POLICY PAPER

Accelerating the Transition to Clean Cooking Approaches in Ghana: an Assessment of Challenges strategies and reforms required

PREPARED BY

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Executive Summary

This report, Accelerating the Transition to Clean Cooking Approaches in Ghana: An Assessment of Challenges, Strategies, and Reforms Required, evaluates Ghana's clean cooking sector by analysing the current landscape, identifying barriers, and recommending strategies to accelerate the adoption of clean cooking technologies. The study was conducted under the Ghana Climate Innovation Centre's SURGE project, aiming to support the green economy through sustainable energy solutions.

Background and objectives

With around 54.3% of Ghanaian households using traditional biomass fuels, adopting clean cooking solutions is crucial for health, environmental protection, and socio-economic development. This study addresses four key objectives: (1) identifying effective clean cooking technologies for Ghana, (2) examining factors that hinder scalability and industrial production, (3) proposing strategies to increase technology adoption, and (4) recommending policy reforms to support SMEs in the clean cooking sector.

Methodology

The research employed a mixed-methods approach involving a literature review, stakeholder interviews, and case studies. Interviews were conducted with 12 experts, 14 manufacturers, and 30 retailers to understand various perspectives on clean cooking technologies, barriers, and market dynamics.

Findings

Globally, initiatives such as the Clean Cooking Alliance (CCA) and the WHO's Clean Cooking Initiative have provided frameworks that align with Ghana's national policies. Ghana's clean cooking market offers several technologies, including improved biomass, LPG, and electric stoves.

However, substantial barriers persist, including high costs, limited infrastructure, cultural resistance, and policy gaps. Experts and entrepreneurs highlighted technical, economic, and policy-related barriers affecting scalability, quality control, and market reach.

Case studies and lessons learned

The report reviews case studies from Rwanda, Uganda, and Kenya, showcasing successful clean cooking initiatives, including public-private partnerships, policy incentives, and subsidy programs that support scalability. These lessons provide a roadmap for replicable strategies in Ghana.

Recommendations

The following recommendations were made to accelerate the clean cooking transition.

- Expand financial mechanisms and industrial scaling support for manufacturers.
- Enhance public awareness and education.
- Strengthen distribution networks and infrastructure.
- Leverage technology and innovation.
- Establish technical standards and reduce testing costs.
- Facilitate government-private sector collaboration.
- Promote gender-inclusive approaches.
- Integrate monitoring and evaluation frameworks to track progress.

Conclusion

The report concludes that with the right policies, investment in infrastructure, and collaboration with stakeholders, Ghana can create a supportive ecosystem to accelerate the adoption of clean cooking technologies while fostering environmental sustainability, public health, and economic growth.

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1 INTRODUCTION AND APPROACH

1.1 Background to the study

Cooking is a fundamental human activity for sustenance, uniting families and cultures. The way people cook plays a crucial role in achieving several Sustainable Development Goals (SDGs), including good health and well-being (SDG 3), gender equality (SDG 5), affordable and clean energy (SDG 7), sustainable cities and communities (SDG 11), and climate action (SDG 13). Many low- and middle-income countries use traditional cooking methods and fuels. Traditional methods of using biomass fuels, such as wood and charcoal for cooking, are a significant source of greenhouse gas emissions, including carbon dioxide and black carbon, which are harmful to the environment (World Health Organization [WHO], 2016). Traditional cooking stoves lead to indoor pollution, which in turn causes respiratory disorders, resulting in over three million deaths annually (WHO, 2016). Clean cooking solutions, such as LPG, electric, and improved biomass stoves, reduce emissions, mitigate deforestation, and lower carbon footprints (Clean Cooking Alliance, 2022). Clean cooking promotes health by decreasing the hazards arising from exposure to harmful smoke, making the health effects of clean cooking critically important. Clean cooking also enhances livelihoods by reducing the time spent on fuel collection, empowering women, and enabling economic participation, thereby fostering healthier, more sustainable communities globally.

In 2021, 71% of the global population had access to clean cooking fuels and technologies, an improvement over the past decade. However, 3 billion people in low- and middle-income countries still face significant health, safety, and environmental risks associated with cooking. As of the last population and housing census in Ghana in 2021, approximately 54.3% of households use wood and charcoal as main cooking fuels. However, the market for improved cookstoves is rapidly growing, offering a pathway to transition from traditional to modern, clean cookstoves. Initiatives to promote clean cooking in Ghana have included the development and dissemination of the improved biomass cookstove 'Ahibenso' in 1989 by the Ministry of Mines and Energy, followed by the Gyapa stove in 2002, introduced by Enterprise Works/VITA under the Energy for Household Cooking project funded by USAID. Current private sector initiatives, such as Holy Cook, CookMate, and Obaapa, have sprung up in recent years.

The Ministry of Energy has launched the Improved Biomass Cookstove Distribution Project, targeting the distribution of about 500,000 improved cookstoves nationwide. Significant policy measures have been implemented, including the Renewable Energy Master Plan, which aims for 3 million improved domestic cookstoves by 2030, and the Nationally Determined Contributions (NDCs), which target 2 million improved cookstoves by the same year. There have been efforts to boost LPG adoption, including the LPG Cylinder Recirculation Model (CRM) and the Ghana LPG Promotion Program.

