

LPG ROADMAP FOR AFRICA

LPG'S GAME-CHANGING ROLE
IN PROVIDING ACCESS TO CLEAN
COOKING FUELS TO AFRICA

December 2024





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A photograph of a person cooking in a traditional outdoor kitchen. A large metal pot with a red handle sits on a wooden stand over a fire of logs. The scene is dimly lit, with smoke rising from the fire. In the background, a person is visible, and there are various kitchen items like a blue plate and a white container. The overall atmosphere is rustic and traditional.

900 million
Africans
lacking access
to clean
cooking fuels



The ongoing health and environmental crisis caused by the use of polluting fuels for home cooking in Africa has reached a critical point. With 900 million Africans lacking access to clean cooking fuels, the impacts on health, particularly for women and children, and economic growth are profound. Traditional solid fuels contribute to deforestation, climate change, and severe health issues due to household air pollution. The International Energy Agency (IEA) and the World Liquid Gas Association (WLGA) have identified LPG as a key solution to this crisis, offering a cleaner, more reliable, and affordable alternative.

As part of its commitment to facilitating access to clean cooking fuels for all, the WLGA has engaged S&P Global Commodity Insights (SPGCI) to review the clean cooking fuels crisis in Africa, analyse the role of LPG as an abundant and immediate clean cooking fuel, and provide recommendations on how to increase access to LPG in sub-Saharan Africa.

1

Prioritise Regulatory Foundations

Establishing clear, enforceable regulations is the first step towards a sustainable LPG market. This includes creating partnerships between governments and industry stakeholders, promoting the Cylinder Recirculation Model (CRM) to ensure safe and efficient distribution, and implementing comprehensive safety regulations for LPG cylinders. Effective regulatory frameworks will build consumer confidence and encourage investment in the LPG sector.

2

Implement Consumer Financing and Payment Strategy

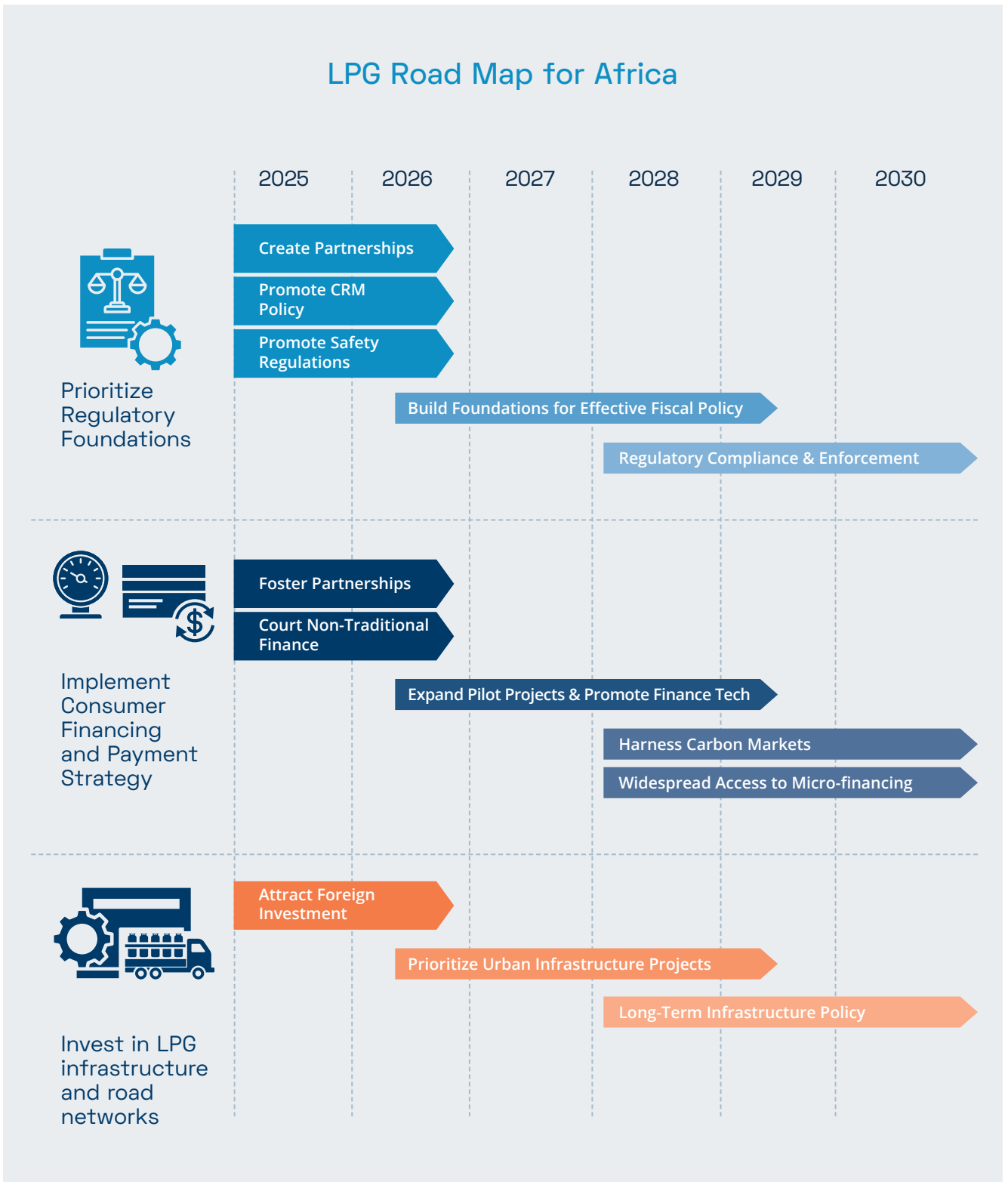
Overcoming the economic barriers to LPG adoption requires innovative financing solutions. Micro-financing, pay-as-you-go systems, and partnerships between financial institutions and energy companies can make LPG more accessible to low-income households. Successful pilot projects in countries like Cameroon and Kenya demonstrate the potential of these strategies to increase LPG usage and improve repayment rates.

3

Invest in LPG Infrastructure and Road Networks

Significant investment in infrastructure is crucial to support the widespread adoption of LPG. This includes developing urban storage and distribution networks, enhancing rural road connectivity, and attracting foreign investment to fund large-scale projects. Prioritizing urban infrastructure can create economies of scale, while improved rural transport networks will facilitate the delivery of LPG to remote areas.

By focusing on these recommendations, Africa can make substantial progress towards providing clean cooking solutions, improving public health, and fostering economic development.



Source: ©S&P Global Commodity Insights

01

The Background



The IEA held its inaugural **Summit on Clean Cooking in Africa** on 14th May 2024 to raise investment and awareness around the ongoing health and environmental crisis of polluting fuels in home cooking in Africa. The Summit brought together high-level government officials from Africa, as well as representatives of European countries and CEOs of international oil companies and innovative clean fuel businesses.

Delegates from Africa reiterated the staggering statistic that 900 million Africans are without access to clean fuels and the subsequent impacts to the health of the growing population, particularly for women and children, and to the economic growth of the region. The goal is to provide adequate and reliable supply of sustainable and clean fuels at an affordable price to consumers, but challenges continue to stunt progress.

A key takeaway from the Summit is the vital role that LPG is expected to play in providing access to clean cooking fuels. The Summit highlighted a number of innovative technologies and alternatives for clean cooking fuels, including electric cooking and small-scale biofuel production, but LPG continued to outshine alternatives in its affordability and reliability.

The WLGA promotes sustainable development goals through LPG as a clean energy source. The WLGA's key focus areas include greenhouse gas emissions reduction, improving energy access, and enhancing energy efficiency. By advocating and facilitating such initiatives, the WLGA contributes to the United Nations' Sustainable Development Goal 7 (SDG7) and other global sustainable and climate actions.

In support of the Summit on Clean Cooking in Africa organised by the IEA, the WLGA signed the Clean Cooking Declaration along with hundreds of stakeholders, pledging to prioritise clean cooking in achieving the SDG7 and make 2024 a pivotal year. Furthermore, the WLGA announced the establishment of the Cooking for Life Africa Task Force (CFLA), which unites industry partners including S&P Global, Equinor, Petredec, Oryx Energies, and TotalEnergies, to develop an LPG Roadmap for Africa.

The Clean Cooking Declaration involves joint forces from governments of Tanzania and Norway, the African Development Bank, and the IEA, a \$2.2 billion USD funding in public and private sectors was committed. The IEA will continue to lead and engage more partners to generate new funds to meet the \$4 billion USD a year in capital investments required between now and 2030 in sub-Saharan Africa.

The WLGA's CFLA Task Force has commissioned this study on an LPG Roadmap for Africa to provide guidance to stakeholders on the countries with the highest potential for making significant strides in expanding LPG consumption by 2030, as well as the support required to achieve these.

THE CONTRIBUTION OF LPG TO THE 17 GOALS



CENTRAL CONTRIBUTION TO SDG7
DIRECT CONTRIBUTION TO 3, 5, 8, 9, 11, 13
INDIRECT CONTRIBUTION TO REMAINING TEN

“

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1.1. The Crisis

Nearly one third of the global population relies on traditional solid fuels, such as firewood, charcoal, animal dung, and crop residues, for cooking. To date, approximately 40% of the total population that does not have access to clean cooking is in sub-Saharan Africa and the rest in developing countries in Asia. The current energy crisis coupled with inflation put further pressure on low-income consumers in a precarious situation, facing reduced income and higher cooking fuel prices.

Reliance on solid biomass fuels also contributes to deforestation and climate change. Harvest of firewood is unsustainable and exacerbates the rate of deforestation. In Africa, the deforestation rate is significantly higher than the global average, driven by agricultural expansion, firewood collection, charcoal production, and infrastructure development. Deforestation has important long-term effects on surrounding communities, including soil degradation, the release of carbon stored in trees, the disruption of water cycles, etc. Traditional cooking methods further contribute to environmental degradation through greenhouse gas emission, as these fuels release carbon dioxide, carbon monoxide, methane, and black carbon.


Significant health issues arise from inhalation of household air pollution from burning biomass fuels. Household air pollution (HAP) from firewood is responsible for one-fourth of global deaths from stroke and other chronic diseases, disproportionately affecting low-income households, particularly in rural areas with limited access to clean fuels.

Women and children face the highest relative risk of exposure to dangerous pollutants, highlighting a critical intersection of health, gender-equality, and poverty. In Africa alone, women and children account for 60% of premature deaths associated with inhaling HAP. Cultural attitudes toward gender significantly influence exposure to HAP, with studies indicating that girls are at a higher risk of pneumonia than boys due to their kitchen activities alongside their mothers. In addition, time and effort spent to gather firewood often hinders the ability of women and girls to education and earn a livelihood.

The issue of access to clean cooking fuels is deeply intertwined with gender inequality women's health, safety, and economic opportunities.



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Not only do women bear the brunt of health issues arising from the use of polluting fuels, but the task of collecting polluting fuels, particularly firewood also predominantly falls on women and girls. This significant time investment detracts from opportunities for education, income-generating activities, and leisure. The burden of fuel collection perpetuates a cycle of time poverty, limiting women's ability to break free from traditional roles and pursue personal and professional growth. The process of gathering fuel often requires women and girls to travel long distances, exposing them to physical risks, including violence and injury. These journeys can be perilous, particularly in regions with high rates of gender-based violence. The safety risks associated with fuel collection further entrench gender inequalities by restricting women's mobility and autonomy.

The time and effort spent on fuel collection and cooking with inefficient stoves reduce women's opportunities to engage in paid work or entrepreneurial activities. This economic disadvantage perpetuates financial dependency and limits women's ability to achieve economic independence. Access to clean cooking fuels can significantly enhance women's economic prospects by freeing up time for productive activities. The responsibility of cooking and fuel collection reinforces traditional gender roles, confining women to domestic spheres and limiting their participation in broader social and economic activities. This reinforcement of gender roles hinders progress towards gender equality and restricts women's potential to contribute to community and national development.

