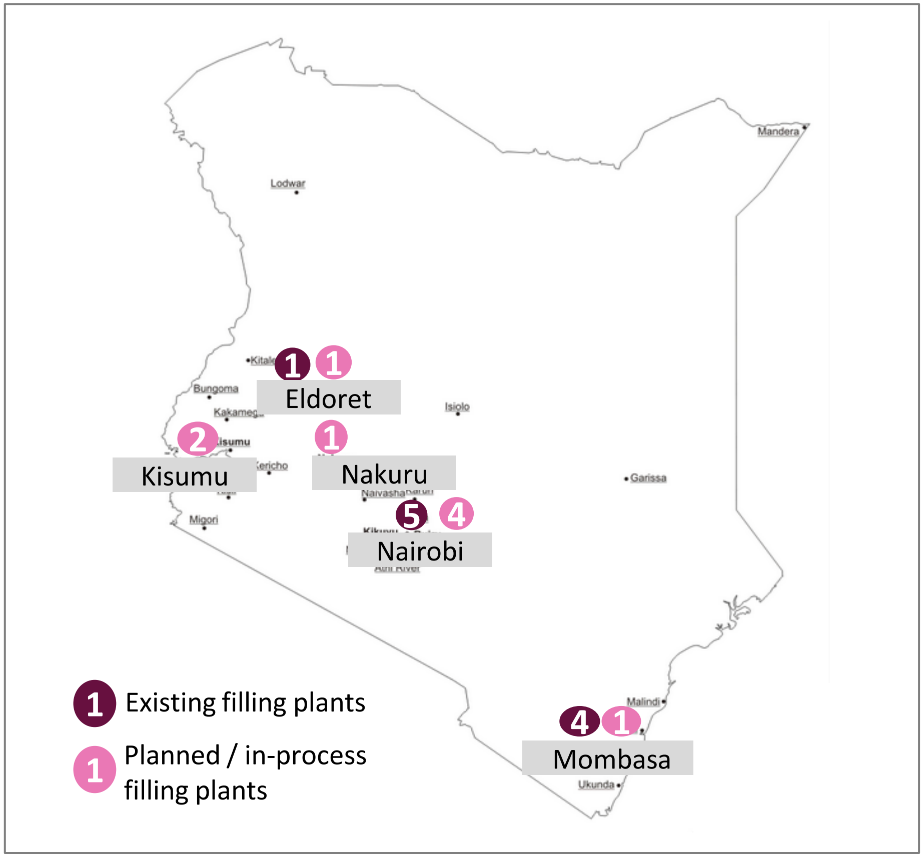


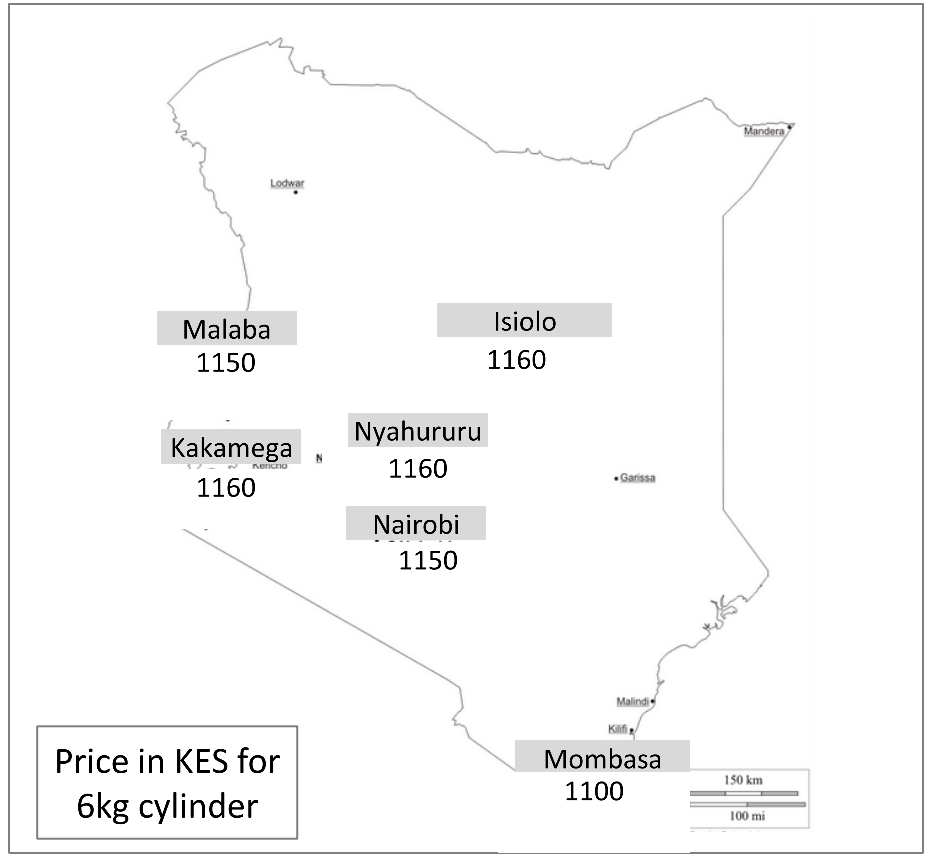
- LPG use is predominantly in urban and peri-urban areas due to:
  - Denser and lower-cost retail and distribution networks in these areas
  - Generally higher HH incomes
  - Generally lower geographic access to fuel wood; e.g. in Nairobi, users of firewood travel an average of 6.44km to access it as compared to 0.59km to access charcoal
  - LPG storage and filling capacity is concentrated in Nairobi and Mombasa, providing a foundation for lower cost distribution – the cost of LPG in Kisumu for example, is much higher due to necessary transport of cylinders
- Remote and very rural areas, especially in the North and the Eastern part of the country, have very limited use of LPG given limited retail networks and relatively higher availability of solid fuels

SOURCE: Kenya integrated household Budget survey (kihbs) 2005/06. KIPPRA, "A comprehensive study and analysis on energy consumption patterns in Kenya," 2010; Dalberg analysis

Access: With few, clustered filling stations and storage facilities, access to supply can be sporadic, though low price variation

Accessibility



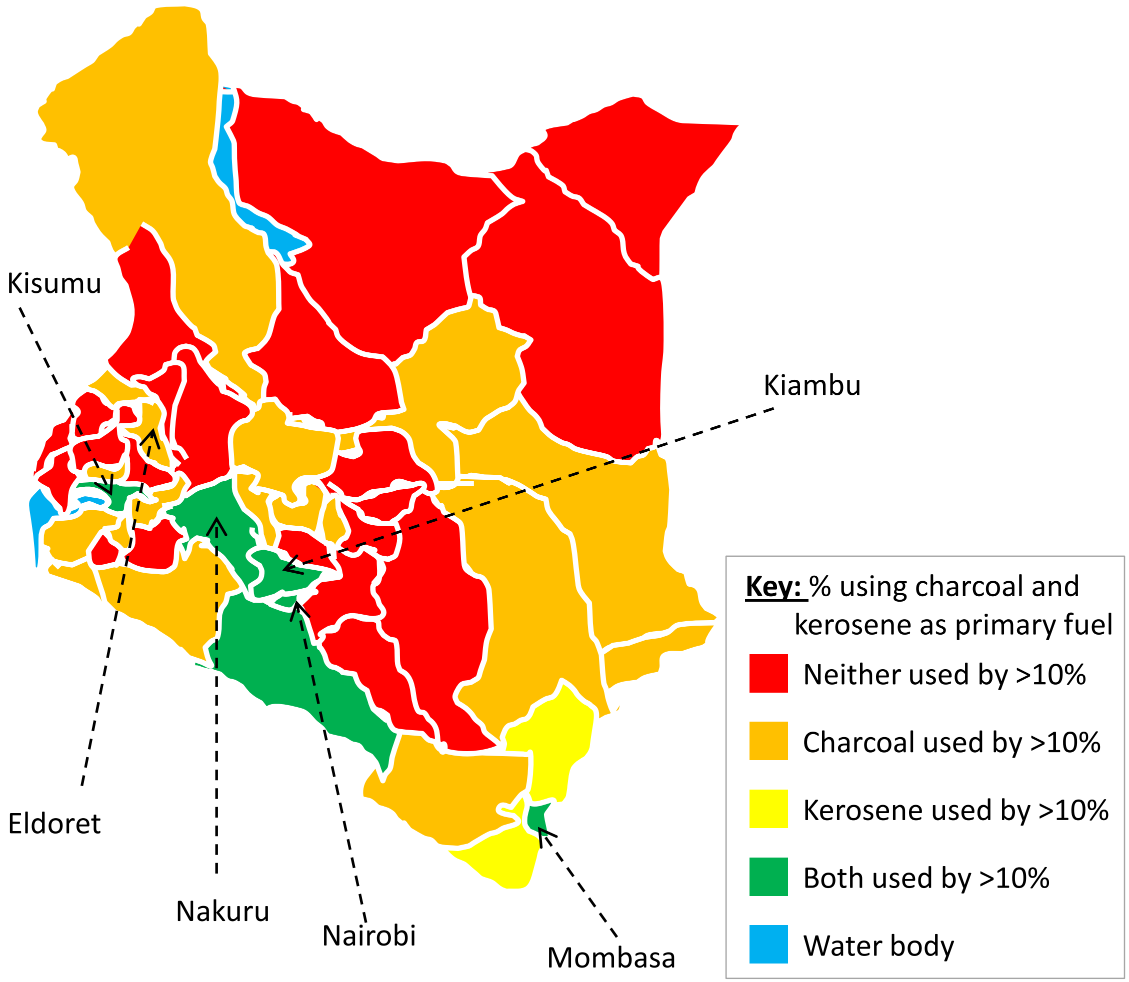


- Currently only 3 locations with legal filling plants in the country, with a heavy concentration in Mombasa and Nairobi. LPG prices in Kenya are not regulated – licensed LPG marketers are free to set their own prices
- LPG prices offered at petrol stations are relatively similar across the country when comparing for a single marketer, except in Mombasa, indicating that transport costs are not significantly driving the final retail price
- Prices at other forms of retail outlet, and at outlets in less densely populated areas, may vary more