Clean cooking is one of six decarbonization techniques in the recently published National Energy Transition Framework. The passage of Legislative Instrument (LI 2454) Renewable Energy (Standards and Labelling) (Improved Biomass Cookstoves) Regulations 2022 has led to the promotion of efficient use of improved biomass cookstoves by enforcing standards, labelling models, and registering them in the Renewable Energy Product Register while prohibiting non-compliant cookstoves.

Despite the significant opportunities to scale up clean cooking solutions in Ghana, several barriers hinder this transition. This research assessed these challenges to suggest strategies and reforms to overcome them.

1.2 Objectives of study

The objectives of the research are as follows:
a) Identify and assess the most effective clean cooking technologies suitable for Ghanaian households.
b) Identify the key factors that inhibit the scalability and industrial production of clean cooking systems in Ghana.
c) Propose strategies and policy reforms to increase adoption and enhance the viability of clean cooking SMEs in Ghana.

1.3 Research approach

A mixed-methods approach was employed to conduct this research. This comprised a literature review, case studies, and expert interviews.

1.3.1 Literature review

An extensive literature review was conducted on clean cooking technologies, policies, initiatives, and barriers to scaling up cleaning cooking technologies in Ghana. Documents reviewed include academic papers, policy documents, project reports, and reports from relevant national and international organizations. The national policy documents reviewed include the Renewable Energy Act (and its amendment), Renewable Energy Masterplan, National Energy Policy, National Energy Transition Framework, and National Energy Transition and Investment Plan, among others. The literature review was used to identify popular clean cooking systems and their effectiveness in Ghana and elsewhere and identify gaps. It also focused on the effectiveness, user preferences, and suitability of clean cooking technologies for Ghanaian contexts.

1.3.2 Stakeholder interviews

Interviews were conducted to complement the information received from secondary sources. Interviews targeted clean cooking technology manufacturers, experts in the industry, and clean cooking technology retailers to gather insights on effective technologies and constraints of scaling up production. Experts were drawn from institutions such as the Ministry of Energy, Energy Commission, Ghana Standards Authority, World Bank, Ghana Alliance for Clean Cookstoves (GHACCO), Institute of Industrial Research of the Council for Scientific and Industrial Research (CSIR-IIR) Regional Testing and Knowledge Centre, and Technology Consultancy Center of the Kwame Nkrumah University of Science and Technology (KNUST-TCC). Both in-person and online survey methods were employed. All retailers were surveyed in person, whereas a combination was used for the experts and manufacturers. Responses were received from thirty retailers, fourteen manufacturers, and twelve experts.

Survey data was analysed to identify trends, correlations, and significant factors influencing the country's adoption of clean cooking technologies. The analysis identified common barriers that inhibit the scalability of clean cooking technologies in Ghana, such as access to materials, costs, technical skills, regulatory hurdles and market dynamics. The analysis helped develop a list of recommendations necessary to scale up clean cooking adoption.

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1.3.3 Case studies

Case studies of successful clean cooking initiatives in other countries were examined to identify best practices and lessons that can be applied in Ghana's context. Five countries were initially identified to be reviewed. Based on available published materials, Kenya, Rwanda and Uganda were reviewed. Case studies on Senegal and Côte d'Ivoire could not be completed because of a lack of readily available published material in the English Language.

1.3.4 Roundtable discussion of research findings

Research findings were presented during roundtable discussions with key stakeholders in the clean cooking sector. The event focused on key insights from the study, including an overview of Ghana's clean cooking landscape and market dynamics. It also highlighted lessons from successful clean cooking initiatives in Rwanda, Uganda, and Kenya. Additionally, actionable strategies were discussed to promote the adoption of clean cooking technologies and to enhance support for small and medium-sized enterprises (SMEs) in the sector.

2. REVIEW OF CLEAN COOKING TECHNOLOGIES, POLICIES, INITIATIVES, AND BARRIERS TO SCALING UP

The review starts with a brief overview of global initiatives promoting clean cooking technologies. This is followed by a review of clean cooking technologies, factors influencing their adoption and usage, and initiatives, policies and plans promoting clean cooking in Ghana. The review ends with the barriers inhibiting the scaling up of clean technologies in Ghana.

2.1 Global initiatives promoting clean cooking technologies

Several global initiatives are working to promote clean cooking technologies, targeting the health, environmental, and economic consequences of traditional cooking methods.

2.1.1 Clean Cooking Alliance (CCA)

The Clean Cooking Alliance (CCA) , established in 2010, is one of the most prominent global platforms advocating for clean cooking solutions. Its goals align with the United Nations Sustainable Development Goals (SDGs), particularly Goal 7 (Affordable and Clean Energy) and Goal 3 (Good Health and Well-Being). Through partnerships with governments, private sector actors, NGOs, and research institutions, the CCA seeks to create an enabling environment for scaling clean cooking solutions by promoting market-based approaches, advocating for policies, and facilitating access to financing.

2.1.2 World Health Organization (WHO) clean cooking initiative

The World Health Organization (WHO) has been at the forefront of clean cooking initiatives, primarily focusing on the health risks associated with household air pollution. The WHO estimates that 3.2 million people die prematurely each year from illnesses attributable to household air pollution caused by inefficient cooking fuels (World Health Organization, 2024). As part of its global initiative, the WHO in 2014 issued the first-ever health-based guidelines on clean fuels and technologies for household cooking, heating and lighting (World Health Organization, 2014). These guidelines aim to help public health policymakers and specialists working on energy and resource issues understand and implement the best approaches to reducing household air pollution. This extensive scientific assessment identifies which energy systems can be considered clean for health and specifies the emissions levels that pose health risks.