1.2. The Target

The SDG7 started in 2015 to target universal access to affordable, reliable, sustainable, and modern energy. The IEA is a co-custodian for tracking SDG7 progress and is responsible for SDG 7.2 and SDG 7.3 representing renewable energy and energy efficiency, respectively. Emissions and the Net Zero Emissions by 2050 Scenario (NZE) depicts a pathway for the global energy sector to achieve net zero CO₂ emissions by 2050, where the NZE incorporates the SDG7 targets, of which includes access to universal electricity and clean cooking by 2030.

According to the IEA, clean cooking access is defined as: “a household that has reliable access to and uses as their primary cooking means, fuels and equipment that significantly limit or avoid the release

of pollutants harmful to human health”. Modern fuels and technologies include natural gas, LPG, electricity and biogas, or improved biomass cookstoves (ICS). Under this definition, sub-Saharan Africa is the only region where the number of people without access continues to climb, while Asia has made progress in overcoming lack of access using LPG as a cooking fuel.

At the COP28 conference, almost 200 countries pledged a net-zero energy system and to share the goal of improving energy efficiency. One of the key targets is to achieve full access to clean cooking in sub-Saharan Africa by 2030. IEA published two scenarios to explore how access to clean cooking will evolve into 2030.



The time and effort spent on fuel collection and cooking with inefficient stoves reduce women’s opportunities to engage in paid work or entrepreneurial activities.

The IEA published States Policies Scenario (STEPS) and Access for All Scenario to model and monitor 2030 targets.¹

States Policies Scenario (STEPS) – current policy



An average of 79% of the global population will have access to clean cooking.



Population without access declines mainly due to policy efforts in developing Asia. People without access to clean cooking in Africa remains at current level of ~980 million.



Universal access to clean cooking by 2030 is far-fetched as the number of sub-Saharan Africans gaining access to clean cooking barely outpace regional population growth.

Access for All Scenario – to meet target



Universal access to clean cooking across the globe.



Funding increases to \$8 billion USD annually by 2030 from the current \$2.5 billion USD investment each year.



LPG remains the leading fuel, which can be accessed by 45% of the population gaining access by 2030. Out of the remaining population, 32% will use improved biomass cook stoves, 12% with electricity and the remaining with biogas and ethanol.



In rural areas, improved biomass cookstoves play a key role due to lower accessibility to electricity and LPG. By 2030, ~45% of rural households without access today would switch to ICS.



Urban households will primarily access LPG and electricity.

¹ International Energy Agency. Stated Policies Scenario (STEPS).

<https://www.iea.org/reports/global-energy-and-climate-model/stated-policies-scenario-steps>



1.3. The Challenges

Increasing access to clean cooking fuels and LPG in developing countries faces several challenges:

1. Economic Barriers:

Many households cannot afford the initial costs associated with LPG equipment, such as stoves and cylinders, as well as ongoing fuel expenses.

2. Infrastructure Limitations:

Inadequate transport infrastructure hampers the delivery of LPG to rural and remote areas, making it less accessible.

3. Cultural Preferences:

Traditional cooking methods are deeply ingrained, and many households are reluctant to switch due to unfamiliarity with LPG or safety concerns.

4. Policy and Coordination Issues: Effective policymaking requires strong leadership and coordination among various stakeholders, which is often lacking.

5. Awareness and Education:

There is a need for greater awareness of the health and environmental benefits of switching to clean fuels, as many households remain unaware of the dangers of traditional fuels. Similarly, isolated safety incidents involving unsafe bottling and containers have led to a belief in some areas that LPG is unsafe or hazardous.

These challenges necessitate integrated approaches that include government intervention, education, and investment to facilitate the transition to cleaner cooking solutions.

1.4. The Role of LPG

The WLGA and IEA identify LPG as a solution to achieve sustainable development goals, extending its benefits beyond addressing health and climate issues. Historically, LPG has been the fuel of choice for numerous countries to improve cooking conditions for large populations. Approximately 70% of countries that gained access to clean cooking since 2010 did so through LPG.

The success of implementing LPG as a clean cooking fuel stems from the accessibility, affordability, and scalability of LPG that is, most importantly, available to employ as a clean cooking fuel right now with the right regulations, enforcement, and investments.

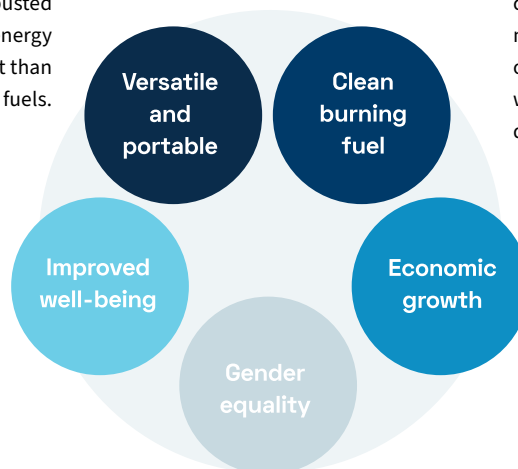
One significant issue is the perception of LPG as merely a transitional fuel rather than a truly clean energy source. This view is compounded by its classification as a fossil fuel, which leads some countries to prioritise solar and electric alternatives. However, since solar and electrification are limited, costly, and require significant lead time, traditional biomass fuels like wood continue to be used extensively, perpetuating health and environmental problems.

LPG remains the most abundant and cleanest available option for many African households. Its ease of transport and storage makes it a practical choice, especially in regions where infrastructure for electricity and solar power is still underdeveloped. LPG is not intended to replace solar or electric energy but rather to serve as an immediate replacement for harmful traditional fuels. By the time Africa achieves widespread electrification, LPG can significantly reduce the reliance on wood and other polluting fuels, thereby improving health outcomes and environmental sustainability.

Understanding the role of LPG involves recognising what it replaces: not the future potential of solar or electric power, but the current reality of inefficient and dangerous cooking methods. As efforts to electrify Africa continue, LPG offers a viable interim solution that can bridge the gap, providing cleaner, safer, and more efficient cooking options for millions of households.

LPG can be transported in small cylinders and then combusted for cooking. LPG has high energy content, making it more efficient than other fuels.

LPG combustion is cleaner and reduces HAP, which is responsible for premature deaths and other diseases.



Combustion of LPG produces much lower levels of CO₂ and other pollutants in comparison to traditional biomass cooking methods and emits virtually no black carbon if spilled that would otherwise contribute to global warming. Switching to LPG also slows deforestation rates.

LPG industry supports economic growth at both national and local levels, creating job opportunities and supporting entrepreneurship.

LPG as a fuel cuts opportunity costs for women, allowing more time to pursue education, livelihood, and other opportunities. Development of LPG industry has engaged many women in the workforce.

02

LPG as an Abundant Clean Fuel for Today





The growing global recognition of LPG as a clean and abundant fuel source has significant implications for energy markets and environmental sustainability. Over the past decade, LPG supply has surged, primarily due to advancements in extraction technologies in the United States, which have transformed the landscape of global energy production. The dynamics of the LPG market reveal the factors contributing to its increased availability and the resulting competitive pricing that positions LPG as a viable alternative to more carbon-intensive fuels. As demand for LPG rises, particularly in the residential and commercial sectors across Asia, the potential for LPG to play a crucial role in achieving clean cooking fuel targets in regions like sub-Saharan Africa becomes increasingly evident. This analysis delves into the interplay between supply, demand, and the socio-economic benefits of LPG adoption, underscoring its significance in the transition to cleaner energy solutions.

2.1. LPG Market Dynamics

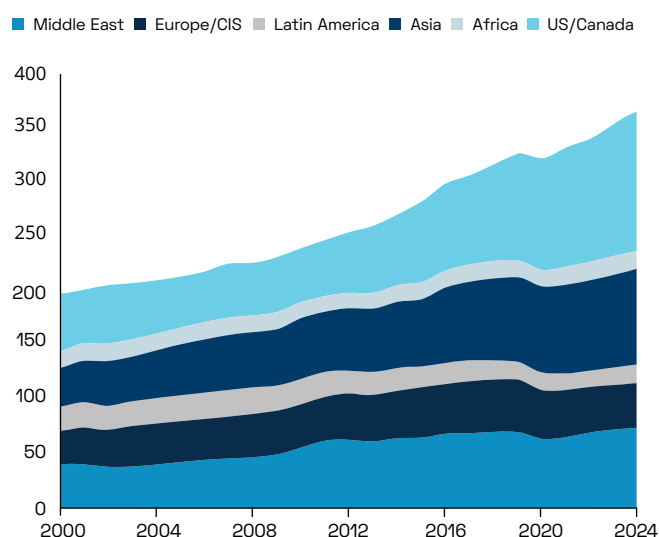
Global LPG supply has grown rapidly in the last decade, primarily driven by the US, where production from shale oil and gas reserves has nearly doubled. Traditionally, LPG was produced at refineries or from processing natural gas at major gas fields in the Middle East. However, the advent of horizontal drilling and fracturing in US shale has led to increased recovery and processing of LPG from natural gas associated with shale oil-focused drilling. This major shift in the LPG market resulted in an abundance of LPG and lower global prices, leading to strong demand responses as LPG became price competitive with other residential and commercial fuels, replacing more expensive and carbon-intensive options like coal and oil products, especially in Asia.

LPG production is expected to continue growing into the mid-2030s, when US shale production peaks, and remain abundant through 2050. Demand will keep pace with supply, with the petrochemical sector playing a significant role in balancing the global LPG market. LPG serves as a price-sensitive feedstock at petrochemical crackers, particularly in Asia, so when

the market is oversupplied and prices are weak, Asian petrochemical companies will source surplus LPG. Therefore, LPG poses an affordable and available fuel option to replace polluting cooking fuels in sub-Saharan Africa, with ample supply to meet aggressive clean cooking fuel targets.

LPG Production by Region

Million metric tons



Source: ©S&P Global Commodity Insights

¹ World LP Gas Association (2013). Substituting LP Gas for Wood: Carbon and Deforestation Impacts.

² World Health Organization (WHO). Household Air Pollution.

<https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health>

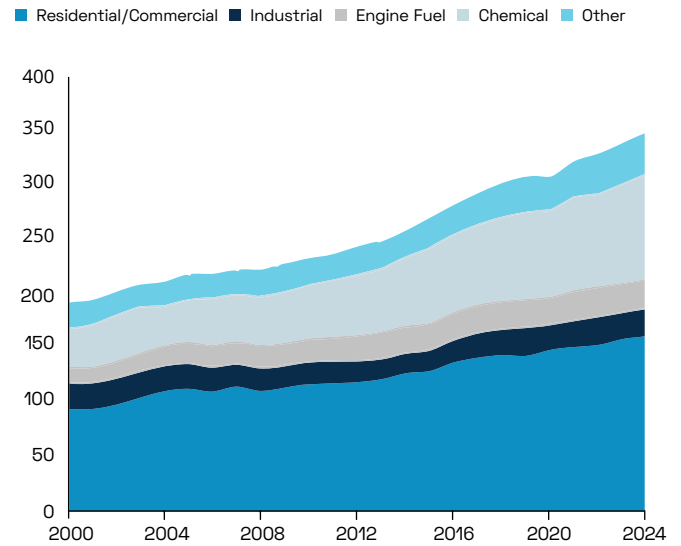
³ The Global LPG Partnership (GLPGP). National Feasibility Study: LPG for Clean Cooking in Cameroon.