SOURCE: Stakeholder interviews; news reports; Dalberg analysis

Access: Counties with high charcoal and kerosene use could be targeted to strengthen distribution networks for increased access

HH using charcoal and kerosene as primary cooking fuel
(% of total)



- LPG might not penetrate well in areas where most fuel is gathered wood, given the lower direct costs of gathered fuel
- Areas using charcoal might be a strong target for LPG adoption because:
  - Health and environmental effects are more "visible"
  - Charcoal prices, though low in Kenya relative to SSA, are rising rapidly
  - Level of control and therefore fuel efficiency low – unused charcoal put out with water and cannot be reused
- Areas with significant kerosene use could also be targeted because:
  - Kerosene costs have been rising since 2006 – continued increases may result in parity with LPG cost (as in 2009)
  - The "kerosene free Kenya" initiative will reduce kerosene subsidies, raising cost
  - Recent findings on kerosene's carcinogenic properties will also lead to a global push away from this fuel

SOURCE: Kenya integrated household Budget survey (kihbs) 2005/06; Dalberg analysis

*Administrative units in the country changed in the past few years. The 70 regions from the 2005/2006 survey are now mapped to 47 counties

Contents

The LPG value chain in Kenya is long and complicated, supported by key input markets and underpinned by access to finance and the policy environment

Cylinder and valve manufacture → Filling / Wholesale

Kiosk and locker manufacture; stoves/appliances, hoses and other components/accessories → Retail, Consumer capacity

Production/ refining + import
- Single domestic refinery operating below capacity, with frequent outages
- Majority of imports through port at Mombasa
- Some imports overland from Zambia/Tanzania

Bulk storage
- ~10,000MT national storage capacity primarily in Mombasa with some in Nairobi
- Existing port capacity sufficient for current market though high cost

Bulk transport
- In the absence of viable pipeline or railway transport infrastructure, bulk transport is by tanker/road

Filling / Wholesale
- Cylinder valves standardized
- LPG Cylinder Exchange Pool reduces HH switching costs among brands
- Concentration of filling depots in Nairobi, Mbsa – need capacity

Transport
- Cylinders are transported from Nairobi and Mombasa to other regions by truck, which is very costly

Retail
- Retail cylinders available in 1kg, 3kg, 6kg, 13kg
- Retail primarily through petrol stations, supermarkets
- Avg retail price of LPG in cylinders for HH use is US$2.3 per kg

Consumer capacity
- Strong and growing consumer demand driven by urbanisation and income growth
- Limited consumer awareness about risks of grey market refillers

Access to finance/capital

- Storage and filling infrastructure and development of cylinder inventory very costly and working capital intensive
- Consumers often liquidity-constrained and cannot bear upfront cylinder deposit costs and stove purchase costs

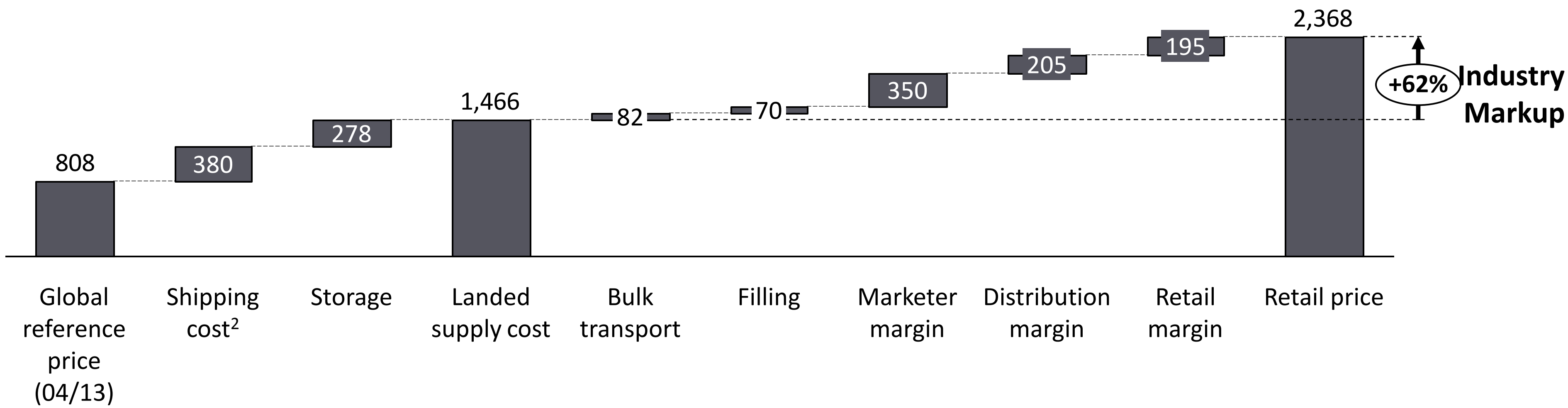
Policy and regulation

- Market regulated by Energy Regulatory Commission (ERC) and standards governed by KEBS. However, in practice enforcement is weak
- Cylinder revalidation required every 8 years, but in practice needed more frequently. Only 3 companies operating, and at relatively high cost
- No VAT on LPG gas, but 16% on cylinders/appliances (+25% import tax)

SOURCE: http://www.guide2kenya.com/information/139/Cooking-Gas-in-Kenya

Value along Kenya's LPG supply chain primarily captured by importers, cylinder transporters, and marketers, with resulting high end-user costs

Kenya LPG supply chain and industry markups
(USD/ton)



% share of total value	Global reference price (04/13)	Shipping cost[2]	Storage	Landed supply cost	Bulk transport	Filling	Marketer margin	Distribution margin	Retail margin	Retail price
	34%*	16%*	12%	62%	3.5%	3.0%	15%	8.7%	8.2%	100%

- Cost of imported gas in Kenya is high –estimates suggest that a large share comes from inefficiencies and high margins
- Bulk transport costs assessed to be fair given tanker transport rather than rail, but cylinder transport cost varies dramatically and is argued to be excessively high
- Related to supply chain costs, cost of cylinder manufacture and revalidation are also assessed to be high:
  - Imported cylinders from Thailand cost 50% that of locally manufactured ones
  - Similarly, revalidation costs 2x international standard cost and is of poorer quality

* To note: With increased storage capacity, import costs will decrease as volumes and negotiating power increase. However, new storage costs are very high so total cost is unlikely to change

[1] Assuming 100% imported LPG and cylinder refill model, 2012 pricing data; [2] Estimate from WLPGA

SOURCE: Stakeholder interviews (2012 data); Kojima, Bacon, and Zhou, 2011; Matthews and Zeissig 2011; Dalberg analysis

Number of players involved in the value chain increases downstream, but many players integrate throughout to ensure supply consistency

Production/ refining + import

- Single refinery in Kenya – imports crude from ME
- Marketers contract own imports
- **Total refining capacity -** 1.6 MT crude p.a; LPG output 30K MT p.a
- **Key players:**

Bulk storage

- Two leading providers – Shimanzi Terminal/KPRL owned by government; new AGOL PPP
- **Total capacity** ~10K MT in Mombasa and Nairobi
- **Key players:**

Bulk transport

- Relatively concentrated industry as government regulations strict on bulk transport
- **Key players:**

Filling / Wholesale

- 10 filling stations country wide- privately owned by marketers
- 1 domestic cylinder manufacturer + 3 revalidation companies
- Most cylinders imported
- **Key players:**

Transport

- Fragmented provision as relatively low barriers to entry
- Marketing companies, bulk transporters, and independent truckers all operate

Retail

- 21 licensed retailers – a small number for entire country
- Regulated by ERC
- **Key players:**