2.1.3 United Nations Clean Development Mechanism (CDM)

The United Nations Clean Development Mechanism (CDM) provides financial incentives for projects that reduce carbon emissions through clean energy solutions, including clean cooking technologies. Under the CDM framework, clean cooking projects that reduce greenhouse gas emissions (such as improved cookstove initiatives) are eligible for carbon credits (Clean Cooking Alliance, 2021). These carbon credits can be sold on international carbon markets, generating

revenue for project developers. Countries like Kenya and Rwanda have successfully used CDM to promote clean cooking initiatives by leveraging Results-Based Financing (RBF) (Modern Energy Cooking Services, 2021). In this way, the CDM incentivizes governments and private companies to invest in clean cooking solutions by offering a financial return for reducing carbon emissions, thus linking the global fight against climate change with local development goals.

2.1.4 Global LPG Partnership (GLPGP)

The Global LPG Partnership (GLPGP) is a public-private partnership focused on scaling the adoption of liquefied petroleum gas (LPG) as a clean cooking solution, especially in low-income and developing countries. GLPGP works with governments to create policies and regulations that support the growth of LPG markets, particularly for cooking. The partnership also works to improve LPG infrastructure, such as distribution networks and safety standards, and to make LPG more affordable through financing and subsidy mechanisms.

2.2 Clean cooking technologies in Ghana

This section briefly reviews clean cooking technologies currently in use in Ghana. Unless cited, photos were taken by the research team. Clean cooking technologies have gained traction in Ghana through various state- and NGO-led initiatives to reduce traditional cooking methods' environmental and health impacts. Ministry of Energy, Energy Commission, and other organizations, including the Clean Cooking Alliance (formerly Global Alliance for Clean Cookstoves), Ghana Alliance for Clean Cookstoves and Fuels (GHACCO), Netherlands Development Organisation (SNV) and Modern Energy Cooking Services (MECS), have supported the development and promotion of cooking technologies that are more efficient compared to traditional biomass cooking technologies, particularly in rural areas where access to cleaner fuels is limited (Global Alliance for Clean Cookstoves, 2021). Clean cooking technologies promoted in Ghana include improved biomass (wood and charcoal) stoves (including gasifier stoves), LPG stoves, ethanol stoves, biogas stoves, and electric stoves. Pilot studies and project evaluations reveal that some of these stoves can lower household fuel consumption by up to 50% compared to traditional biomass stoves and significantly decrease indoor air pollution, benefiting women and children who are most exposed (Mensah et al., 2019).

2.2.1 Improved biomass stoves

Improved biomass stoves are advanced biomass cooking devices that burn organic materials – such as wood, charcoal, agricultural residues, or animal dung – more efficiently and with lower emissions than traditional biomass stoves. These stoves are designed to:

a) Increase Efficiency: Improved biomass stoves are engineered to burn fuel more completely, extracting more energy from the same amount of fuel. This reduces the need for fuel collection and lowers overall fuel consumption.
b) Reduce Emissions: Traditional biomass stoves can release harmful pollutants like carbon monoxide, particulate matter, and black carbon. Improved stoves incorporate design features such as better airflow, insulation, or secondary combustion chambers that reduce the emission of these harmful substances.

c) Minimize Health Impacts: By reducing indoor air pollution, improved biomass stoves help mitigate the risks associated with cooking in poorly ventilated spaces, a significant health issue in many developing countries where biomass is commonly used for cooking.

d) Lower Environmental Impact: Improved stoves typically burn fuel more efficiently, reducing deforestation pressures as they require less biomass to cook the same amount of food.

e) Increase Safety and Durability: Many improved stoves have added safety features to minimize the risk of fires or burns and are designed for longer-lasting performance under rugged conditions.

These stoves can vary in design, ranging from simple, low-cost models to more advanced versions with added features like thermal insulation, forced air combustion, or even integrated cooktops and ovens. Generally, improved biomass cookstoves are classified based on performance, combustion mode, and construction material type. Based on this, some are designed as Top-Lit Up-Draft, i.e. lit from the top with primary airflow from the bottom to the top. In contrast, some are Top-Lit Down-Draft, i.e. lit from the top with primary airflow from the top to the bottom. Improved biomass stoves in Ghana include CookMate, Holy Cook, Gyapa, Envirofit, Ace, Philips, Ahibenso, Eja, Morrison, and Donago (See Figure 1). Figure 2 shows some improved biomass stoves displayed by retailers in some Ghanaian markets.

Figure 1: Some improved biomass stoves available in Ghana

Man and Man

Mensah

CookMate

Morrison

Holy Cook

Gyapa

Envirofit

Donago

Philips

Ahibenso

Obaa Hemaa

Eja

Figure 2: Improved cookstoves displayed at retail points in some Ghanaian markets

2.2.2 LPG cooking technologies

LPG fuel and stoves are among the most used clean cooking fuels and technologies encouraged by the Government of Ghana due to their health and efficiency benefits over biomass fuels and stoves. Despite significant government efforts to promote the use of LPG, its adoption remains low, but it is improving steadily. According to the latest census in 2021, 36.9% of households in Ghana use LPG as the main cooking fuel. In the Greater Accra region, over 68% of households use LGP as the main cooking fuel. In urban communities in Ghana, more than 51% of households use LPG as their main cooking fuel. The main barriers to widespread LPG adoption include infrastructure limitations, especially in rural and remote areas where only 14.8% of households use LPG as the main cooking fuel, and supply chain issues that result in poor accessibility.