<https://glpgp.org/s/GLPGP-Clean-Cooking-for-Africa-Cameroon-National-Assessment-2019.pdf>

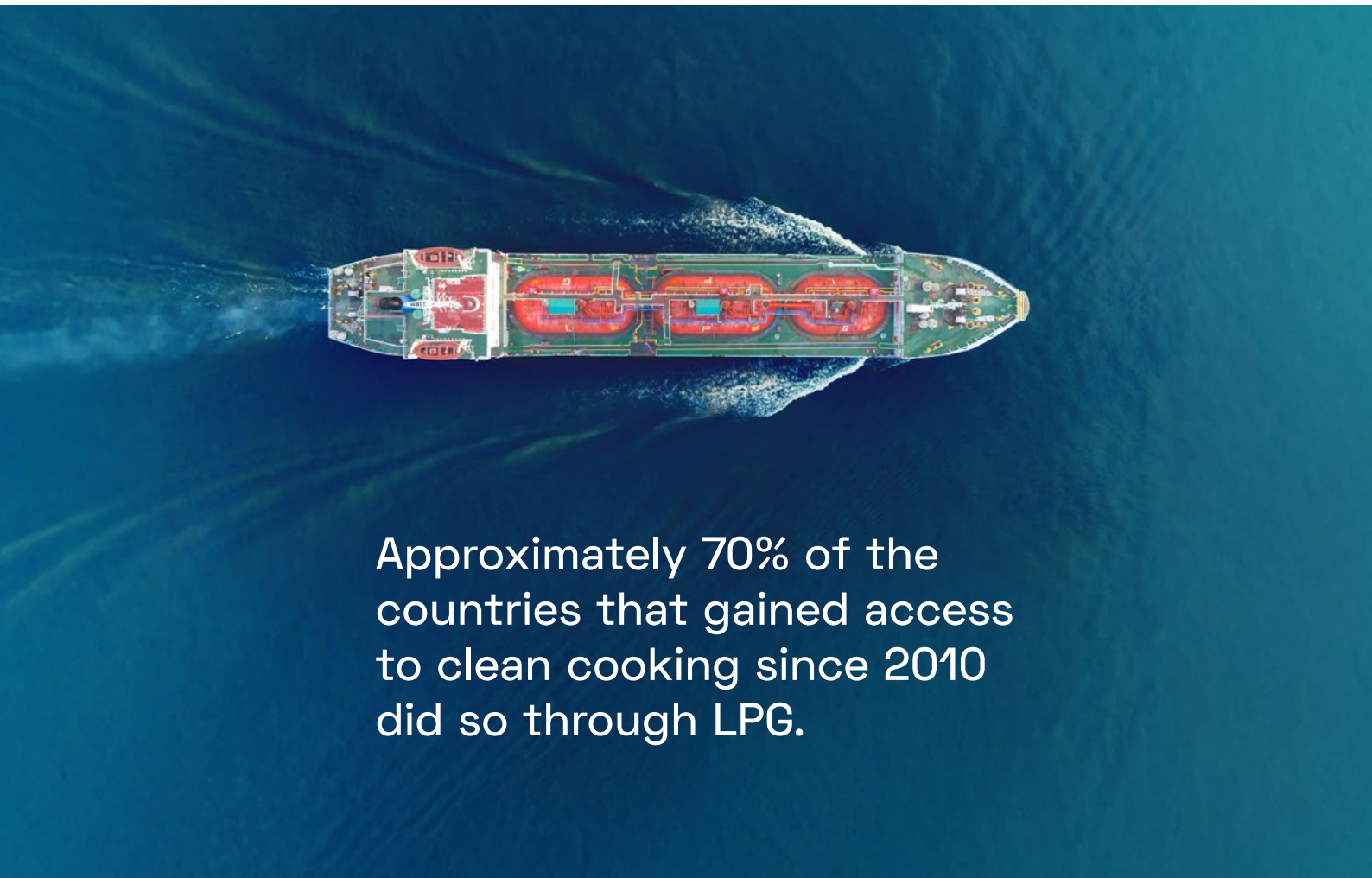
Global LPG demand continues to be driven by the residential and commercial sectors, with increasing consumption from the petrochemical sector. Notably, an increase in LPG consumption in the residential and commercial sectors is observed across various countries, particularly in China, India, and Indonesia. As LPG demand in these sectors stagnates in the long term, the petrochemical feedstock is expected to consume the surplus. Northeast Asia, primarily driven by refinery production in China, has experienced significant production increases, accounting for roughly a quarter of global growth over the last decade.

North America and the Middle East are the largest net exporters of LPG, primarily exporting to Asia and the Indian Subcontinent. The Far East mostly imports from the US, while the Middle East focuses more on Southeast Asia and the Indian Subcontinent. Europe will continue as a net importer of LPG, albeit with a drop in trade volumes in the long term.

LPG Demand by Sector
Million metric tons



Source: ©S&P Global Commodity Insights



Approximately 70% of the countries that gained access to clean cooking since 2010 did so through LPG.



Providing access to LPG for just half of the sub-Saharan Africa population would save 260 million to 312 million trees per year or about 400,000 hectares of forestland that would otherwise be used for fuel, an area roughly three times the size of Lagos.

2.2. Social and Environmental Benefits of LPG as Clean Cooking Fuel

The adoption of LPG as a cooking fuel offers substantial environmental and social benefits. By reducing reliance on traditional biomass fuels, LPG can significantly mitigate deforestation and conserve vital forest resources. This transition also addresses household air pollution, which is linked to millions of deaths globally, particularly among vulnerable populations. Additionally, LPG use can lead to considerable reductions in carbon dioxide and black carbon emissions, enhancing air quality and public health. The shift to LPG not only promotes environmental sustainability but also supports gender equality by reducing the time spent on fuel collection, allowing women and children to engage in more productive activities. Overall, the widespread adoption of LPG can yield significant socio-economic advantages, positioning it as a critical solution for clean cooking and energy access.

Averted Deforestation

Use of wood in traditional cooking has led to a wave of deforestation in Africa and around the world, which has a dual impact of depleting forests while also leading to longer times and distances for families to source firewood. Deforestation concerns and declining supply of accessible firewood is an especially prevalent concern in countries like Kenya and other East African countries. Increasing access to LPG would lead to a decrease in localised deforestation, while also reducing the time spent gathering firewood.

If over a billion people switch to LPG by 2030, 1.2 million hectares per year would be saved – equivalent to nearly one-quarter of current global deforestation. At the household level, switching 100 households from consuming 200 tons of harvested wood per year to instead consume 1.8 tons of LPG would save one hectare of forest each year. Each household would save about 100 square meters of forest and a typical 13 kg cylinder of LPG would avert deforestation of seven square meters of forest.²

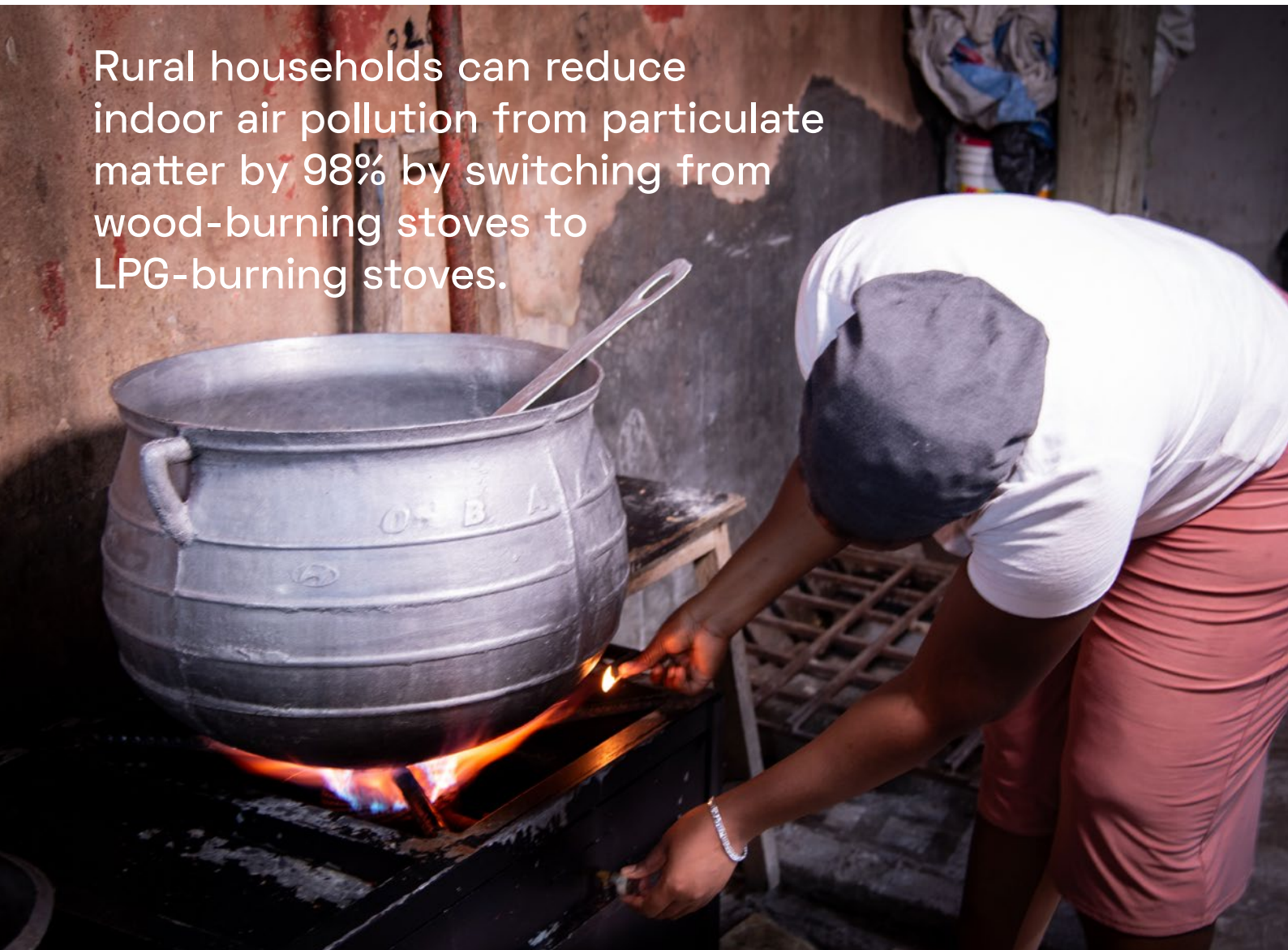
² World LP Gas Association (2013). Substituting LP Gas for Wood: Carbon and Deforestation Impacts.

Household Air Pollution (HAP)

The World Health Organization (WHO) estimated that household air pollution was responsible for an estimated 3.2 million deaths per year as of 2020, including over 237,000 deaths of children under the age of five. Particulate matter and other pollutants in household air pollution inflame the airways and lungs, impair immune response, and reduce the oxygen-carrying capacity of the blood.³

The Global LPG Partnership (GLPGP) found in its evaluation of Cameroon's microfinance programmes that the level of household air pollution fell significantly, to below the WHO's indoor air pollution interim targets, in households that adopted LPG through these programmes. It also found significant reductions in headaches and eye problems likely caused by household air pollution.⁴

Rural households can reduce indoor air pollution from particulate matter by 98% by switching from wood-burning stoves to LPG-burning stoves.



³ World Health Organization (WHO). Household Air Pollution.

<https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health>

⁴ The Global LPG Partnership (GLPGP). National Feasibility Study: LPG for Clean Cooking in Cameroon.