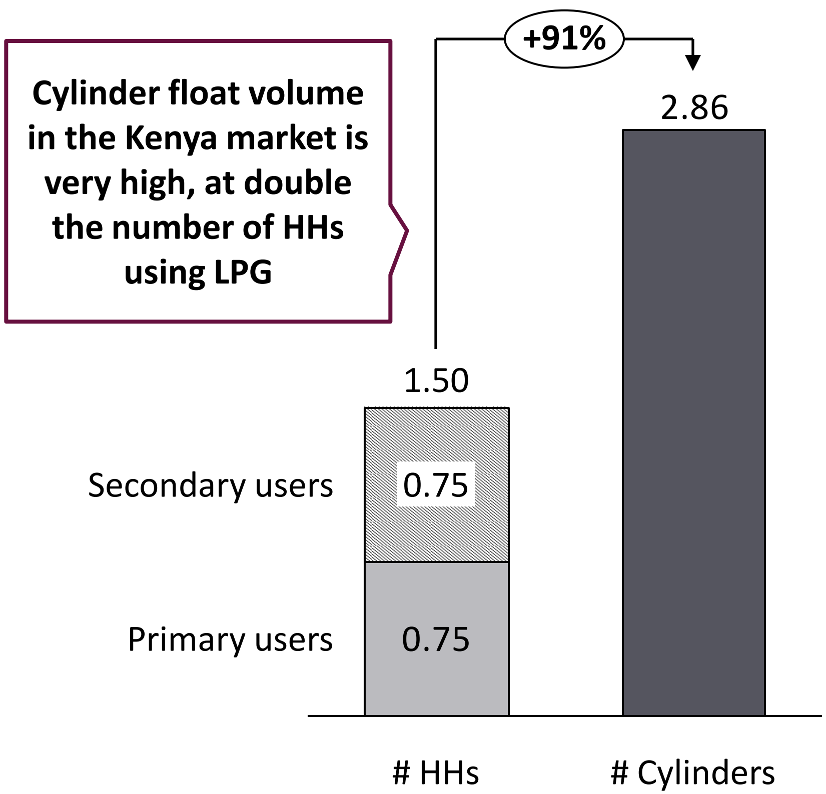
Consumer capacity

- Consumer finance quite fragments – including carbon financiers, commercial banks, MFIs, and SACCOs
- Additional players engaged in consumer education
- **Key players:**

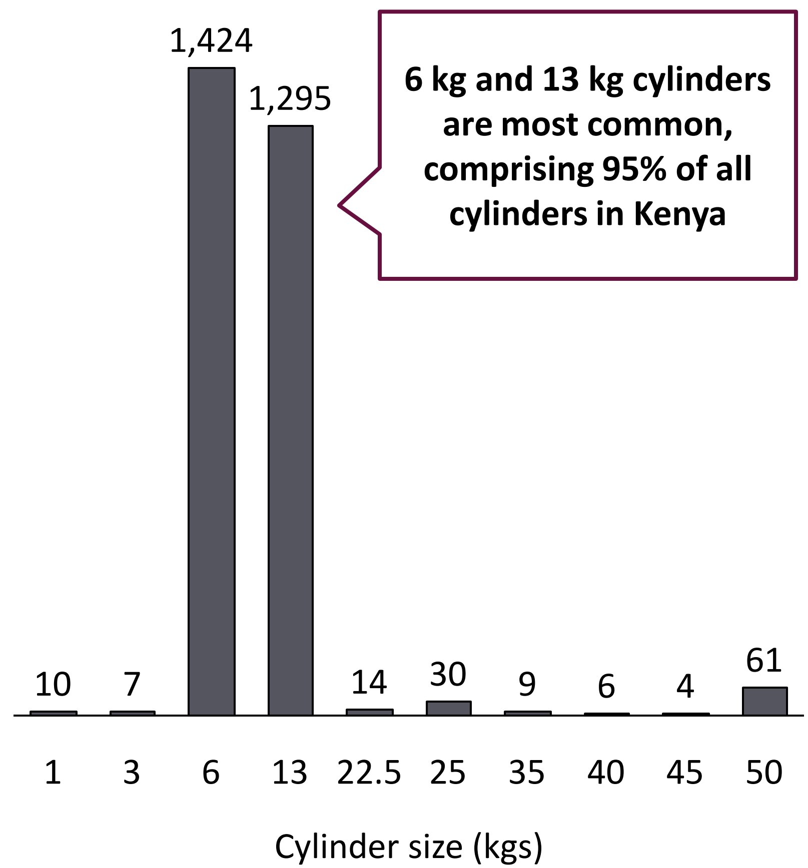
SOURCE: Petroleum Insight 2012; Stakeholder interviews; Dalberg analysis

Cylinder market – nearly all cylinders in Kenya are sizes 6 kg or 13 kg; the number of cylinders is nearly double that of HHs using LPG

Estimated HHs using LPG vs. cylinders in market
(Number of HHs, cylinders, millions)



Distribution of cylinders by cylinder size
(Number of cylinders, ‘000s)



Kenya’s high cylinder float volume suggests that HHs may be holding on to additional cylinders due to concerns over shortages in the market

Assumptions: 7.5% of HH use LPG as primary fuel, and an equal percentage use it for secondary fuel, totaling 15% of Kenya’s ~10 million HHs.

Actors in the value chain, products and processes are regulated by various governmental bodies supported by common enforcement capacity

Government of Kenya

Ministry of Trade

- Weights and Measuring Dept. audits LPG dispensing procedures and equipment to ensure consumers safety

Ministry of Energy and Petroleum

- Formulation of energy policies
- Hosts the Central Planning and Project Monitoring Unit (CPPMU) which is mandated to increase LPG consumption

National Environmental Management Authority

- Assesses potential impacts of LPG filling depots along with the Department of Occupational Safety and Health

Kenya Bureau of Standards

- Issues technical standards regarding cylinder design, construction, transportation and maintenance as well as operating code of practice

Energy Regulatory Commission

- Implements the Energy (LPG) Regulations, 2009
- Reviews and licenses LPG operations: Import, storage, transport, filling, retail, and is responsible for ensuring consumer safety
- Responsible for enforcing laws against illegal refilling and cross-filling with police support as needed

Cylinder Exchange Pool

- Committee comprises one rep from MoEP, one from KEBS, 6 from marketers
- Regulates exchange of cylinders to promote competition
- Participation in Pool mandatory for all fillers + wholesalers

Energy Tribunal

- Quasi-judicial body which mediates disputes of marketing companies and appeals against the decisions of ERC

SOURCE: Ministry of Energy documents and website; News reports; ERC website and regulations; UBA guide; Dalberg analysis

Key pieces of legislation and standards that regulate the LPG industry have been developed over time by the different ministries and agencies involved

Year and legislation	Finance Bill 2005	Energy Act 2006	Energy (LPG) Regulations 2009	Kenya Standards Periodic
Key changes and implications	• Ministry of Finance in accordance with EAC regulations zero-rated LPG imported through the port of Mombasa and a 15%surcharge on imports through neighboring countries • Gas importers to pay 0.475% to KEBS for inspection of gas imported through the port at Mombasa	• Established the ERC to – Regulate import, export, transport, refining, storage and sale of petroleum and petroleum products – Issue, renew, modify, suspend or revoke licenses and permits – Formulate, enforce and review environmental, health and safety standards – Energy Tribunal to arbitrate disputes between the ERC and stakeholders in the energy sector	• Focused on increasing consumer access through effective regulations of LPG import, export, transport, refining, storage and sale • Efforts to increase competition including: – Establishing the LPG Cylinder Exchange Pool – Standardizing d LPG cylinders with a unified valve • Includes measures to protect public safety through setting regulations on quality throughout value chain	• KS 03-91:Specifications for Liquefied Petroleum Gas • KS ISO 4706: Refillable welded steel cylinders-Test pressure 60 • KS 06-896:Specification for periodic inspection, testing and maintenance of transportable gas containers • KS 201:2007:Unified valves for LPG • KS 1938 Part 1- 3: Handling, storage and distribution of LPG in domestic, commercial and industrial installations

SOURCE: News reports; KEBS documents and website; ERC website; Dalberg analysis

Further review and updates of this legislation are planned or in progress to improve regulatory and enforcement capacity in particular

The Ministry of Energy in partnership with industry associations and the Energy Regulatory Commission are in process of reviewing two key pieces of legislation.

Under the new constitution, process for legislation review and development is extensive, including review by Minister, Attorney General, Parliamentary Energy Committee, and final approval by Minster.

Energy Act 2008:

To be updated to particularly combat issues of illegal refilling, including penalties and enforcement:

- Illegal filling of LPG currently attracts a fine of 0-1M KES so penalty will be updated to a minimum of 1M KES and a jail term
- Independent inspectorate that has already been mandated by ERC (and contracted to SGS Kenya Ltd) will be formalised to ensure ERC has the monitoring and enforcement capacity to ensure adherence to LPG regulations
- The inspectorate will have the regulatory power to seize and destroy illegal LPG equipment

LPG Regulations 2009:

To be updated to address gaps that have emerged from the last few years of LPG marketing including :

- Regulations around establishment and use of common user LPG facilities
- Licensing requirements for oil and gas facilities
- Stricter licensing of LPG transportation including regulations around safety and quality standards
- Specific requirement of monthly submission of LPG import and sales data to Kenya National Bureau of Statistics to enable better understanding and monitoring of market – currently no specific requirement so data are poor

These updates are expected to be reviewed and completed by the end of 2013

SOURCE: Stakeholder interviews; Dalberg analysis

Appropriate regulations and effective enforcement are still major challenges to expanding the LPG market in Kenya