Additionally, the cost of LPG poses a challenge for low-income earners, as the expense of accessing LPG stoves and refills often exceeds their financial capacity, especially since they can obtain lower amounts of wood and charcoal for free or at very low prices at a time (Acheampong et al., 2019). This is evident in the northern regions of Ghana. In the Savannah and Upper East Regions, less than 5% of households used LPG as their main cooking fuel. LPG cylinders and various stove types are shown in Figure 3.

2.2.3 Electric cooking technologies

Electric cookers and induction stoves represent cleaner and more efficient alternatives to biomass and LPG, aligning with the increasing use of the electrical grid by urban households. Electric cookers and induction stoves have strong market potential in Ghana's urban areas. In contrast to rural areas, urban infrastructure and access to electricity are relatively better. However, constant power failures and fluctuating voltagemake using electric cookers inconvenient for daily cooking. Moreover, the high price of induction stoves, despite their environmental and health benefits, contributes to their low adoption rate (Acheampong et al., 2019). Ghana's National Electrification Scheme (NES) aims to expand electricity access nationwide to achieve universal access in a few years, which should support electric cooking (Ministry of Energy, 2023). However, supply stability is needed to support electric cooking options fully.

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Figure 3: LPG cylinders and stoves displayed in retail markets in Ghana

2.2.4 Solar and biogas cooking technologies

Solar cooking and biogas cooking are two clean cooking technologies used experimentally in Ghana. Although promising, both technologies need further support and cost-reduction measures to become viable for widespread use in Ghana. Solar cookers use sunlight to heat the base plate of the stove, making them suitable for rural areas with limited access to traditional fuels. A pilot study of solar cookers conducted by SNV Ghana found that their use can significantly reduce fuel costs and indoor air pollution in Northern Ghana. However, they face drawbacks such as unpredictable sunshine and high initial costs (SNV Ghana, 2020). The use of solar cookers can decrease fuel expenses by 60%, although their effectiveness is limited by climate conditions (SNV Ghana, 2020)

Biogas stoves, which utilise methane from organic waste, have seen moderate success in Ghana. Generally, there are very few biogas plants in the country that provide fuel for cooking purposes. When properly maintained, biogas stoves monitored by the Kumasi Institute of Technology indicate increased user satisfaction. However, their use is characterized by challenges, particularly the lack of a consistent supply of organic waste feedstock (KITE, 2018).

2.2.5 Ethanol fuel cooking technologies

Ethanol fuel stoves are stoves that burn ethanol. They are clean-burning, have higher efficiency, and produce fewer emissions than traditional biomass stoves. Some ethanol stoves available in Ghana are shown in Figure 4.

Figure 4: Ethanol cookstoves on display at the Future of Energy Conference in Ghana

2.2.6 Adoption and usability factors of clean cooking technologies

There is a significant relationship between the adoption and usability of clean cooking technologies and the extent to which they are used in Ghanaian communities. Studies reveal that cultural acceptability is important, as most households prefer traditional biomass stoves due to familiarity and conformity to local cooking styles. As noted by Mensah et al. (2019), there is considerable focus on improved biomass stoves since they align with tradition, whereas technologies like LPG stoves are more efficient. However, maintenance requirements for newer technologies, such as biogas stoves, present barriers; biogas digesters require a consistent supply of organic waste and regular upkeep, limiting their appeal in rural areas where resources may be scarce (KITE, 2018). Therefore, while clean cooking technologies present many advantages, their adoption is limited by cultural acceptance, user experience, and cost implications. This understanding is crucial to enhance the adoption and usage of clean cooking technologies, as their implementation must be grounded within specific settings.

2.3 Clean cooking initiatives

2.3.1 Government-Led Initiatives

The Government of Ghana has implemented multiple initiatives to scale up clean cooking technologies, with the 2008 Sustainable Energy for All (SEforALL) policy setting ambitious goals. Some initiatives have been promoted in collaboration with international organisations such as the United Nations Development Program (UNDP). UNDP and government ministries have partnered to distribute clean cooking technologies, especially improved biomass stoves, in targeted communities (UNDP Ghana, 2022). In addition, these partnerships sometimes also train local stakeholders to manufacture and disseminate clean cooking systems.

The Rural LPG Promotion Program, launched in 2013, distributed LPG stoves and cylinders to low-income rural households to reduce dependence on biomass fuels. However, studies indicate that despite initial distributions, sustained use remained low; for instance, only about 5% of households continued using their LPG stoves nine months post-distribution (Carrión et al., 2020). This low continued usage highlights gaps in policy execution, primarily due to challenges in fuel affordability and availability in remote regions (Dickinson et al., 2018).

2.3.2 Non-governmental Organisations (NGOs) and Community-Based Initiatives

NGOs in Ghana play a crucial role in promoting clean cooking through awareness campaigns, hands-on training, and pilot projects. SNV Ghana, for example, launched the Voice for Change Partnership, encouraging rural and peri-urban communities to adopt clean cooking solutions by offering technical training on stove usage and maintenance (SNV Ghana, 2020).