<https://glpgp.org/s/GLPGP-Clean-Cooking-for-Africa-Cameroon-National-Assessment-2019.pdf>

Black Carbon Emissions Averted

Black carbon, also known as soot, is produced by the incomplete combustion of biomass. As a greenhouse gas, black carbon absorbs sunlight and heats the atmosphere. In fact, it absorbs one million more times energy than CO₂, making it the second largest contributor to climate change after CO₂.⁵ As indoor air pollutant, black carbon is known as a fine particulate matter that, when inhaled, penetrates deep into the lungs and enters the bloodstream, leading to inflammation of the lungs, restricted lung function, and overall lead to degradation of lung functioning, as well as chronic lung conditions. LPG emits no black carbon upon combustion, averting essentially all black carbon emissions and nearly all indoor air pollution.

Increasing access to LPG to 25 kg/year per capita would reduce black carbon emissions by 130,000 tons of black carbon in 2030, which is equivalent to 117 million tons of CO₂ each year, nearly offsetting Nigeria's annual CO₂ emissions of 123 million tons.

⁵ Cho, Renée. "The Damaging Effects of Black Carbon." Columbia Climate School, March 22, 2016. <https://news.climate.columbia.edu/2016/03/22/the-damaging-effects-of-black-carbon/>.

CO₂ Emissions Averted

LPG as a cooking fuel in Africa offers significant environmental benefits, particularly in terms of reducing carbon dioxide (CO₂) emissions. LPG burns more efficiently than traditional biomass fuels like wood and charcoal, resulting in lower CO₂ emissions. This efficiency is due to LPG's higher hydrogen-to-carbon ratio, which allows it to produce more energy per unit of carbon emitted. Additionally, LPG does not emit significant amounts of black carbon and methane, which are potent climate pollutants. By reducing these emissions, LPG helps mitigate climate change more effectively. Some estimates suggest that if 1.2 billion people switch from wood to LPG, this would create a net annual atmospheric reduction of 279 million tons of carbon dioxide. That is roughly equal to current annual emissions from mid-sized countries such as Taiwan and Malaysia.⁶

Each household in Africa that switches from firewood to LPG as a cooking fuel would avert 490 kg of CO₂ per year, the equivalent of driving a gasoline-powered car 1,200 miles.

⁶ World LP Gas Association (2013). Substituting LP Gas for Wood: Carbon and Deforestation Impacts.

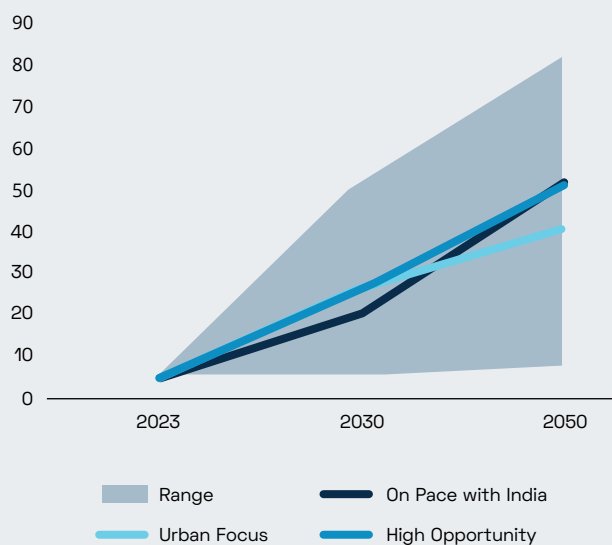
2.3. LPG Access Scenarios

SPGCI modeled a number of scenarios for access to LPG as a clean cooking fuel in sub-Saharan Africa in order to determine a range of LPG consumption as more of the population gains access to LPG. Each scenario lies within a range representing the minimum or baseline growth and the maximum potential for LPG consumption through 2050.

The **bottom of the range** projects current LPG per capita consumption by country, assuming demand grows alongside population growth, but demand is limited by lack of investment and supportive policy and regulation. This corresponds to a “business as usual” scenario, a scenario in which moderate growth continues in the countries that have made inroads in recent years, but without any further policy or investment support that would allow growth to continue. It formulates the bottom of our “range” of potential outcomes. At 4.8 million tons of LPG consumption and population of 1.2 billion, sub-Saharan Africa consumes roughly 4 kg per capita of LPG, far below even Western Europe, where most of the population has easy access to electricity and natural gas, and even further below other developing regions like Latin America, where LPG markets are mature (80-90% of households use LPG) and consumption is 30 kg per capita. Without immediate and considerable advancement in regulation and investment, there remains risk that access to LPG will remain limited, which will prevent providing the population of sub-Saharan Africa access to clean cooking fuel in the forecast period.

Residential LPG Demands Scenarios, Sub-Saharan Africa

Million tons



Source: ©S&P Global Commodity Insights





The **top of the range** reflects a scenario in which the IEA's goal of universal access by 2030 is met primarily with LPG, effectively projecting the highest potential consumption of LPG in sub-Saharan Africa by 2030 and 2050. This scenario assumes there are no bounds to LPG consumption as a primary residential fuel. At 25 kg per capita of LPG consumption in 2030, sub-Saharan Africa would still be consuming less LPG per capita than Latin America, and LPG demand would be roughly in-line with US LPG consumption volumes. Though the growth in this scenario is exceptional, ~50 million tons of LPG consumption in a populous and growing region such as sub-Saharan Africa can be attainable in the future with the right regulations and targeted investment.

In the middle of the range are three scenarios that chart an aspirational course in LPG demand growth by 2030 and by 2050. These scenarios present plausible outcomes enabled by the recommendations in this Roadmap, which include LPG regulation, investment, and infrastructure.

In the **On Pace with India** scenario, average LPG per capita in Sub-Saharan Africa grows from an average of 4 kg per capita to 10 kg per capita, one of the fastest five-year per capita growth rates that a developing country has accomplished. India's twenty-year per capita growth is then applied to 2050. Though India is an unprecedented success story in adopting LPG as a clean cooking fuel, there are many dissimilarities between the country of India and the region of sub-Saharan Africa. However, India serves as proof that the magnitude of growth in this scenario is possible within the confines of existing LPG market conditions.

The **Urban Focus** scenario assumes that sub-Saharan Africa's urban centres, which account for ~44% of the population, are prioritised for the switch to LPG throughout the forecast, reaching 25 kg per year in 2030 and 40 kg per year in 2050, while LPG consumption in rural areas remains at current levels. Prioritising urban LPG infrastructure, like storage, filling stations, and distribution networks, will support access to large urban and peri-urban populations, where access to financing and capital is often greater, and create economies of scale that can be expanded into rural areas in the future.



The **High Opportunity** scenario assumes that LPG per capita consumption grows to 25 kg per year in 2030 and 40 kg per year in 2050 in the countries this study has identified as “High Opportunity” while the remainder of Sub-Saharan African countries remain at current levels of LPG consumption. SPGCI has identified 11 sub-Saharan African countries (Figure 4) that have experienced LPG demand growth and/or have made considerable progress in creating the regulatory and investment environment to support substantial LPG growth – even if opportunities remain to make these efforts more lasting. This scenario assumes that foreign investment and capital is targeted to these countries amenable to LPG and LPG markets within these countries expand considerably, which can then be replicated in other sub-Saharan African countries in the future.



	Population	LPG Residential/ Commerical Demand	Consumption per capita (2024)	Target Consumption per Capita (2030)
Angola	37	471	13	25
Burkina Faso	23	119	5	25
Cameroon	29	130	4	25
Ghana	34	297	9	25
Kenya	59	399	7	25
Mozambique	35	39	1	25
Nigeria	228	1114	5	25
Rwanda	14	34	2	25
South Africa	62	411	7	25
Tanzania	67	198	3	25
Togo	9	17	2	25

High opportunity markets for LPG consumption in Sub-Saharan Africa

	Supply	Infrastructure	Economic Growth	Existing LPG Market	Policy	Investment Climate	Affordability
 Angola	Excess domestic production and LPG exports; additional supplies needed in future	Considerable existing oil infrastructure and transport network primarily along coast; rural buildout needed	Oil prices and inflation impacting growth; long-term growth requires structural reform and eliminating corruption	Strong retail markets in urban centers; NOC plays large role along with private, int'l operators	Private partnerships like Eni's Clean Cooking Program; limited gov't policy	Tax concessions and reform of state control positive; corruption continues to deter int'l lenders	Unwinding fuel subsidies; domestic supply should keep prices lower than importing countries
 Burkina Faso	No domestic supply; relies primarily on imports from neighboring countries	Entirely dependent on trucking, but only 24% of roads paved, heavy investment needed	Security issues and inflation impacting growth; dependence on mining	Strong retail markets with strong int'l LPG market players	Gov't proactive in promoting LPG, and initiated partnership with international LPG stakeholders	Security issues pose serious risk to investment; limited infrastructure	LPG still subsidized, long-term affordability at risk
 Cameroon	No domestic supply; proximity to producing regions and import infrastructure positive	Established oil product storage, rail/road transport	Strong growth in agribusiness, forestry, services; strong gov't spending; structural reform needed	Established, competitive retail market with multiple private and int'l players	National LPG Master Plan promoting LPG as a clean cooking fuel; multiple pilot studies underway	Political stability at risk; France and China large investors	Proximity to supply regions and Atlantic imports positive
 Ghana	Domestic production from refineries and natural gas production; additional supplies need in future	Significant investment in LPG bottling, transport on roads/rail; growing storage; rural buildout needed	High public debt, inflation, and interest rates impact growth; structural reform needed	Strong gov't commitment to LPG, diverse and established retail market	National LPG Promotion Policy as clean cooking fuel agenda with LPG at the forefront	Relatively low risk; macroeconomic factors impact attractiveness; positive for extractive markets, incl. LPG	Existing markets and distribution to lead to economies of scale; proximity to supply and Atlantic imports positive
 Kenya	No domestic supply; limited storage infrastructure	Investment in storage and bottling plants underway rural buildout needed	Among Africa's fastest growing economies; risk on strict monetary policy, reduced public spending	Diverse and experienced distribution and retail markets	Ambitious clean cooking fuel goals and strategy with LPG at the forefront	Economic uncertainty, rural safety risks; gov't support for LPG very strong	Established distribution networks positive; efforts to reduce taxes on gas cookers, etc.; import price uncertain
 Mozambique	Mixed domestic and int'l supply, imports will decrease as LNG project takes off this year	Current storage, ports and pipeline available for international trade; expansion planned in near future	Overall robust growth and will likely improve in the near term as LNG exports start	TotalEnergies to serve LPG via retail market and PAYGO solutions with local government support	Gov't identified gap in clean cooking access, however, still lacks LPG incentives and actionable items	NOC's (Petromoc) dominant market position and subsidy burdens deter investments	Supply from the new LNG project provides short term relief
 Nigeria	Excess domestic production, redirecting exports to domestic market; add'l supplies needed in future	Established oil product storage, rail/road transport	Limited growth; long-term risk due to corruption, political instability, insufficient diversification	Diverse and experienced retail market with private investment in LPG storage, distribution	National Clean Cooking policy positive; enforcement of CRM needed	Political and economic risk compounded by very high inflation	Currency deflation leading to high fuel prices
 Rwanda	No domestic supply, dependent on imports which will increase with demand	No refining capacity and insufficient storage capacity; landlocked country with expensive road access	Heavily focused on agriculture, gov't pivoting towards industrial and services economy	Liberalized LPG market; diverse retail market with multiple international and domestic companies	Gov't developed National LPG Master Plan and results-based financing program rollout with partners	Licensing requirements induced international investment and M&A in a fairly liberalized downstream market	Positive regulatory environment to improve affordability through investment and financing instruments
 South Africa	Previous supply shortages overcome, new import infrastructure to support supply security	Established oil product storage, rail/road transport in east of country; more rural investment needed	Moderate growth expected; complex and diverse economy; challenges to rural economic growth	Established, competitive retail market with multiple private and int'l players	Some NGO and private partnership efforts; lack of strong gov't commitments to clean cooking agenda	Stable, low risk investment climate	Improving, import parity prices are competitive for distributors
 Tanzania	No domestic supply; proximity to Middle East markets positive	Relatively expansive existing road and rail network; more storage and rural investment needed	Strong growth from agricultural sector; strong diversification efforts, but economy still commodities-driven	Relatively small volumes, strong distributors and some smaller distributors, expansion needed	Strong government-led National Clean Cooking Strategy	Relatively stable and low risk investment climate; increasingly open to foreign investment	Rail/road network positive for cost
 Togo	No domestic supply; proximity to producing regions and import infrastructure positive	Growing storage, trans-country highway, major coastal port positive; secondary road investment needed	Strong growth expected following series of reforms; region instability remains a risk	Relatively small volumes, strong distributors and some smaller distributors, expansion needed	Climate change plan Nationally Determined Contribution; strong advocates for LPG as clean cooking fuel	Stable, low risk investment climate	Proximity to supply regions and Atlantic imports positive

Legend: ● Drivers of Opportunity ● Challenges to Overcome ● Major Roadblocks

Case Study: LPG as a clean Cooking Fuel in India

India's journey towards universal access to clean cooking fuels has been marked by significant reforms and innovative strategies. The country's LPG subsidy reform, initiated through a decade of understanding the barriers to mass adoption, culminated in the introduction of the Direct Benefit Transfer of LPG Scheme (PAHAL) in 2014.