Regulatory Governance & Enforcement

- Kenya has implemented formal regulations to encourage development of the LPG market
  - Laws requires LPG marketers to own branded cylinders, and cross-filling is illegal
  - Laws in place to help consumers cope with chronic LPG shortages
    - However, some laws likely prevent market from developing rapidly in the absence of shortages, and/or add risks to the market that will deter international investment
- Common valve requirement has contributed to rampant cylinder theft and illegal filling
- Additionally, challenges arise in the enforcement of regulations, a source of risk for the market
  - ERC has been historically ineffective with 'sue and pursue' enforcement of regulations
    - Illegal filling runs to 20-30% of the cylinder market today
    - Historical reports of corruption
    - Cylinder branding requirements are not well enforced

Market Structure

- Limited delineation of permissible roles and relationships across the supply chain
  - Misalignments and overlaps in permitted roles – and associated licensing requirements – facilitate illegal filling, disincentivize large-scale cylinder investment, and add risk to the market
- Cylinder Exchange Pool will unintentionally limited market competition and growth at larger scale
  - This will aggravate the asymmetries developing among competitors' cylinder inventories
- Sanction of microfilling increases risks to public safety, and is expected to facilitate illegal filling activities during the market's eventual high-growth phase
- Monopolistic pricing power is tolerated, to the detriment of consumers
  - An alternative public-utility model for such infrastructure, with appropriately regulated tariffs and open access rules, or through facilitation of effective competition, likely to result in lower end-user costs

SOURCE: Expert interviews

Summary: Key challenges along the value chain include high cost storage, limited geographic distribution of filling stations, and high illegal refilling

Production/ refining + import	Bulk storage	Bulk transport	Filling / Wholesale	Transport	Retail	Consumer capacity
Low refining capacity utilization	High storage cost and pricing in new facility	Weak rail transport infrastructure	Limited geographic distribution of filling stations	High cost of road transport	Illegal filling, underfilling, and cylinder theft	High upfront cylinder and stove cost
High refining cost	Age of ship and movement yield safety concerns	Tankers/Trucks are expensive to use	Illegal refilling , cross-filling; weak CEP enforcement	Safety rule non-compliance – e.g. use of old vehicles, overloading	Inconsistent safety checks on cylinders in circulation; poor quality revalidation	Re-filling large cylinder of gas not aligned with daily wage incomes
Shallow port depth limits ship size	Lack of space at port for capacity expansion for on-shore facilities	Unsafe driving practices and road congestion/ degradation	Limited knowledge of handling and safety practices for some staff		Retailers not evenly distributed geographically	Perceptions of unreliability– sporadic stock-outs, partial refilling, etc.
Discharge facility limitations	Limited bulk storage capacity outside NBO, MBSA		Local cylinder manufacture/ revalidation high cost and low quality		Poor enforcement of regulations	High relative cost of gas compared to other fuels

SOURCE: Stakeholder interviews; Dalberg analysis

Production and Import: Key constraints include shallow port depth and high costs – investments made to address capacity constraint

Production/ refining + import → Bulk storage → Bulk transport → Filling / Wholesale → Transport → Retail → Consumer capacity

Production/refining and import

Key challenges/constraints:

- KPRL running at 40-50% capacity - Installed capacity ~4M MT pa, currently processing ~1.6M MT (~30K MT LPG produced)
- High cost – refining is on contract by marketers; KPRL charges about Ksh3 ($3.5 cents) per liter for crude oil refining
- Key constraints to increased utilization include discharge facility limitations (restricted to small 50K MT crude cargo discharge)
- Majority of imports through Mombasa – until recently only small volumes due to limited storage and lack of depth for larger ships – results in high demurrage costs and limited economies of scale
- Need for port dredging disputed. Est. cost $25M - importers argue economies from using 8000-10K MT ship sufficient improvement over current – no need for depth for 40K MT ship for foreseeable future
- Some imports overland from Zambia/Tanzania – reportedly lower cost: est $1380/MT from Dar vs. $1500/MT from Mombasa

Planned / in progress interventions:

- 3-year, ~$1B planned upgrade of KPRL to increase refining to full utilisation, but momentum appears slow. Progress made on installation of own 9MW power plant, but talk of potential closure due to high inefficiencies, financial losses, and marketer pressure

SOURCE:

Bulk Storage: Investments being made to address capacity constraints, but costs remain extremely high relative to alternatives and benchmarks

Production/ refining + import | **Bulk storage** | Bulk transport | Filling / Wholesale | Transport | Retail | Consumer capacity

Primary Storage

Key challenges/constraints:

- Historical capacity constraints largely eased through new AGOL floating storage facility. Current capacity ~11,000MT is assessed by industry players to be sufficient for current demand plus some buffer, however, ship is >40years old (regulation requires <30years) so policies of some marketing companies prohibit use. As such constraints not eased for all, requiring imports overland
- Ex-storage price of LPG charged to marketers still very high – est $220/ MT compared to $60-70 charged by government terminal, because it is pegged to previous costs of small tanker volumes and demurrage
- Some concern over safety of discharge – due to shallow port depth, ship must move out to sea to be loaded, then moved back. Given ship age, safety of this movement is of concern
- Limited bulk storage capacity outside of Nairobi and Mombasa resulting in higher costs in other areas

Planned / in progress interventions:

- AGOL current capacity 7K MT, plan to increase to 14K MT, and potentially ~20K MT
- KPC considering investment in additional 8-9K MT storage in Nairobi, Mombasa, Kisumu, Eldoret, Nakuru, Sagana.
- Hunkar expanding storage facility from 50MT to 200MT

SOURCE:

Transport: Despite lack of rail or pipe infrastructure, truck and tanker transport assessed as adequate although trucking costs quite high

Production/ refining + import → Bulk storage → **Bulk transport** → Filling / Wholesale → **Transport** → Retail → Consumer capacity

Transport (Bulk and cylinder)

Key challenges/constraints:

- Bulk tankers/trucks used in the absence of reliable, safe rail and pipeline infrastructure – potentially much more expensive
- Overloading of tankers and trucks
  - Safety concern
  - Road debilitation
- Poor and unsafe driving practices
- Major oil companies more compliant – challenge largely with independent transporters and dealers
- Rail transport infrastructure weak – some old rolling stock still held, but tracks debilitated resulting in frequent capsizing etc so not safe for LPG transport

Planned / in progress interventions:

- ERC trying to more strongly enforce KEBS standards
- Hashi Energy considering venture in piped gas, expected to save 15% in transport costs

SOURCE:

Filling/Wholesale: Huge filling/storage depot shortage across the country – limited geographic spread means higher transport cost and sporadic supply

Production/ refining + import → Bulk storage → Bulk transport → **Filling / Wholesale** → Transport → Retail → Consumer capacity

Filling and wholesale

Key challenges/constraints:

- Limited geographic distribution of filling stations/depots makes access difficult and expensive outside Nairobi
- Rampant and increasing illegal filling – est. 30% last year (up from 10% 2-3 years ago)
    - Partly facilitated by standardized valves which – though increasing consumer flexibility and protecting against supplier shortages – facilitates illegal filling and cross-filling
    - Creates safety concerns due to limited knowledge of staff, poor LPG and cylinder handling practices, and reduces incentives for marketers to invest in cylinder assets
    - Lax enforcement due to vested interests or political interference, and also limited capacity
- Challenges with Cylinder Exchange Pool due to inability/ unwillingness of some marketers to pay to take back their cylinders

Planned / in progress interventions:

- Investments in new cylinder filling plants in Kisumu, Nakuru, Eldoret, Mombasa, Nairobi, by Addax, Kenol/Kobil, Hass, Hunkar – total ~$20M
- ERC cut cylinder deposit by 50% in the cylinder exchange pool in a bid to lower cost to consumer
- NOCK and KPC both considering plans to establish shared filling facilities, but industry confidence in their ability to do so is low. Some suggest they JV or otherwise partner to ensure competitiveness & efficiency

SOURCE:

Retail: Locations not distributed geographically, but likely to grow with market demand; key constraint is weak enforcement against illegal refilling

Production/ refining + import → Bulk storage → Bulk transport → Filling / Wholesale → Transport → **Retail** → Consumer capacity

Retail

Key challenges/constraints:

- Widespread cylinder theft which poses safety risks and reduces incentives for investment e.g. 4000 Total cylinders stolen in ~50 robberies in 2012; ~580 cylinders stolen from EA Spectre in 2013
- Inaccessibility outside core urban centers as retail centers are not evenly distributed geographically

Planned / in progress interventions:

- NOCK investing in developing mobile units for partial filling to increase consumer access
- Premier Gas piloting "Pima Gas" micro-filling model which refills for as low as KES 50
- New inspectorate to be established to monitor refilling, conduct spot checks, etc mandated by ERC and supported by industry. SGS (security firm) appointed to serve

SOURCE: GNESD/AFREPREN 2008; News reports; Stakeholder interviews; Dalberg analysis

Consumer Capacity: Relatively widespread awareness, and limited safety concerns; key constraints are high upfront costs and expensive gas itself

Production/ refining + import → Bulk storage → Bulk transport → Filling / Wholesale → Transport → Retail → **Consumer capacity**

Consumer Capacity

Key challenges/constraints:

- Key challenges are financial:
  - High cost of LP gas itself relative to other fuels, especially charcoal, even if bought in large cylinders and economics are considered over the long term. Given low cost of substitutes, LPG is relatively expensive. The limited availability of smaller, lower-refill-cost cylinders compounds affordability for most daily-wage-earner HHs
  - Upfront cylinder deposit and stove purchase represent significant first barrier
  - Limited geographic spread of retail points subjects potential users to transportation/mobility constraints
- Some lack of confidence or perceptions of unreliability due to history of periodic supply shortages, certain marketers only partially filling cylinders, etc.
- Despite general knowledge of LPG as a product, limited consumer knowledge of need for cylinder inspection and maintenance encouraging commerce with closer-by or lower-cost illegal filling outlets, leading to unsafe cylinders

Planned / in progress interventions:

- NOCK plan for media / grassroots campaigns for consumer/retailer/distributor education on safe handling /use
- NOCK proposal to develop LPG community kitchens in urban areas to increase awareness, comfort, and use
- Major banks and MFIs partnering with marketers and SACCOs to provide cylinder loans to ease first adoption
- PIEA launching radio and mobile cinema awareness campaign in Q3 2013 – to include education on safety (e.g. what to do if there's a leak), regulations, where to buy/fill, etc.