In the Northern Region, SNV engaged local women as ambassadors, empowering them to advocate for clean cooking within their communities. Such projects address cultural and practical barriers to adoption, increasing acceptance and promoting sustainable change (Global Alliance for Clean Cookstoves, 2021).

2.3.3 Private Sector and Public-Private Partnerships (PPP)

Private companies manufacture and distribute these products at the heart of clean cooking technologies in the country. There are both Ghanaian-owned and foreign-owned companies, as well as partnerships working in the sector to increase access. Local companies, such as CookClean Ghana Ltd., collaborate with international organizations, including the Global Alliance for Clean Cookstoves, to manufacture and distribute clean cooking systems at affordable prices (GACC, 2021). These partnerships enable large-scale distribution, supporting market sustainability by ensuring clean cooking products are accessible and cost-effective. Reports from the Energy Commission indicate that public-private partnerships have created more resilient supply chains, facilitating scalability and addressing supply challenges in remote areas (Energy Commission Ghana, 2022).

2.4 Policies and plans promoting clean cooking

There are several legal instruments, policies, and plans in Ghana that promote access to clean cooking technologies. These include the Renewable Energy Act, Renewable Energy Masterplan, National Energy Policy, Ghana's Nationally Determined Contributions, and the recently published transition framework and investment plans. This section briefly reviews these plans and policies.

2.4.1 Renewable Energy Act

The Renewable Energy Act of 2011 and its Amendment 2020 emphasize the investment in renewable energy to offset greenhouse gas emissions and the establishment of financial incentives for renewable energy projects. While the Act includes provisions for renewable energy technologies and encourages investments in non-utility scale renewable energy, it does not specifically address clean cooking initiatives or forecasted targets related to clean cooking solutions. The focus is more on electricity generation and the regulatory framework surrounding renewable energy procurement and distribution.

2.4.2 Renewable Energy Master-plan

The Renewable Energy Master Plan (REMP) of Ghana outlines a comprehensive strategy for promoting clean cooking solutions to reduce reliance on traditional biomass fuels. Key policies and plans for promoting clean cooking are summarised below.

a) Promotion of improved cookstoves: The REMP emphasizes the dissemination of improved biomass cookstoves for domestic and institutional use. This includes providing business development support to artisans for manufacturing improved cookstoves and fast-tracking the development of standards and labelling for these stoves.

b) Incentives and awareness: This involves creating household awareness and promoting research and development for improved local stoves. Also, to provide financial incentives for their adoption.

c) Alternative fuels: The REMP encourages using alternative fuels, such as liquefied petroleum gas (LPG), to complement the use of improved biomass cookstoves.

d) Encouraging briquetting and pelleting: The aim is to support local pellet and briquette stove production to promote pellet and briquette production and reduce reliance on wood fuels. It also proposes removing import taxes on pelleting and briquetting equipment to lower production costs and encourage adoption

e) Local Production and Assembly: The plan supports local manufacturing and assembly of cookstoves and related technologies to boost the local economy and create jobs.

Table 1: Clean cookstove targets in REMP

Biomass Stove type	Target (No. of units)	Year
Improved domestic cookstoves	1,300,000	2020
	1,800,000	2025
	3,000,000	2030
Improved institutional/commercial cookstoves	3,000	2020
	10,000	2025
	18,000	2030

2.4.3 National Energy Policy

The National Energy Policy 2020 identifies LPG as a preferred alternative to traditional biomass. As part of its clean cooking initiatives, the government aims to increase LPG penetration to 50% by 2030. The policy also encourages the development of a regulated and sustainable wood fuel and cookstove market, supporting both environmental sustainability and economic opportunities.

The National Energy Policy outlines Ghana's clean cooking promotion strategy with clear targets set for 2030 as follows:

- LPG penetration target: 50% of the population by 2030

- Improved cookstove distribution: By 2030, three million improved biomass cookstoves across Ghana will be distributed, similar to what was proposed in the REMP. These cookstoves are designed to cut fuelwood consumption by up to 40%, addressing environmental sustainability and efficiency.

2.4.4 Nationally Determined Contributions

Policies and measures aimed at promoting clean cooking in the Nationally Determined Contributions (NDCs) are as follows:
- Market-based cleaner cooking solutions: The policy emphasizes expanding market-based solutions for cleaner cooking.
- Sustainable charcoal production: This involves encouraging youth and women entrepreneurs to participate in sustainable production practices.
- Promotion of LPG and efficient cookstoves: This includes targets for higher LPG penetration and distribution of improved biomass stoves to reduce emissions and improve air quality.

The forecasted targets for promoting clean cooking in the NDCs include the following:
- Sustainable Charcoal Production Reduction Goals: Target a 31% reduction in black carbon emissions from charcoal production by 2030.
- Carbon reduction through cleaner cookstoves: The Target set is to avoid 2,617 tonnes of carbon emissions by 2030 by adopting improved biomass stoves and LPG as primary cooking fuels.