This program transformed the subsidy mechanism by providing unconditional cash transfers directly to households' bank accounts after purchasing LPG cylinders, thereby eliminating the inefficiencies of the previous system.

Previous system

- **Fixed price for all:** Unlimited LPG cooking fuel delivered to residence in response to consumer bookings with one the Oil Marketing Companies (OMCs) at subsidized prices fixed by the government.
- **Heavy subsidy burden:** OMCs, government, and different income-level consumers carry the price discrepancy between subsidized and international market prices of LPG, where subsidized price could be multiples higher.
- **"Ghost" LPG:** The difference in LPG prices incentivized intermediaries to divert LPG for profit, where evidence pointed to a much higher black-market cylinder price. End-consumers were unaware of this "disappearing" LPG supply.



New system

- **LPG supply chain transparency:** Online portal for consumers to check their LPG cylinders and services, evaluate distributor performances and change distributors if needed, and provide information on the entire LPG supply chain for improved social audits.
- **"Give It Up" and beyond:** Government initiated "Give It Up" campaign to urge wealthier households to voluntarily relinquish their LPG subsidy, and eventually proposed an income limit for households to qualify for LPG subsidies.
- **De-duplication:** Capped quantity on subsidized LPG to each connection holder and scrutinize each legitimate connection to eliminate all falsified connections, thus minimizing leakage.

Implementation of Clean Cooking Gas Scheme

In 2016, India launched the Pradhan Mantri Ujjwala Yojana (PMUY) to provide free LPG connections to below poverty line households, further boosting LPG penetration. Educational fairs (Melas) were organized to raise awareness about the health benefits of LPG and simplify the process of obtaining new connections.

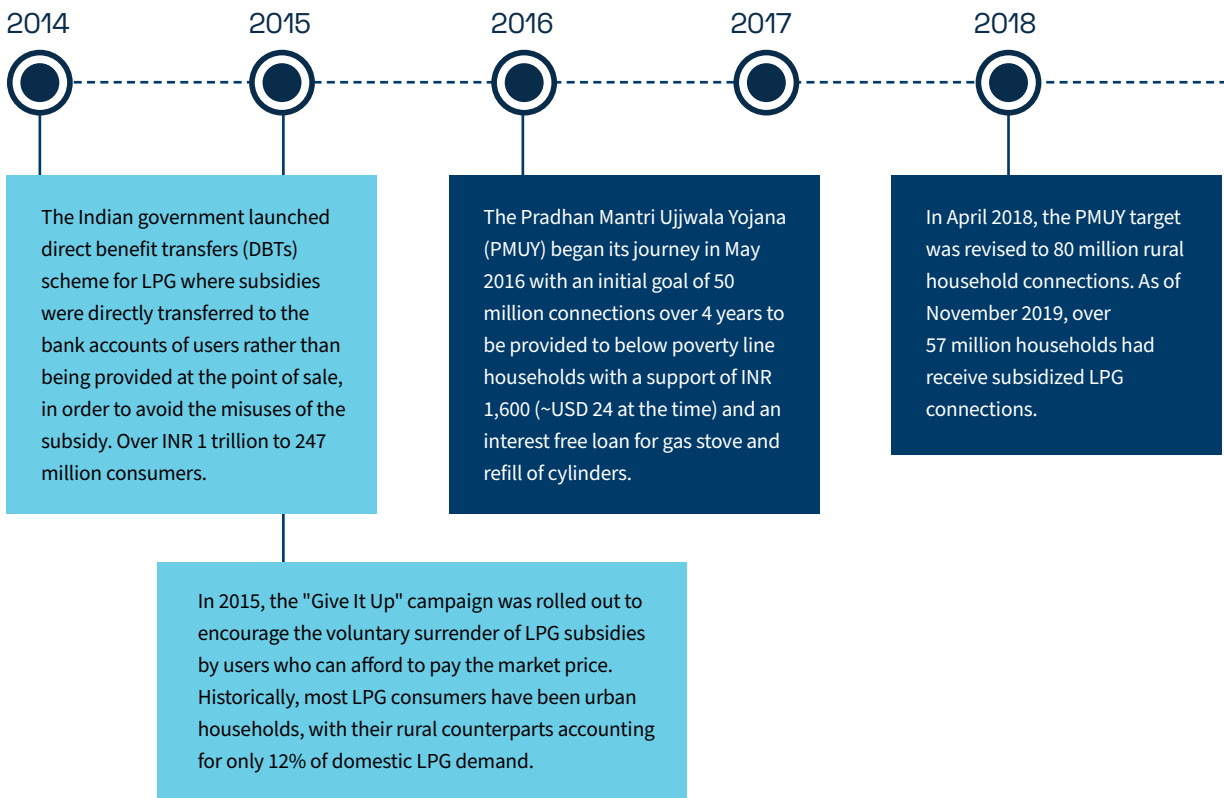
Achievements

By 2019, the government had distributed 80 million LPG connections, increasing penetration from 62% to 99.8% by April 2021. The PAHAL scheme, recognized by the Guinness Book of World Records as the largest cash transfer program, played a crucial role in this success. The “Give It Up” campaign and the PMUY scheme collectively enhanced LPG accessibility, particularly among rural and marginalized communities.

Continued Growth and Future Prospects

LPG coverage continued to grow, reaching 99.5% in January 2021. The government announced PMUY 2.0 in August 2021, targeting an additional 10 million connections, which was completed by January 2022. As of September 2022, the total number of connections under PMUY stood at 90.4 million, with a subsidy of INR 200 per cylinder for all beneficiaries. The goal is to achieve 100% LPG penetration by the end of FY23.

India’s LPG subsidy and roll-out program has been a cornerstone of its energy transition towards cleaner fuels. By improving the equity of LPG access and empowering women, the program aligns with India’s sustainable development goals and its commitment to reducing greenhouse gas emissions under the Paris Agreement. The success of this initiative demonstrates the potential of well-designed subsidy reforms and targeted campaigns in achieving widespread adoption of clean cooking solutions





2019

2020

2021

2022

LPG coverage penetrated to about 90% across the country, of which about 45% were active rural domestic connections. The Indian government achieved its 80 million target ahead of time in September 2019, increasing LPG penetration rate from 62.7% in April 2016 to 96.5%.

LPG coverage continued to grow and reached 99.5% in January 2021. In August 2021, the government announced PMUY 2.0 with a target of 10 million new connections. The scheme was completed in January 2022.

The total number of connections released under the PMUY is 90.4 million as of September 2022. The government announced INR 200 (~USD 2.5) subsidy per LPG cylinder to all beneficiaries. The government aims to reach 100% LPG penetration in all states by the end of FY23.

03

Foundations & Best Practices for an LPG-led Solution



3.1. Prioritise Regulatory Foundations

Every country will face its own challenges in increasing access to LPG, depending on infrastructure, investment environment and risk, and will necessarily craft its own LPG roadmap. However, the first and most important step on the pathway to access is to create, execute, and enforce clear regulations around a country's growing LPG industry.

Create Partnerships

The first steps to prioritising regulatory foundations are to build, strength, and expand new and existing partnerships between African government representatives and market players and industry associations. The process begins with education and awareness of the benefits of LPG as a clean cooking fuel, the functionalities and trends in LPG markets, and the importance of recommendations. This awareness campaign will help to identify key advocates in African governments and in the LPG industry that can work together to apply key regulatory foundations for the growth of LPG in progressive African governments.



Promote the Cylinder Recirculation Model (CRM)

Among the regulations to promote and support, the Cylinder Recirculation Model (CRM) should be at the forefront of the regulation conversation. The WLGA has published extensive guidelines for and analysis of the CRM in its *Guidelines for the Development of Sustainable LPG Markets – Early Stage*.⁷

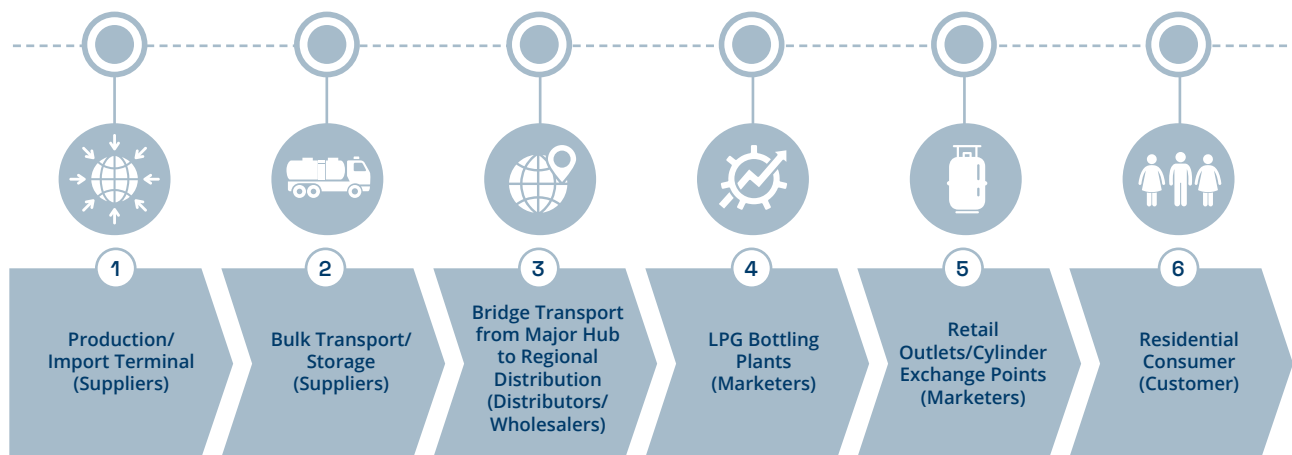
The marketer-controlled cylinder distribution model or “Cylinder Recirculation Model” (CRM) has proven its success in most countries around the world, as it increases consumer access, enhances cylinder safety, encourages infrastructure investment and market supply, and ensures transparency and accountability of every cylinder.

The growth of early-stage (< 10 kg per capita per year of LPG consumption) LPG markets is closely linked to the efficiency and effectiveness of a national system for safe transportation of LPG cylinders between suppliers and end-users. Therefore, the WLGA emphasised the importance of local government regulation in implementing the CRM and identified that a commercially sustainable LPG market should enable and encourage LPG marketers to continually inject new cylinders into the market, make on-going investments to improve distribution networks such that cylinder retail points are within walkable distance to end-users, and ensure public safety through regulations on the distribution system.