SOURCE: GNESD/AFREPREN 2008; News reports; Stakeholder interviews; Dalberg analysis

Of the various challenges outlined above, several are being addressed by current interventions, but others remain as severe constraints

Production/ refining + import	Bulk storage	Bulk transport	Filling / Wholesale	Transport	Retail	Consumer capacity
Low refining capacity utilization	High storage cost pricing, in new facility	Weak rail transport infrastructure	Limited geographic distribution of filling stations	High cost of road transport – high margins, heavy cylinders	Illegal filling underfilling and cylinder theft	High upfront cylinder and stove cost
High refining cost	Age of ship and movement yield safety concerns	Tankers/Trucks are expensive to use	Illegal refilling , cross-filling; weak CEP enforcement	Safety rule non-compliance – e.g. use of old vehicles, overloading	Inconsistent safety checks on cylinders in circulation; poor quality revalidation	Re-filling large cylinder of gas not aligned with daily wage incomes
Shallow port depth limits ship size	Lack of space at port for capacity expansion for on-shore facilities	Unsafe driving practices and road congestion/ degradation	Limited knowledge of handling and safety practices for some staff		Retailers not evenly distributed geographically	Perceptions of unreliability– sporadic stock-outs, partial refilling,etc
Discharge facility limitations	Limited bulk storage capacity outside NBO, MBSA		Local cylinder manufacture/ revalidation high cost and low quality;		Poor enforcement of regulations	High relative cost of gas compared to other fuels

KEY: Severe constraint | Moderate constraint | Mild constraint/ Current intervention likely to address

SOURCE: Stakeholder interviews; Dalberg analysis

The leading constraints to growth of LPG adoption and penetration in Kenya can be grouped into cost/affordability, supply strength, and enforcement

Low consumer affordability	• High upfront cost of cylinder deposit and stove to consumers • High relative cost of gas itself (compared to substitute fuels and as a share of HH expenditure)
High upstream costs	• High cost of bulk storage in Mombasa – new facility increases capacity, but cost pegged to previous which included demurrage. Cost of import will reduce with increased capacity and price competition (or public utility model), but little effect on total cost if storage cost is high
Supply constraints	• Limited bulk storage capacity and filling stations outside Nairobi/Mombasa and not well distributed geographically, resulting in sporadic supply and higher costs due to cost of transporting heavy cylinders • Uneven retail distribution, lowering access and reducing incentive to adopt LPG
Low enforcement capacity	• Illegal re-filling and cross-filling of cylinders as well as theft and re-branding of cylinders resulting in lost revenue to marketers but also loss of consumer touch points for safety checks • Weak enforcement of CEP obligations e.g. non-payment or collection of cylinders

The leading constraints to growth of LPG adoption and penetration in Kenya can be grouped into cost/affordability, supply strength, and enforcement

Higher priority options to be considered

	Potential intervention options	
Low consumer affordability	Cylinder affordability • Low-interest loans • Installment payments • Reductions of import tariffs, duties, etc. • Shift to smaller cylinder sizes • Automatic savings (lay-away) schemes for periodic refills, for daily wage HHs • Cross-subsidation • Direct subsidisation	LP gas affordability • Investments in supply chain to increase economies of scale • Market structure reform to switch profit centers to cost centers, increase competition, reduce cost burden from illegal activities • Policies to raise cost of substitutes • Targeted subsidisation • Broad subsidsation
High upstream costs	• Advocacy with government to regulate/ index price to regional benchmark • Installation of additional capacity at port to generate competition and lower costs • Strengthening of overland infrastructure to bypass port import requirement	
Supply constraints	• Advocacy with government to develop public/parastatal-owned shared filling facilities • Partnership with selected marketing companies to develop pooled/shared facilities • Technical support to companies trying to establish individually owned facilities	
Low enforcement capacity	• Technical assistance to Ministry, Energy Regulatory Commission, contracted inspectorate, industry partners/associations to implement best practices from global enforcement efforts	

Note: Further analysis required to assess potential of intervention options in Kenyan context and to make firm recommendations as to most appropriate path forward. Broad fuel subsidies are not recommended and should be evaluated further for consideration.

Various mechanisms have been tried around the world to lower the upfront cylinder cost with varying success including loans, subsidies, and installments

Challenge and implications	**High upfront cost of cylinder deposit to consumers**		**High first time adoption costs which are hard to overcome for cash-poor consumers – results in low LPG adoption**	
Potential interventions	**Policy engagement:** **Government supports for cylinder and appliance costs**	**Financial investment:** **Support to provision of low interest loans for cylinders**	**Private sector support:** **Cross-subsidisation of cylinders**	**Private sector support:** **Development of installment payment plans for cylinders**
Case study	*Indonesia – 3kg cylinder sold at 50%; single burner stove + regulator free*	*Kenya – partnership between local banks/MFIs and marketers to provide loans*	*Senegal – 2.7kg and 6kg cylinders subsidised by cost of 12.5kg cylinder*	*Guatemala – covers purchase of suitable stove and cylinder deposit fee*
Target outcomes	Rapid fuel switching and adoption of LPG by first time users. Increased consumer comfort with LPG to sustain preference	Enables first access by spreading cost of connection over time using channels already familiar to and with customers	Effort to target lower income consumers who typically purchase smaller volumes, and to lower the cost of LPG to them	Enables first access by spreading cost of connection over time without consumer burden of additional interest
Key risks and considerations	• May be difficult to withdraw subsidy once in place • Free /subsidised distribution may not instill value for product	• Loan size is small so for commercial banks transaction cost is high • Cylinders portable so hard to use as collateral esp. with mobile populations	• Potential for unintended incentive to use only smaller cylinders meaning little revenue from large cylinders with which to cross-subsidise	• Total upfront cost actually higher than if paid outright to cover time/transaction cost (20%-25% higher in Guatemala)

SOURCE: USAID, World Bank Studies; Dalberg analysis

Considering the high cost of bulk storage in Mombasa (~$220/MT at the new terminal) there are various potential interventions that could lower this

Challenge and implications	**High cost of bulk storage in Mombasa as charges are pegged to previous total cost which included large demurrage fees due to small shipments** →		**Increased cost of gas to consumer as cost passed along value chain; heavy value capture upstream**
Potential interventions	**<u>Policy engagement:</u>** **Advocacy with government to regulate prices**	**<u>Infrastructure investment:</u>** **Installment of additional capacity at port to compete**	**<u>Infrastructure investment:</u>** **Strengthened overland import infrastructure to bypass port**
Case study	*Malaysia -Subsidy Rationalisation Programme to keep retail prices of LPG and other commodities constant*		*India-88% of LPG is transported over land via pipeline, railway and road*
Target outcomes	Relative price stability of imports with prices set or indexed to regional competitive benchmarks	Increased competition to ensure lowest possible cost of storage	Stronger infrastructure for LPG import that can additionally improve access to interiors areas
Key risks and considerations	• Perceptions of government control over pricing may deter additional private sector investment	• Significant investment cost, and need for additional capacity not certain – could lower cost in the immediate term, but end up with excess capacity • Current facility is structured as PPP and has strong government interest; support for additional facility may be limited	• Theoretically, land transport more expensive as scale is smaller • Large additional investment required to strengthen quality control systems at land borders • Even with improved access in interiors, low purchasing power may lower uptake

SOURCE: News reports; Dalberg analysis

Despite adequate storage capacity at the port to meet current LPG demand, the poor geographic coverage limits supply consistency and raises some costs

Challenge and implications	**Limited bulk storage capacity and filling stations outside Nairobi/Mombasa and not well distributed geographically**	▶	**Sporadic / unreliable supply and higher transport costs**
Potential interventions	**Policy engagement:** **Advocacy with government for development of public/parastatal owned shared filling facilities**	**Infrastructure investment:** **Partnership with selected marketing companies to develop pooled/shared facilities**	**Private sector support:** **Technical support to companies trying to establish individually owned facilities**
Case study	*Indonesia/Vietnam – parastatal firms own strategic upstream infrastructure*	*Morocco – Salam Gas JV of 4 marketers - have 12 filling depots countrywide*	*Ghana – companies mandated to construct LPG infrastructure across Ghana*
Target outcomes	Provision of shared facilities through utility model to ensure non-discriminatory access and pricing that considers social objective	Ensuring access by partnering with companies with capacity for scale and who's reputation and brand can help to ensure quality and increase uptake	Development of necessary infrastructure by companies who see commercial opportunity and have incentive to growth their business by increasing uptake
Key risks and considerations	• Private sector may perceive risk of inefficiency or low quality from public provider • Would likely require (concessional) finance partner as upfront investment would be large and payback period long	• Such large Investment requires long-term commitment by marketing companies • Perceptions of "favouritism" or non-neutrality if particular companies supported • Harder to ensure fair access to all players	• Without government mandate, pure TA avoids risk of perception of excessive public interference • Company selection and proposal due diligence must be thorough to avoid