2.4.5 National Energy Transition Framework

Targets and key plans regarding clean cooking technologies in the National Energy Transition Framework are as follows:
- Promotion of LPG: Maintains the targets of the National LPG Promotion Policy, and additionally targets over 70% rural access to LPG by 2070.
- Adoption of Improved Cookstoves: Maintains the target of the REMP.
- Transition to Electric Stoves: By 2050, the framework sets a target for more than 50% of urban households using electric stoves
- Sustainable Biomass Production: The establishment of sustainable woodlots, ensuring that biomass can be sourced in an environmentally friendly manner without contributing to deforestation.

2.4.6 Energy Transition and Investment Plan

The Ghana Energy Transition and Investment Plan (ETIP) outlines approaches to promote clean cooking, with specific targets aimed at reducing reliance on traditional fuels and increasing the adoption of cleaner alternatives by 2060. As part of the broader strategy to achieve net-zero emissions by 2060, the ETIP has the following plans:

Transition to Clean Fuels: The plan aims to phase out traditional biomass as the dominant cooking fuel by 2030, aligning with SDG7.
Electric Cooking: By the 2030s, electric cooking will emerge as a key low-carbon solution, particularly in urban households. The plan forecasts that by 2060, electric cooking will dominate in urban areas, while improved biomass will be more prevalent in rural households.

2.5 Barriers to the adoption of clean cooking technologies in Ghana

Ghana has made some progress in promoting clean cooking technologies, particularly by introducing improved biomass stoves and LPG initiatives. The Ghanaian government has been promoting LPG as a clean cooking fuel through initiatives like the LPG Cylinder Recirculation Model (CRM) and the Ghana LPG Promotion Program. Improved cookstoves like the Gyapa stove have also gained traction as cost-effective alternatives to traditional cooking methods. However, despite these efforts, the adoption of clean cooking technologies remains limited, particularly in rural areas where traditional biomass is the primary cooking fuel. Various barriers hinder the adoption of clean cooking solutions, including economic, cultural, infrastructure, and policy-related challenges. This section elaborates on these barriers, supported by findings from the literature.

2.5.1 Economic Barriers

a) High initial cost of clean cooking technologies

The high upfront cost of acquiring clean cooking technologies, such as liquefied petroleum gas (LPG) stoves, electric stoves, and improved biomass cookstoves, is one of the most significant barriers to their adoption. Studies have shown that many low-income households in Ghana cannot afford the initial investment in these technologies, especially in rural areas where incomes are lower. For instance, Adams et al. (2023) found that the cost of LPG stoves and cylinders significantly deter adoption, particularly in regions where biomass (wood and charcoal) is readily available at little or no cost. Compared to traditional biomass, the high price of clean fuels, such as LPG, further exacerbates the problem, making it difficult for households to switch.

b) High fuel costs

Even when households can afford the initial cost of clean cooking stoves, the periodic cost of fuel, particularly LPG, remains a barrier. Matthews (2014) highlights that LPG prices in sub-Saharan Africa, including Ghana, are among the highest in the world due to limited distribution networks, high transportation costs, and taxes. This economic burden discourages households from adopting LPG, particularly when cheaper biomass

alternatives, such as wood and charcoal, are available. Studies have indicated that high fuel costs are a key reason many households revert to traditional cooking methods after initially adopting LPG (Dongzagla & Adams, 2022).

2.5.2 Cultural and behavioural barriers

a) Cooking preferences and taste

Cultural preferences play a major role in Ghana's slow adoption of clean cooking technologies. Many households in rural areas prefer cooking with firewood or charcoal because of the perceived taste and flavour imparted to food when cooked over an open fire (Oluwatosin et al., 2022). Dzikunoo et al. (2021) point out that traditional cooking methods are deeply ingrained in Ghanaian culture, and any alternative technology that does not replicate these preferences faces resistance. For instance, improved biomass stoves may offer efficiency but not eliminate the cultural appeal of cooking over an open flame.

b) Lack of familiarity with clean cooking technologies

In addition to cultural preferences, a lack of familiarity with clean cooking technologies is another barrier. Households are often reluctant to switch to technologies they do not fully understand or are unfamiliar with. This is particularly true in rural communities where education and awareness of the health and environmental benefits of clean cooking technologies are limited. Studies such as Tawiah et al. (2022) emphasize the importance of community-level awareness campaigns and user training to overcome resistance stemming from unfamiliarity.

2.5.3 Infrastructure and distribution barriers

a) Limited distribution networks

The lack of widespread infrastructure for distributing clean cooking fuels, especially LPG, is a critical barrier in Ghana. Rural and peri-urban areas, where biomass usage is highest, often lack access to LPG refilling stations and retail outlets. Carrión et al. (2021) report that in rural areas, households must travel long distances to access LPG refilling stations, making the cost and effort of refilling cylinders prohibitive. This limitation creates a geographic disparity in access to clean cooking technologies, with rural households disproportionately disadvantaged.

b) Poor road networks and logistics

In addition to limited distribution networks, poor road infrastructure and transportation logistics make it difficult to deliver clean cooking technologies and fuels to remote areas. Broni-Bediako & Amorin (2018) notes that poor road conditions in Ghana's rural regions increase the cost of transporting LPG cylinders, cookstoves, and other equipment, further driving up the price and reducing access for low-income households. This logistical challenge is a major reason traditional biomass continues dominating in these areas.