With many countries in Africa in need of additional cylinders, managing the risk to investment in cylinder expansion is crucial. Instilling confidence in private sector participants regarding their investments in LPG cylinders involves two policies: a refundable deposit scheme and government oversight to prevent illegal activities. Understanding the associated risks with the CRM will enable proper implementation and government intervention.

⁷ World Liquid Gas Association (2014). Guidelines for the Development of Sustainable LPG Markets – Early Stage.

<https://www.worldliquidgas.org/wp-content/uploads/2014/10/guidelines-for-the-development-of-sustainable-lpg-markets.pdf>



In Cameroon, the government has adopted the CRM in its National Master Plan as of 2016. While LPG consumption has grown 30% since adopting its CRM policy, per capita consumption remains at the sub-Saharan Africa average of 4 kg per capita per year. The National Master Plan currently includes a provision for local “wholesalers,” which handle one-third of the country’s LPG, permitting them to accept cylinder returns of any brand.⁸ In the case of Cameroon, there are still improvements to be made in the implementation of its CRM policy.

Ghana, on the other hand, followed an alternative Customer-Controlled Cylinder Model (CCCM), in which the customers owned their own cylinders. Because this model often leads to improper filling and incomplete inspections, there were a number of accidents at refill stations and during the transport of LPG. These accidents created safety concerns among consumers and LPG consumption has declined by 20% since peak consumption in 2011. Ghana committed fully to the CRM policy as of September 2023 to improve safety and accessibility.

The commitment to and enforcement of the CRM will ensure the long-term viability of LPG as a clean cooking fuel as it will ensure safety and transparency for the consumer and will encourage the long-term investment in cylinder supply from the LPG industry.

Promote Cylinder Safety Regulation

LPG cylinders involve multiple safety concerns throughout the lifecycle, including cylinder integrity, handling, transportation, and refilling.

The WLGA provided details on design and safety of LPG cylinders, correct refilling procedures to avoid overfilling and contamination, regular inspections to ensure no cylinder leakage. The *Good Practice Guidelines for LPG Cylinder Management* is an international standard that covers everything from the type of material from which the cylinder is manufactured, to procedures for refilling a cylinder at the filling plant. For example, a filling plant must test and verify that cylinders are leak-free before refilling and withhold refilling if the cylinder does not meet safety specifications.⁹ The guidelines also consider safety throughout the lifecycle of LPG cylinders. This includes aspects such as cylinder selection, design, manufacturing, maintenance, repair, requalification, and scrapping.

One key advancement in cylinder safety has been the development of composite LPG cylinders, or cylinders made from heavy-duty high-density polyethylene (HDPE) plastic instead of the traditional steel. Composite cylinders are explosion-proof due to their fiber-reinforced materials, which can withstand high pressures and impacts. Their jointless design minimises weak points, further enhancing safety. Composite cylinders have historically been more expensive, limiting distribution, but manufacturing costs have continued to decline and composite cylinders have become increasingly cost competitive relative to traditional steel cylinders, especially when considering long-term savings associated with increased safety, cylinder lifespan, lower weight relative to steel, and environmental impact.

⁸ The Global LPG Partnership (GLPGP). National Feasibility Study: LPG for Clean Cooking in Cameroon.

<https://glpgp.org/s/GLPGP-Clean-Cooking-for-Africa-Cameroon-National-Assessment-2019.pdf>

⁹ World Liquid Gas Association (2013). Guide to Good Industry Practices for LPG Gas Cylinder Management.

<https://www.worldliquidgas.org/wp-content/uploads/2013/05/guide-to-good-industry-practices-for-lp-gas-cylinder-management-2.pdf>



Foundations for Competitive and Effective Fiscal Policy

A range of fiscal policies have been implemented to promote the adoption of LPG as a cleaner and safer alternative to traditional cooking fuels in Africa and globally. Subsidies tend to be one of the most common policies in countries committed to ramping up LPG and other fuel consumption. While subsidies do contribute to short-term energy access and accessibility, these subsidies have also been a strain on national budgets, particularly in Africa. Subsidies are also difficult to retract, as evidenced in Latin American markets, and lead to long-term price uncertainty, lack of private market investment, and atrophy in clean cooking fuel consumption. Nevertheless, competitive and effective fiscal policy is still crucial to growing LPG imports and distribution in Africa.

The Angolan government controls fuel prices (gasoline, diesel, LPG) and retail fuel prices are among the lowest in sub-Saharan Africa because of subsidies. Since 2014, the government has been reducing subsidies and increasing fuel prices due to the financial strain of subsidies. These fuel prices often fall considerably below international market levels due to heavy subsidies that include a fixed retail price. Total fuel subsidies are estimated to be 3.7% of GDP, with gasoline, diesel, and LPG combined accounting for 94% of the total subsidies. However, individual households absorb only 32% of the subsidised amount, as subsidies disproportionately benefit industries and wealthy individuals or due to fuel smuggling, black market activities, inefficient distribution networks.

Similar to the experience in other countries around the world, Angola's spending on fuel subsidies has negatively impacted

the nation's fiscal balances and limits spending on development elsewhere. This is particularly the case when subsidies are broad (and not targeted), such as has been the case in more developed markets like Ecuador and Morocco. Once subsidies are in place for a long time, it is very difficult to reduce or eliminate them. This occurred in Ecuador, where the government tried to tackle subsidies and was forced to abandon the measures. In the case of Morocco, the objective of reducing the government deficit led the country to announce a gradual decrease in LPG subsidies. Furthermore, heavy subsidies in Angola have incentivised fuel smuggling, particularly to neighboring countries like the Republic of Congo and the Democratic Republic of Congo, aggregating to 10% of total fuel consumption.

Domestic fuel usage is concentrated in the wealthier 40% of the population, and only 7% is consumed by the poorer 40% of the population. This creates an undesirable cycle that high-income households would benefit more from fuel price subsidies than low-income households, thus affecting the purpose of subsidy policies. However, the elimination of subsidies would have a substantial negative impact on low-income households as there would be even fewer Africans with access to clean fuels including LPG.

The challenges of subsidies continue to develop in North Africa, as well. However, direct subsidies are only one of the potential policies that encourage the use of LPG and increase affordability to the consumer, such as targeted subsidies, indirect subsidies, and tax incentives, such as a waiver of duties and/or VAT on LPG equipment.

Targeted subsidies that support low-income consumers have been successful in some countries. In El Salvador, universal price subsidies were replaced with income transfers based on electricity consumption. In India, the Direct Benefit Transfer (DBT) system leverages modern Information and Communication Technology (ICT) to transfer benefits into the bank or postal accounts of accurately targeted beneficiaries. The system often uses Aadhaar, India's unique identification number, to ensure that benefits reach the intended recipients. Beneficiaries are required to link their bank accounts with their Aadhaar numbers, which helps in accurately targeting and delivering benefits. The system uses core banking channels for transferring funds, ensuring efficiency and reducing the chances of fraud. These targeted subsidies schemes require extensive financial technology and widespread access to banking and financial institutions, which may be challenging for countries in Africa.

Subsidies typically impact private investment in fuel markets as producers, distributors, and marketers often fail to profit when LPG prices are artificially low. In addition to subsidising LPG for low-income consumers, India's DBT system compensates LPG producers and distributors for the difference between the market price and the subsidised price directly to the producers. Indonesia and Saudi Arabia also compensate domestic producers to account for the low domestic LPG prices and Mexico utilises a government-funded stabilization fund to compensate LPG producers and distributors for revenue losses when domestic prices fall below international prices.

In lieu of direct compensation to LPG market players, an option for a competitive and effective fiscal policy is to subsidise and/or incentivise enablers along the supply chain, including in transportation, distribution, and manufacturing. Kenya and Ghana have experimented with various financial initiatives in order to create a more favorable regulatory environment that includes reducing import duties on materials and equipment necessary for clean cooking solutions, such as gas cookers and other LPG-related equipment.

In 2022, Kenya reduced its Value-Added Tax (VAT) to 8% and, in 2023, the Finance Bill proposed to exempt LPG from all taxes and levies, including VAT, Import Declaration Fees (IDF) and Railway Development Levy (RDL) to make it more affordable, leading to an increase in demand. Nigeria's Gas for Growth Initiative exempts machinery, equipment, or spare parts imported into Nigeria for the exploration, processing, or power generation through the utilisation of Nigerian gas from customs duties and the LPG conversion kits, cascades, dispensers, storage tanks, and LPG vehicles also qualify for this import duty waiver.

Determining the right fiscal policy for each country's LPG market will be a long-term process that includes trial and error. Understanding international LPG pricing, subsidy schemes, and other fiscal policies implemented elsewhere in countries with burgeoning will be important to the foundations of a competitive and effective fiscal policy. The implementation and refinement of a country's fiscal policy will be further supported by strong public-private relationships and efficient regulation.





Promote Enforcement and Regulatory Compliance

Ultimately, supportive and productive regulations are only supportive and productive if there is proper compliance and enforcement. Promoting LPG regulatory compliance in Africa involves several strategic actions to ensure safety, efficiency, and widespread adoption. Some approaches include:

- **Strengthening Regulatory Frameworks:** Developing clear, comprehensive regulations that cover all aspects of LPG production, distribution, and usage is crucial. This includes setting standards for equipment, safety protocols, and operational procedures.
- **Capacity Building and Training:** Providing training programs for regulators, industry stakeholders, and end-users can enhance understanding and adherence to regulations. This includes workshops, certification programmes, and continuous professional development.
- **Public Awareness Campaigns:** Educating the public about the benefits of LPG and the importance of compliance with safety standards can drive better practices. Campaigns can use various media channels to reach a broad audience.
- **Incentives for Compliance:** Offering incentives such as tax breaks, subsidies, or grants for companies and individuals who comply with LPG regulations can encourage adherence. This can also include recognition programmes for exemplary compliance.
- **Regular Inspections and Audits:** Conducting regular inspections and audits of LPG facilities and operations ensures ongoing compliance. This can help identify and address non-compliance issues promptly. Non-compliance can have a detrimental effect on policy implementation. It can range from incentives being used for an unintended demand segment (e.g. commercial instead of residential) or socioeconomic bracket (e.g. high-income household) to enabling a black market for cylinders or refills.
- **Public-Private Partnerships (PPPs):** Collaborating with private sector stakeholders can enhance regulatory compliance through shared resources, expertise, and investment in infrastructure and technology.
- **Penalties for Non-Compliance:** Implementing and enforcing penalties for non-compliance can deter violations. This includes fines, suspension of licenses, and other legal actions.
- **Technological Solutions:** Utilizing technology for monitoring and enforcement, such as digital tracking systems for LPG cylinders and automated compliance reporting tools, can improve regulatory oversight. India is one of the best examples of how technology can be leveraged to simultaneously ensure compliance and streamline operations.

By combining these strategies, African countries can enhance LPG regulatory compliance, ensuring safer and more efficient use of this important energy source. solutions, such as gas cookers and other LPG-related equipment.

3.2. Implement a consumer financing and payment plan

One of the greatest challenges to replacing polluting fuels in the residential sector with LPG is the upfront cost to the consumer of the stove and canister of fuel. Micro-financing and pay-as-you-go systems, as well as other consumer solutions, will be crucial to overcoming this challenge and requires investment in financial tools and infrastructure from government, private companies, and non-governmental organisations.

Foster Partnerships

Many successful pilot projects that have incorporated consumer financing of LPG were a product of partnerships and collaborations between financial institutions, energy companies, and distributors. First steps towards affordability may start with promoting and building more relationships between financial institutions and energy companies.