SOURCE:

However, even with interventions across the value chain, cost of gas itself is high relative to substitutes – without adjustment, growth will be slower

Challenge and implications	**High relative cost of gas per unit and over a cooking year relative to substitute fuels**	►	**Low per capita consumption by volume and limited ability to promote adoption beyond particular income brackets**
Potential interventions	**<u>Policy engagement:</u>** **Subsidisation of LPG**	**<u>Policy engagement :</u>** **Formalisation and taxation of charcoal/other fuels**	**<u>Policy engagement:</u>** **Technical assistance to develop carefully targeted and regulated subsidies for the poor**
Case study	*<u>Ghana</u> – Government provision of ~15% subsidy on LPG*	*<u>Senegal / Rwanda</u> – formalisation/ regulation of charcoal production incl. tree-cutting permits, quotas, etc*	*<u>Brazil</u> – Bolsa Familia scheme was leveraged to direct LPG subsidies*
Target outcomes	Increase uptake and use of LPG by lowering cost to be closer to substitutes and less impactful on HH budgets	Inverse to lowering cost of LPG itself is raising cost of substitute fuels, to lower the barrier to switch fuels and to neutralise the HH budget impact	To avoid the heavy public budget burden of a blanket subsidy, careful targeting can lower the cost of LPG to lower income consumers, improving access.
Key risks and considerations	• Not recommended by policy experts in the long term • Impact on government budget grows as use grows • Potential for unintended beneficiaries, e.g. industries, transport sector • Limited perceived appetite from Kenya government for subsidies	• Charcoal sector highly political in Kenya – both as a high employment sector, but also due to heavy vested interests • Gap to LPG in Kenya is higher than elsewhere so charcoal parity unlikely though kerosene possible	• Difficult to implement as requires means testing, and typically leverages existing instruments which do not exist in Kenya • As with all subsidies, difficult to remove once in place

SOURCE: KNUST study; Dalberg analysis

To summarize, interventions across the value chain may include TA, infrastructure investment, and policy engagement

	Value chain constraint to be addressed	Key constraint and recommended GLPGP intervention	Potential partners/ Key stakeholders	Extent of GLPGP engagement
Policy engagement	**Import/Bulk Storage**	Engage with regulators to lower and index the cost of import/storage in Mombasa to reduce the cost of LPG to the end-consumer	• PIEA • ERC • MoEP • AGOL	Short term
Infrastructure investment	**Filling/storage**	Partner with government, parastatals and/or private LPG marketing companies to co-invest in shared storage and filling facilities in strategic locations around the country	• KenolKobil • Total • Shell/Vivo • Oil Libya • County govts	Short - Medium term
Financial investment	**Access to Finance**	Provide concessional finance for cylinder and appliance purchase through existing organisations to finance either installment plans or low-interest loans for first time consumers	• Marketers e.g. Vivo, Hashi, Total, • Financial institutions e.g Equity, Faulu	Medium – Long term
Technical assistance	**Policy and regulation**	Leverage GLPGP internal and global industry expertise and networks to support efforts to improve LPG regulatory enforcement in Kenya, including sharing learnings from global experience with standardised valves and exchange pools	• ERC • SGS security • Industry groups (PIEA, WLPGA) • Petroleum marketers assoc	Short term

SOURCE: Dalberg analysis; GLPGP industry input

Additional investments could be supportive of a stronger LPG ecosystem, over time improving access and adoption

	Value chain constraint to be addressed	Key constraint and recommended GLPG intervention	Potential partners/ Key stakeholders	Extent of GLPGP engagement
Infrastructure investment	**Filling/storage**	Partner/JV with international revalidators who can establish global-standard operation for the region, or partner to upgrade existing provider	• Butan Palma (Spain) • Allied EA • Cylinder works	Medium term
Financial investment	**Retail**	Support to companies/organisations that are developing innovative retail distribution models or have extensive BoP access/ insight who could grow retail access to cylinders	• Govt health clinics • Coca Cola • Equity Bank • Unga • Living Goods • M-PESA	Medium – Long term
Financial investment	**Production/Import**	Financial support to dredge Mombasa port to allow larger ships through and to reduce need for floating storage facility movement	• MoEP • AGOL • Int'l partner e.g. Dredging International	Short term
Infrastructure investment	**Bulk transport**	Co-investment with international/ domestic private or public investor to develop LPG specific rail infrastructure (tank-tainers, etc) once base rail infrastructure improved (e.g. tracks)	• Min of Transport • Kenya Railways/ RVR • Int'l partner e.g. China Railways Construction	Long term

SOURCE: Dalberg analysis; GLPGP industry input

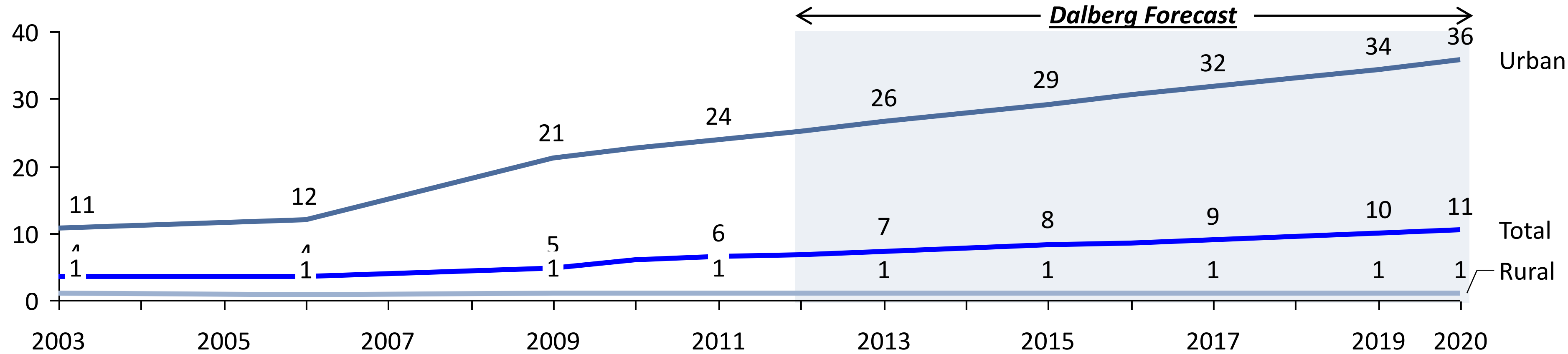
Implications for action: Potential next steps by key stakeholder groups

Stakeholder group	Possible next steps/considerations
Private sector/ Energy Industry players	• Share any pre-prepared feasibility studies or business plans for potential/proposed interventions • Engage with partners to explore possible co-investment opportunities • Continue to provide local-level guidance and input into development of country-level strategies and investment plans
Donors/Funders	• Support further investigation and validation of intervention options, to identify appropriate mechanisms and prioritise against country needs preferences • Develop funding mechanism or pool funding where instrument exists to support infrastructure investments and support to financial services providers
Sector support coalitions / Others	• Identify core areas of focus/priority areas to ensure maximisation of support resources rather than duplication • Engage particularly on consumer education and finance side as private sector/donors likely better places to support infrastructure investment and development

Contents

Base case: based on historical trends, we project a business as usual scenario of 11% LPG penetration by 2020

% of HH (urban, rural, total) using LPG as primary fuel
(Kenya, 2003-2020 projected)