2.5.4 Policy and Regulatory Barriers

a) Inadequate policy support

Although Ghana has established policy frameworks, such as the Renewable Energy Master Plan (REMP) and the National Energy Transition Framework , implementing policies that specifically target clean cooking technologies has been slow and fragmented. Furthermore, the government's efforts to promote clean cooking have been largely focused on urban areas, with insufficient attention given to rural regions where biomass usage is most prevalent (Yiran et al., 2020). Additionally, there is limited coordination between government agencies, NGOs, and the private sector, leading to inefficiencies in program implementation and duplication of efforts.

b) Lack of financial incentives and subsidies

Another policy-related barrier is the absence of financial incentives or subsidies for clean cooking technologies. In countries such as India and Kenya, government subsidies have played a pivotal role in promoting the adoption of LPG and improved cookstoves among low-income households. However, Bukari et al. (2021) argue that the government should adopt a medium-term strategy or policy framework that incentivizes the private sector to invest in clean cooking solutions to make it affordable for the poorest households. Without subsidies or microfinancing options, the upfront costs remain prohibitive for many families.

c) Import tariffs and taxes

High import tariffs on clean cooking technologies and fuels, such as LPG, further increase the cost of adoption. In Ghana, import taxes on cookstoves and LPG equipment increase the retail price, making them less competitive with traditional biomass fuels (Bobio et al., 2024). Reducing these tariffs could make clean cooking technologies more affordable, especially for rural and low-income households.

2.5.5 Perceived health and safety risks

While clean cooking technologies are designed to improve health outcomes by reducing indoor air pollution, there is often a perception that LPG or electric stoves pose safety risks, such as explosions or fires. This concern is particularly prevalent in households unfamiliar with modern cooking technologies. Abdulai et al. (2018) found that some Ghanaian households are hesitant to adopt LPG because of a fear of accidents, even though these risks can be mitigated with proper usage and maintenance.

3. FINDINGS FROM SURVEY

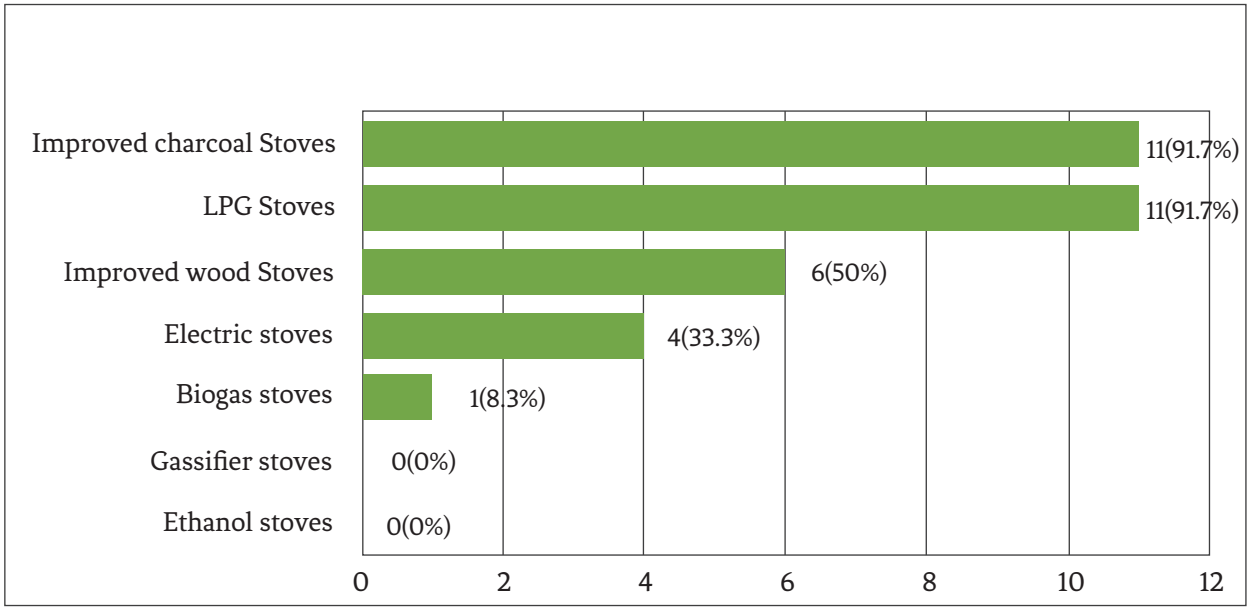
3.1 Perspective of clean cooking technology experts

This section provides insights into the clean cookstove market in Ghana from the perspective of twelve industry experts. These experts represent various sectors, including government agencies, cookstove manufacturers, NGOs, and research institutions, with multiple years of experience. More than 75% of the respondents have at least 10 years of experience in the sector.

3.1.1 Commonly used clean cooking technologies in Ghana

The experts identified several clean cooking technologies commonly used in Ghana, with significant preferences for improved charcoal and LPG stoves, followed by improved wood and electric stoves, respectively (See Figure 5). Other technologies, such as gasifier stoves, ethanol/ gel stoves, and solar stoves, were also mentioned but with lower usage levels.