Examples of collaboration efforts between energy companies and financial institutions to finance LPG include:

- **TotalEnergies partners with Bboxx's Smart Cooking Valve in Rwanda**
- **Puma Energy teams up with Zanaco bank to develop microfinance solution for LPG customers in Zambia**
- **National Oil Corporation of Kenya partners with Equity Bank Kenya on micro-loan pilot project in 150 credit-constrained households**

Successful partnerships will include African government representatives, financial institutions with a history of supporting energy projects, energy companies committed to expanding LPG access, and distributors with robust supply chains, as well as the local and global associations committed to fostering these partnerships.

Court Non-traditional Financing

The rise of impact investing and green funds means capital is increasingly available for equitable and environmental investments via debt and equity financing. The Spark+ Africa Fund is particularly invested in clean cooking solutions, but there are many Africa-focused funds with interests not just in equitable solutions, but also in financial technology solutions and locally owned businesses.

Expand Pilot Projects and Promote Financial Technologies

Where pilot projects are already underway, particularly in markets with established microfinance sectors and high personal banking access (like Kenya, where ~80% of the population has a bank account), microfinancing can be expanded to a greater population in collaboration with energy and cylinder companies and LPG market leaders. Pilot projects in Cameroon and Kenya have showed optimistic results.

The “Bottled Gas for Better Life” pilot project was launched in Cameroon and spearheaded by the Global LPG Partnership (GLPGP). Cameroon experienced severe deforestation which was partly due to the widespread use of firewood and charcoal for cooking. Since 2015, the government of Cameroon worked with GLPGP experts to create the country’s first national LPG Master plan, which was implemented in 2017. Loans were provided to low-income households to cover the upfront cost of a 13kg gas cylinder, double-burner stove and accessories, with a total cost of around \$80-100 USD. Loans were to be repaid in six monthly installments with commercial interest rates. Participants also received education on LPG as a fuel.

This pilot showed a 94% repayment rate, and health and environmental benefits were also recorded. This project was expanded in 2018 to nine communities across regions in Cameroon, and in 2019 reported a 98% repayment rate and an average use of 21k per capita per year LPG usage. Through 2019, over 700 Cameroonian households switched to clean cooking.

This same programme was piloted in a low-income community in Kenya in 2018, where over 60 households registered to use LPG. Kenya had been developing its microfinance sector for many years and it was fully formalised when the Kenyan Micro Finance Act was enacted in 2006. Financial inclusion in Kenya has increased tremendously from 26% to 75% over the past two decades, with a variety of formal and informal MFIs across the nation, making access to loans for LPG implementation easier. Furthermore, mobile banking in Kenya reached 68% of the adult population, which is well above the average in sub-Saharan Africa. This convenience enabled easier monitoring of LPG purchases and refills, as well as “leakages” from participants purchasing LPG from illegal distributors. At the end of the pilot phase, 90% of borrowers repaid all loans, and average LPG usage was 12 kg per capita per year.

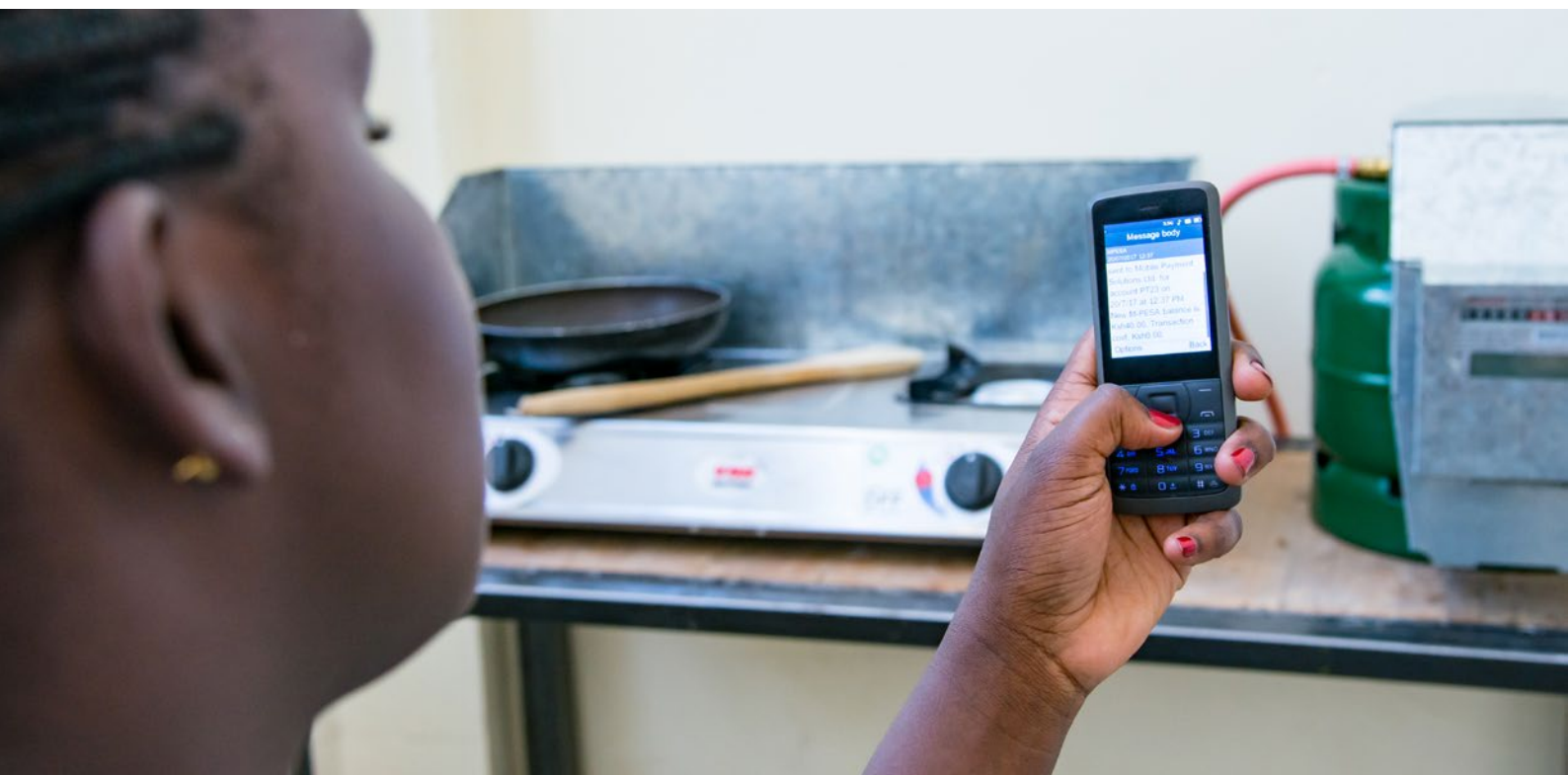
In addition to expanding pilot projects that allow consumers to finance the initial costs of converting to an LPG cookstove, pay-as-you-go technologies will be crucial for the long-term affordability of LPG for consumers who cannot afford to purchase an entire cylinder, but can better afford to pay for the LPG used in smaller, regular payments.

In Tanzania, KopaGas has developed a pay-as-you-go LPG solution in partnership with Oryx Energies.

This program uses smart meters to allow households to purchase LPG in small increments, making it more affordable for low-income families. The technology enables users to pay for the exact amount of gas they need, reducing the financial burden of buying a full cylinder upfront. In Kenya, several companies have adopted pay-as-you-go models to address the high upfront costs of LPG. One notable initiative involves the use of smart meters that allow consumers to pay for LPG using mobile money. This system has been particularly effective in informal settlements, where traditional payment methods are less accessible.

India has also utilised a pay-as-you-go system to scale LPG consumption, using innovative financial technology. Consumers prepay for the amount of gas they need, which activates a GPS-enabled SmartGas Valve to supply the purchased amount. This system notifies customers before the gas supply is turned off, ensuring they can manage their usage effectively.

The PAYG model helps overcome the high upfront costs associated with purchasing full LPG cylinders and the necessary equipment. By allowing payments in smaller, more manageable amounts, it makes LPG more accessible to low-income households. This approach not only promotes the adoption of clean cooking fuels but also enhances convenience and financial flexibility for users.



Microfinance

Financing Solution	Case Studies
<p>Microfinance institutions (MFI) provide loan services to low-income individuals who otherwise would not have access to loan or credit services.</p> <p>The purpose of microfinance programs is to assess whether LPG consumption can be encouraged and sustained on a commercial scale through replicable and profitable microloans that assist consumers in transitioning to LPG as their cooking fuel.</p>	<p>Low Smoke Stoves (2008)</p> <ul style="list-style-type: none"> • Initiators and supporters: Practical Action, Carbon Clear, Women's Development Association, Nile Petroleum • Country of operation: Sudan • Impact: 12,080 households • Micro-loan to low-income households, full LPG set of cylinder (12.5 kg) and stove ~\$ 160 USD • Repayment rate: >90% • Registered carbon-credit program <p>Bottled Gas for Better Life (2017-2019)</p> <ul style="list-style-type: none"> • Initiators and supporters: Global LPG Partnership, MUFFA, MC2, Afriland First Bank, GLOCALGAZ, Tradex, Equity Bank, Social Economic Mobilisation Agency, NOCK • Countries of operation: Cameroon, Kenya • Impact: 4,000 people in Cameroon (707 households) and 300 people in Kenya (69 households) • Micro-loan amount issued per household was \$ 85-100 USD • Repayment rate: 90%-98% <p>AKIBA YETU & UNCDF Challenge Fund (2022)</p> <ul style="list-style-type: none"> • Initiators and supporters: UNCDF, Coopec AKIBA YETU, Ihusi Gaz • Countries of operation: Democratic Republic of Congo (DRC) • Impact: 513 LPG kits and 7,500 kg of LPG sold • Micro-loan ranging from \$ 50 - 30,000 USD offered to individual households and small-medium businesses

Pay-as-you-go

Financing Solution	Case Studies
<p>Pay-as-you-go (PAYG) pricing model allows the consumer to pay for the amount they need instead of paying an upfront cost or sign a long-term contract.</p> <p>The modern PAYG technology involves an internet-connected LPG smart meter that is attached to the nozzle of the LPG cylinder, and through micropayments of mobile money, consumers can refill LPG bottles based on the amount they need. When a consumer's LPG credit runs low, the smart meter would halt the gas flow, prompting the consumer purchase more fuel. This system enables providers to track household fuel levels and proactively refill cylinders.</p>	<p>Bboxx, a for-profit UK company, launched a PAYG LPG pilot in Kigali, Rwanda in 2019. Rwanda depends heavily on firewood for cooking in rural areas, and the urban population split between using charcoal and firewood. In 2018, only 5% of urban Rwanda uses LPG and significantly lower in rural areas. The government of Rwanda aims to expand LPG use through investments in infrastructure and interventions, where PAYG program is a method to increase affordability. High-density charcoal using districts within the city of Kigali were selected for this pilot, and 90 households were involved where they paid a downpayment over a 3-month period. The LPG distribution hub was strategically located in the heart of the Kigali nearby the targeted districts. The participants had to pay an initial downpayment for the stove and initial fuel credit, followed by monthly payments over six months to own the stove and accessories. Bboxx had technicians to teach participants on using the stoves and educated them on LPG. The PAYG LPG model for this pilot allowed consumers to purchase LPG in small, affordable increments. Participants typically topped up LPG credits based on their needs albeit at a higher than market LPG price (approximately \$1.90 USD versus \$1.12 USD per kilogram). This has caused a perception of increased fuel spending, yet the actual monthly average fuel cost decreased via the PAYG program versus purchasing a full bottle of LPG. A challenge faced was the PAYG LPG could not provide uninterrupted service, the consumers who ran out of LPG during the evenings or weekends must wait until the next working day for service. At the end of the pilot, 70% of participants continued to use LPG and many responded that they would recommend PAYG LPG.</p>

Carbon Markets

There are many different pathways to monetise the environmental and health benefits of clean cooking fuels through global carbon markets, including generating marketable carbon offsets that would effectively subsidise LPG and other clean cooking fuels.