Methodology

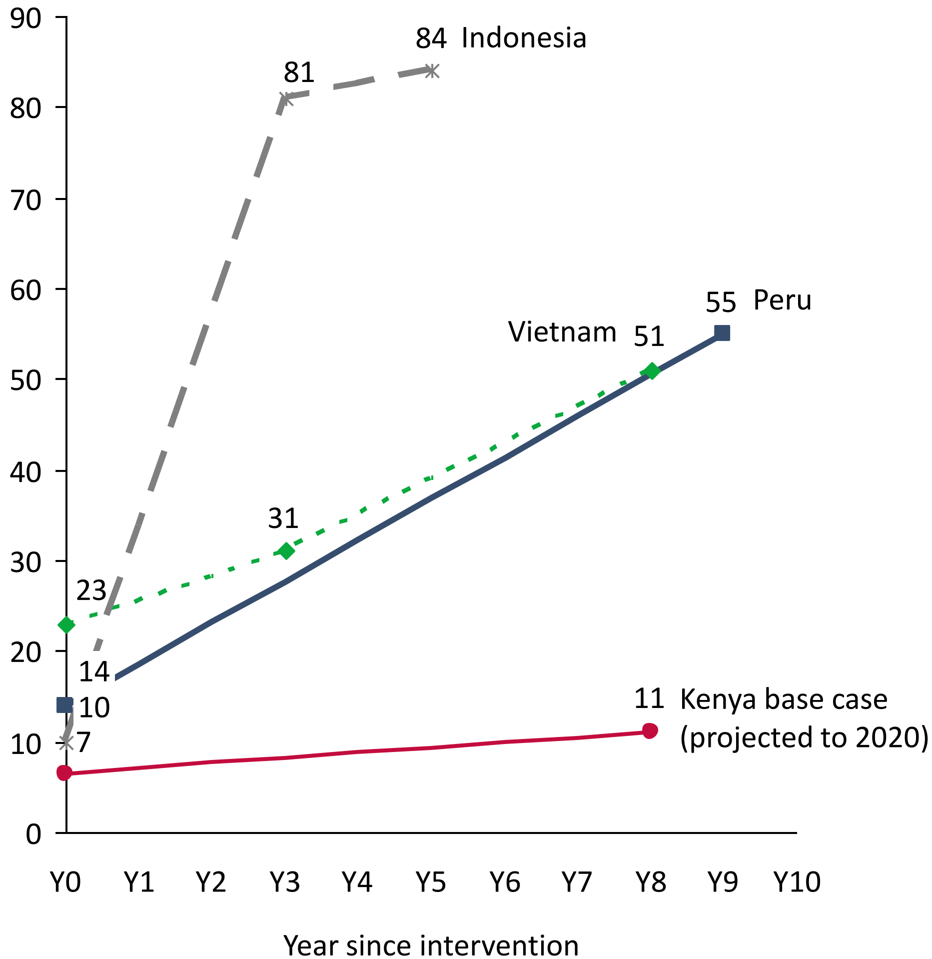
- This base case analysis projects **~11% primary LPG penetration** nationally by 2020, with 36% in urban areas
- LPG use projections are based on historical LPG annual growth rates from 1999-2009 for both urban and rural areas. The respective historical average annual growth rates were used to project forward LPG use, taking into account Kenya's urbanisation rate
    - This forecasted growth rate reflects historical rates for urbanisation (1.7%), population growth (2.66%), and absolute growth of urban LPG users (12%), which results in a 1.3 percentage point increase in urban LPG penetration per year
- We confirmed this growth rate with two additional methods:
    - Using a **historical LPG volume growth** assuming steady use per person and growing volumes accordingly using a historical 10-year CAGR (2002-2012), **LPG penetration was estimated to be 12%**
    - In addition, an **income-based growth model** isolating the income effect and adjusting for urbanization yielded an **8% LPG penetration rate** for 2020. The most recent annual GDP per capita growth rate was used to project forward HH incomes, assuming conservative population growth, a 10% decrease in HH size per decade, and the same % of HH using LPG in each income bracket in 2020 as in 2009

Note: Scenarios do not reflect domestic demand elasticities, for which data is unavailable. Further research required to develop such scenarios

SOURCE: Fuel use databases collected by DHS, WB, etc. and maintained by WHO; Dalberg analysis

Range of possible outcomes: Different policy reforms and market investments have lead to varying growth rates for LPG adoption around the world (1/2)

% of HH using LPG as primary fuel
(Select country transition examples)



- Countries have experienced widely varying rates of LPG penetration growth, driven by underlying factors such as: extent, speed, and efficacy of policy interventions; private sector investment to expand domestic LPG markets; and size and growth trajectory of the middle class
- In countries with the fastest growth in LPG penetration such as Indonesia, the confluence of major policy changes and a large middle class led to the country's rapid conversion from kerosene to LPG
- In medium growth countries such as India, the rapid rise of the middle class coupled with subsidies to lower the retail price enable more HHs to afford LPG as a primary fuel
- Senegal and Morocco benefited from heavy government subsidies of small cylinders and tight control over retail prices

Note: Scenarios do not reflect domestic demand elasticities, for which data is unavailable. Further research required to develop such scenarios.
Source: Kojima et al 2011, Dalberg analysis, GLPG estimates

Range of possible outcomes: different countries have achieved low, medium, and high LPG use growth rates over the years (2/2)

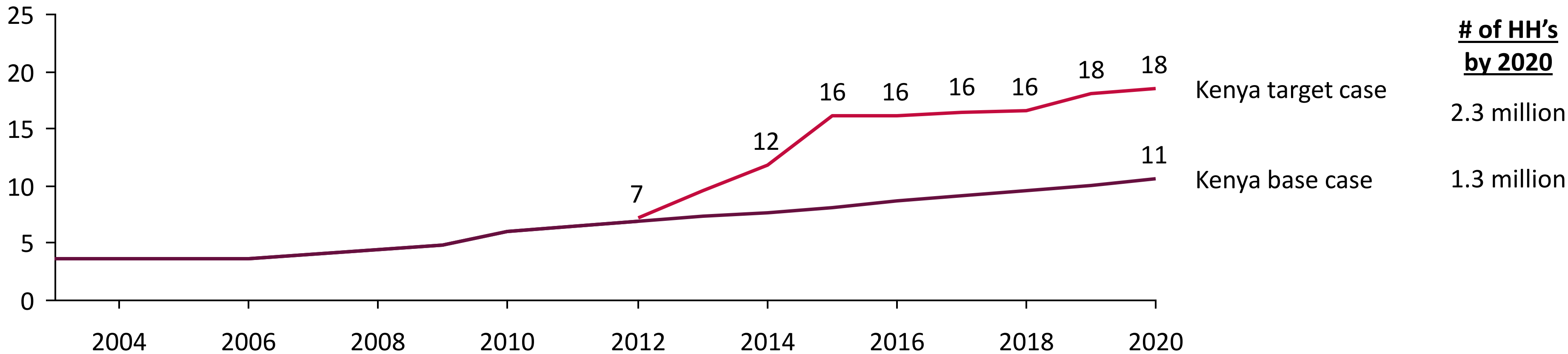
	Growth rate/year	Y10 LPG penetration	Country examples	Typical reforms
Low	1%	10-15%	Senegal, Morocco	• Governmental subsidies for LPG; micro-credit channels developed for equipment • High quality and well-regulated distribution system • Facilitated private sector collaboration and development of local industry
Medium	2%	18%	India	• Subsidies (directly deposited into users' bank accounts) • Strict regulatory environment to prevent the misuse of cylinders (e.g., for commercial purposes)
High	3-5%	50%	Peru, Vietnam	• Major and rapid policy interventions, including decreasing VAT/import tax of LPG, instituting LPG retail price ceiling, taxing biomass consumption
	18%	84% (Y4)	Indonesia	• Conversion of existing infrastructure; establishing LPG conversation PPPs • Heavy investment in infrastructure, education, and promotion of LPG

The range of LPG penetration growth for these countries will inform the bounds of our projections for Kenya's growth

SOURCE: Fuel use databases collected by DHS, WB, etc. and maintained by WHO; Dalberg analysis

<u>Target case:</u> With the right interventions, Kenya LPG penetration can grow to ~18% of HHs by 2020

% of HH using LPG as primary fuel
(Kenya, 2003-2020 projected)



Methodology

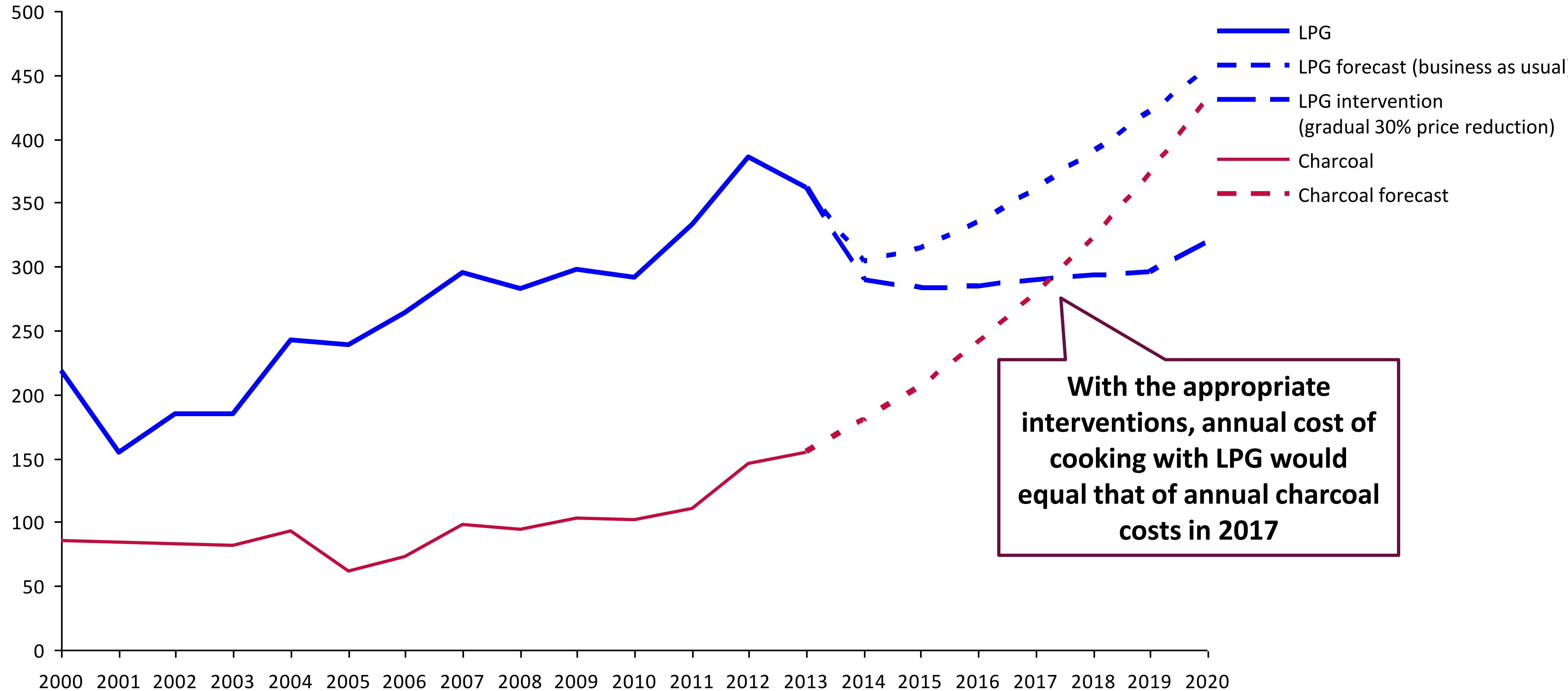
- Forecasts of future LPG penetration are modeled taking into account both supply side interventions (e.g., optimizing the Kenya LPG supply chain) and demand growth (driven by urbanization and growth of the Kenyan middle class)
- Primary assumptions include:
  - Global LPG prices decline through 2016 (IHS forecasts), then increase slightly through 2020, following 2014-2016 forecasted growth rates
  - Investments in LPG supply chain in Kenya between 2014-2016 result in 20% average reduction in domestic margins by 2020
  - HH income continues to increase at a conservative rate of 1.62% per year for all income segments
  - Projection assumes HHs will be willing to spend a greater percentage (up to 10% from 2013-14, then up to 12%) of their income on LPG by 2020 (due to its status as an aspirational fuel), while charcoal prices will continue to rise at historical rates of 16% per year
- In addition to the primary users converted, secondary users of LPG are also projected to increase to 18% of HHs, resulting in a total of 36% of HHs in Kenya using LPG at least occasionally

<u>Note</u>: Scenarios do not reflect domestic demand elasticities, for which data is unavailable. Further research required to develop such scenarios. Please see Appendix for projections of income pyramid distribution for Kenya. Kenya's population in 2020 is estimated to be 53.5 m (at a 4.36% urbanization rate), with 11.9 m HHs at 4.5 people/HH

Price: Interventions to decrease LPG price could help accelerate achieving price parity between LPG and charcoal

Affordability

Trends in cost of one year of cooking using LPG and charcoal
(USD, LPG and charcoal)



Assumptions: We used an average of historical (2006-2012) yoy growth in LPG and charcoal prices to project future prices until 2020; rates used were 8% yoy for LPG after 2016 and 16% yoy for charcoal. Annual consumption of LPG assumed to be 154.3 (GLPGP analysis) while charcoal consumption is 794, assuming 50% of population use KCJ stoves since 2005, with a previously graduated increase in use from 2000-2005.

SOURCE: LPG Global prices are from 2011 LPG Association Report (calculated as avg. of butane and propane prices for Saudi Oil) and Purvin and Gertz, ; Kenya LPG and charcoal prices from 2005 to 2013 Q1 obtained from Timetric, data as of Apr. 2013. Fuel use databases collected by DHS, WB, maintained by WHO; Dalberg analysis

Contents

An initial assessment suggest ~$150M of investment is needed over three years to expand access to 1M additional households in Kenya

Preliminary assessment of investment needs; To be further refined as part of country investment planning

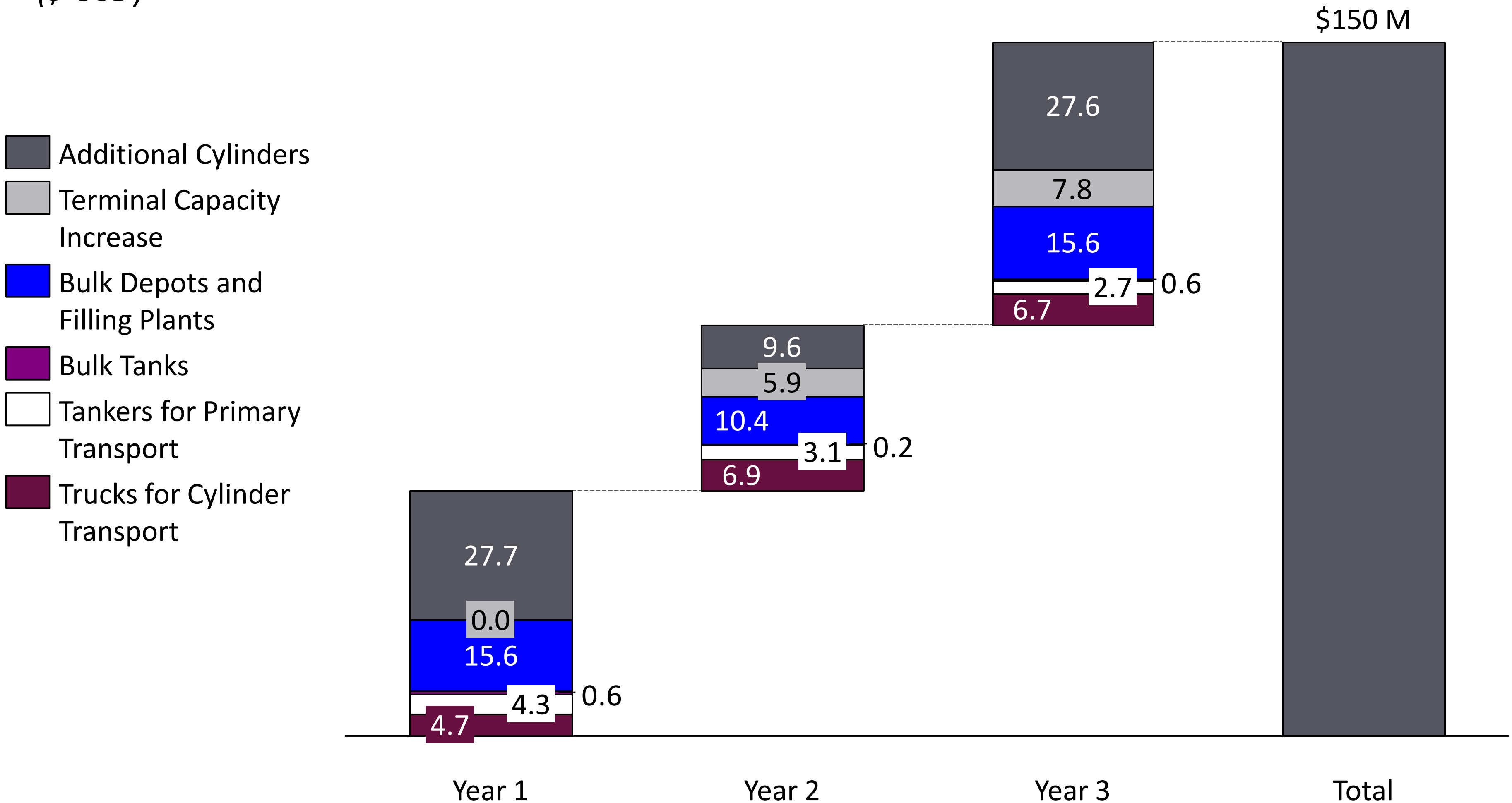
Focus Area	Primary Domestic Partners	Estimated Investment ($USD)
Additional Cylinders	Marketers	~$65M over three years
Terminal Capacity Increase	Utility or marketers	~$14M for Years 2 and 3
Bulk Depots and Filling Plants	Utility or marketers	~$42M over three years
Bulk Tanks	Marketers	~$1M over three years
Tankers for Primary Transport	Utility or bulk transporter	~$10M over three years
Trucks for Cylinder Transport	Distributors	~$18M over three years
Land for Filling Plants/Depots	Utility or marketers	• Investment depends on many factors including safety distances required by national safety law and potential for land concession by government

An estimated 1 million additional Kenyan households will be able to access LPG as a result of these coordinated investments in the LPG value chain in Kenya

Based on GLPGP and industry models; Preliminary estimates only. Additional assessment to be completed in subsequent phases, including assessment of geographic issues and corresponding optimization/rationalization of facilities, transport, and other factors which will ultimately determine final investment needs. Assumes new AGOL port capacity remains in use in parallel with new capacity to be built. Assumes number of cylinders (at the existing mix of sizes) rises to 5m from the existing ~3m.

New investments totaling $150M over three years can catalyze significant expansion of domestic LPG use in Kenya

Preliminary assessment of incremental investment needs across LPG value chain in Kenya
($ USD)



Based on GLPGP and industry models; Preliminary estimates only. Additional assessment to be completed in subsequent phases, including assessment of geographic issues and corresponding optimization/rationalization of facilities, transport, and other factors which will ultimately determine final investment needs. Assumes new AGOL port capacity remains in use in parallel with new capacity to be built. Assumes number of cylinders (at the existing mix of sizes) rises to 5m from the existing ~3m.