Carbon markets have already been utilised in many African countries to finance improved cookstove distribution. Carbon credits have been sold directly to businesses aiming to reduce their carbon footprint, such as in the case with BP who, together with C-Quest Capital, funded the deployment of efficient cookstoves to 500,000 rural households in Angola in 2022 through the use of carbon credits, which BP purchased in full in a unilateral long-term purchase agreement.¹⁰

There is also an opportunity to support country-level emission targets by offsetting carbon emissions in clean cooking. Switzerland's Klik Foundation, a private organisation established by the Swiss Petroleum Association to meet the association's obligation to offset carbon emissions from motor fuels as mandated by the Swiss CO₂ Act, financed the 'Transformative Cookstove Activity in Rural Ghana Project,' which will distribute 180,000 improved cookstoves in rural Ghana, by purchasing the resulting Internationally Transferred Mitigation Outcomes (ITMOs).¹¹

The well-established and regulated voluntary and compliance carbon offset markets are also an opportunity to utilise carbon markets to finance projects in Africa. DGB Group, a developer of nature-based forestation carbon credit projects, has developed two energy-efficient cookstove projects, the SAWA Cookstove Project in Cameroon and the Hongera Energy Efficient Cookstove Project in Kenya, to supply 300,000 households with energy-efficient, locally manufactured, and sustainably produced cookstoves.

These cookstoves are expected to generate 4.9 million credits in the voluntary offset market.¹²

These cookstove projects set a precedent for more carbon-avoidant projects in Africa going forward. Though there have been relatively few LPG-centric projects that have generated carbon offsets, "Low Smoke Stoves" was a project led by Practical Action in partnership with Carbon Clear to provide LPG cylinders and stoves to Darfur, Sudan. Carbon Clear funded the microfinance initiative, and was managed by a local community, the Women's Development Association Network. This was the first registered carbon credit programme in Sudan, and Carbon Clear was able to recover its project costs through the sale of carbon credits. There are many challenges with harnessing carbon markets to finance projects in Africa and in the world, particularly the challenge of meeting stringent verification standards, which were developed based on US and European carbon projects. Additionally, despite the substantial carbon emission reductions achieved by switching from wood-fired cookstoves to LPG-fired cookstoves, there is a persistent belief that fossil fuel-related projects cannot generate carbon credits. At the same time, as the Summit on Clean cooking in Africa evidenced, global associations and influential organisations, both public and private, recognise the need to support Africa in its transition to universal access to clean cooking fuels.

To address this imbalance, international organisations, including the IEA, industry associations, and energy companies, should collaborate with organisations that verify carbon offset projects to develop a clear, concise framework that allows African companies and entrepreneurs to understand and meet verification requirements. This collaboration would ensure that verification processes are fair and applicable globally, ultimately encouraging more carbon reduction projects in Africa.

¹⁰ BP. (2022). BP Reimagining Energy for People and Our Planet, Sustainability Report 2022.

<https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/sustainability/group-reports/bp-sustainability-report-2022.pdf>

¹¹ Klik Foundation. "Next Generation Cookstove Mitigation Activity Authorized by Switzerland and Ghana."

<https://www.klik.ch/en/news/news-article/next-generation-cookstove-mitigation-activity-authorized-by-switzerland-and-ghana>

¹² Green Earth. "Cookstoves for Carbon Reduction." <https://www.green.earth/blog/cookstoves-for-carbon-reduction>





Widespread Access to Micro-Financing

To support universal access to clean cooking fuels and the means to finance and pay for LPG, widespread access to micro-loans for cooking stoves and mobile payment solutions to limit lump-sum payments are crucial for increasing access to LPG.

The first step to increasing access to micro-financing for LPG is to increase access to micro-financing, in general. The Grameen Bank in Bangladesh, for example, is one of the most famous microfinance institutions globally. It provides small loans to the rural poor, particularly women, without requiring collateral. This model has been replicated in many other countries and has significantly improved financial inclusion in Bangladesh.

The foundations of micro-financing can then be applied to LPG consumption. India's Pradhan Mantri Jan Dhan Yojana (PMJDY), its successful financial institution initiative, first focused on universal access to banking facilities, opening basic bank accounts, and providing debit cards. It was implemented in 2014 with widespread success utilising biometric identification systems and financial literacy programmes. As India implemented its LPG programme, this financial initiative allowed for the safe and trackable distribution of LPG subsidies in India.

By leveraging these proven micro-financing models and financial inclusion initiatives, countries can effectively facilitate the adoption of LPG, ensuring that clean cooking solutions are accessible and affordable for all.



3.3. Invest in infrastructure and roads

Prioritising urban LPG infrastructure, like storage, filling stations, and distribution networks, will support access to large urban populations, where access to financing and capital is often greater, and create economies of scale that can be expanded into rural areas. Concurrently, investment in rural roads and transport is crucial, so delivery services and distribution can expand organically.

Attract Foreign Investment

Foreign investment will be required to fund the large-scale infrastructure investments needed to bring LPG to large African populations. Initial steps to attract foreign investment to African LPG markets include identifying LPG storage capacity and shortfalls in key markets and evaluating the cost of scaling up storage capacity to meet future LPG demand. Countries must create a wish list of storage projects that can be marketed to international oil companies as investment opportunities.

South Africa's Sunrise Project, for example, is funded through a combination of public and private investment, as well as international partnerships, and includes the establishment of a large LPG import and storage terminal in Saldanha Bay, Western Cape. The Sunrise Energy Terminal is designed to import and store LPG in large quantities in order to increase LPG availability, mitigate energy shortages, support economic growth, and enhance energy security, especially during periods of high demand. This project is crucial to providing energy in times of load sharing and power and electricity outages. For investment in road infrastructure, transport ministries can be connected to private funding and collaboration with key infrastructure funds to understand the investment appetite from the private sector and the immediate challenges that can be overcome to attract private capital to infrastructure investment in Africa.

Recent foreign investment in road infrastructure in Africa includes:

- **China Road and Bridge Corporation (CRBC) investment in the Nairobi Expressway, Kenya**
- **Lekki Concession Company (underpinned by a group of private investment funds) public-private partnership for the Lekki Toll Road, Nigeria**
- **Ghana's Infrastructure Investment Fund and private investors, such as Meridiam, expand the Accra-Tema Motorway, Ghana**

Cameroon's National LPG Master Plan outlines several key investments necessary to support growth in LPG consumption, including the establishment of 6,600 new retail outlets, 277,000 tons of additional filling capacity, 2,857 tons of increase storage at filling plants, and enhancements to trucking distribution, at an estimated cost of €274 million.¹³

In Ghana's National LPG Promotion Policy, the National Petroleum Association has identified key infrastructure investments as LPG cylinders, refilling plants, storage facilities, retail outlets, and logistics systems. As a result, four bottling plants have been constructed in Ghana, two of which were built by the state-owned Ghana Oil Company Limited and two of which were built by private distributors Blue Ocean Investments Limited and New Gas Ghana. Similarly, the state-owned Ghana Cylinder Manufacturing Company worked with private cylinder producers APPEB Cylinder Manufacturing Company and Sigma Cylinders to manufacture additional cylinders to meet demand.

In Kenya, the government is constructing a 30,000 metric ton storage and handling facility that will enhance the importation, storage, and distribution of LPG, plus another 10,000 metric tons of inland LPG storage.

¹³ GLPGP (2019). National Feasibility Assessment: LPG for Clean Cooking in Cameroon. New York: The Global LPG Partnership.

Companies like Blue Ocean Investments and Taifa Gas SEZ Kenya Ltd are investing in large-scale LPG storage and bottling plants, including a 30,000 ton LPG storage facility in Mombasa.

Kenya has also entered a partnership with Nigeria's Asharami Synergy Plc, a subsidiary of the Sahara Group, aiming to establish additional large-scale LPG storage and handling facilities in Mombasa. Asharami is providing financial backing, while KPC contributes strategically located land. In certain cases, rail and pipeline infrastructure can be feasible and more effective. Algeria's National Company for Marketing and Distribution of Petroleum Products (Naftal) has partnered with Sonatrach TRC to construct a 424 kilometre LPG pipeline along the Mediterranean coast, with a project cost of US\$364 million. The pipeline, designed to deliver 1.2 million tons of LPG annually, will stretch from Arzew to Algiers, passing through seven administrative divisions, and is expected to enhance LPG distribution in western and central Algeria. This initiative is part of Sonatrach's broader investment strategy, which includes US\$40 million for oil and gas exploration and a total budget of US\$8 billion for 2022, aimed at improving production capacities and meeting national fuel demands.

Petredec and Transnet Freight Rail have announced a partnership to enhance LPG distribution in South Africa through a new rail freight solution, which includes a dedicated train system and a modern LPG hub at Sentrarand. This initiative aims to improve the efficiency, cost-effectiveness, and environmental sustainability of LPG logistics, with the hub receiving bulk LPG by rail from the Richards Bay terminal. The project is a significant investment in the country's energy infrastructure, supporting South Africa's long-term energy security and making clean cooking solutions more accessible.

Prioritise Urban Infrastructure Projects

As shown in SPCGI's scenario analysis, a focus on urban access to LPG can lead to LPG access that matches and even exceeds LPG consumption growth in India in a five-year period. An investment focus on urban storage, filling stations, and distribution centers, as well as urban transport infrastructure, will increase

LPG consumption considerably and create economies of scale and facilitate distribution outside of urban centers.

Alongside urban infrastructure projects, investment should be dedicated to expanding and maintaining highways to rural hubs. Major arteries from urban centres to rural hubs are often well-traveled, poorly maintained, and, in some countries, unpaved. These rural feeder roads are crucial to building and growing LPG distribution to rural areas and should be prioritised as projects for foreign investment and partnerships.

Long-Term Infrastructure Policy

Continuous policy and institutional reforms are needed to address the evolving challenges in the road sector. Leveraging public-private partnerships can help mobilise resources and expertise to increase accessibility and reduce transportation costs. The longer-term solution for infrastructure investment will depend on various country-level factors, such as population density.

In the case of India, India launched PMGSY-I in 2012, which was focused on connecting communities with a population of 500 or more with all-weather roads. In 2013, PMGSY-II was launched to upgrade 50,000 km of existing rural roads. In 2019, PMGSY-III was launched to consolidate 125,000 km of through routes and major rural links.

Prioritising urban LPG infrastructure, such as storage and distribution networks, is essential for enhancing access to energy in densely populated areas, fostering economies of scale that can extend to rural communities. Attracting foreign investment is critical for funding these large-scale infrastructure projects, as demonstrated by successful initiatives like South Africa's Sunrise Project and various partnerships across Africa. Additionally, improving rural transport infrastructure is vital for effective LPG distribution, necessitating collaboration between public and private sectors. Continuous policy reforms and strategic investment in both urban and rural infrastructure will be crucial for meeting growing LPG demand and ensuring energy security across the continent.





About the World Liquid Gas Association

The WLGA promotes the use of Liquid Gas to foster a safer, cleaner, healthier and more prosperous world. WLGA is the authoritative voice of the global Liquid Gas industry and represents the full Liquid Gas value chain. The WLGA brings together over 300 private and public companies operating in more than 125 countries involved in one, several or all activities of the industry; develops long-term partnerships with international organisations; and implements projects on local and global scales. The Association was established in 1987 and granted Special Consultative Status with the United Nations Economic and Social Council in 1989.

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