Figure 5: Most commonly used clean cooking technologies in Ghana

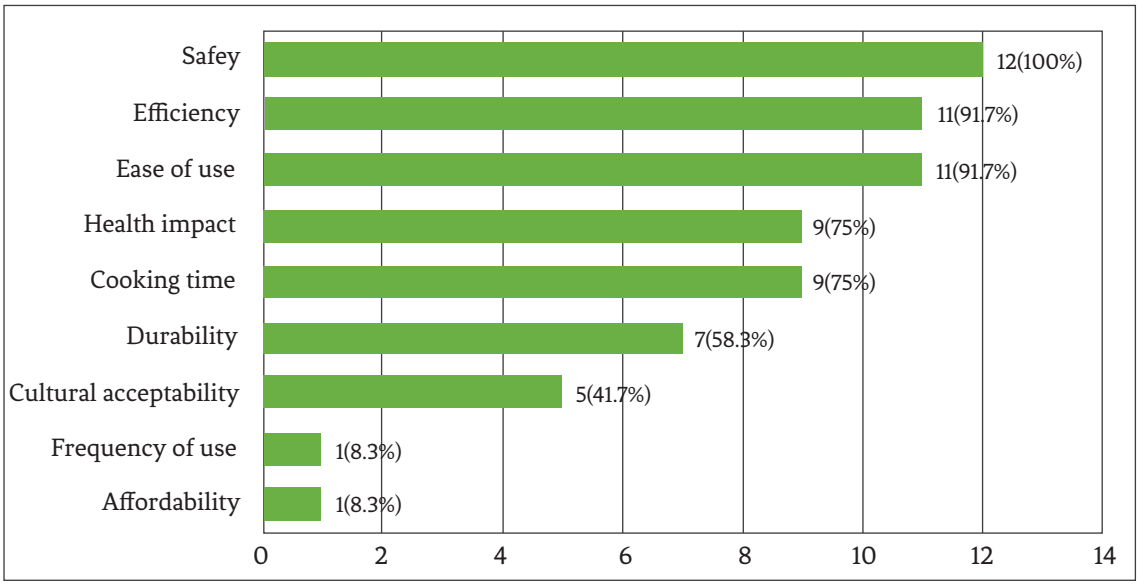


Experts mentioned LPG stoves and improved biomass stoves as the leading technologies with the highest potential for scalability in Ghana due to their affordability and cooking efficiency (cooking time, ease of use, and emission levels). Among biomass stoves, specific models like the Gyapa, Ahibenso, Envirofit, and Jikokoa were popular due to their affordability and efficiency. These preferences indicate that LPG and improved biomass stoves align well with Ghanaian households' economic, cultural, and cooking needs.

3.1.2 Factors defining the effectiveness of clean cooking technologies

The respondents outlined several factors that define the effectiveness of clean cooking technologies, with safety, efficiency, and ease of use being the most cited as primary factors, as presented in the chart in Figure 6. Respondents also emphasised other factors like health impact and cultural acceptability, especially regarding reduced indoor air pollution and the need for technologies that integrate easily into household routines compatible with Ghanaian culture.

Figure 6: Factors defining the effectiveness of clean cooking technologies in Ghana



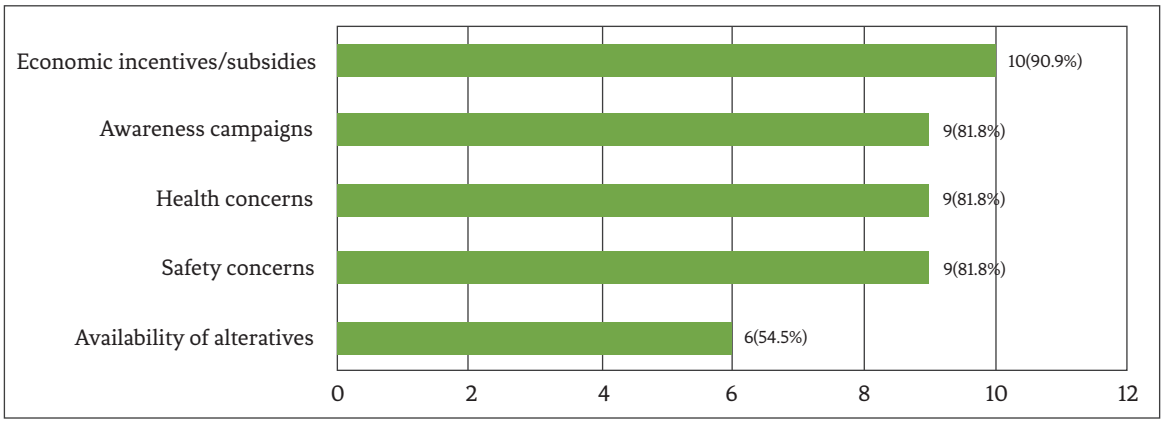
3.1.3 Changes in user behaviour and preferences

Experts reported observing steady shifts in household preferences for cooking technologies, noting economic incentives and subsidies, largely driven by health concerns and awareness campaigns being significant drivers, as indicated in Figure 7. These observations suggest that awareness and education are instrumental in changing household preferences toward clean cooking solutions.

For availability and affordability, the jiko charcoal stove is the most effective option.However, in terms of efficiency, ease of use, and convenience, LPG stoves are superior. Ethanol and possibly LPG stoves are likely the best choices for thermal efficiency. Modern imported cookstoves outperform jiko stoves regarding thermal efficiency, aesthetics, and portability.

Respondents also enumerated traditional three-stone/ mud stoves as unsuitable cooking technology as modernity makes flat-bottom pots not adaptable to these tripod stoves. Others mentioned grid-electric, solar, and LPG stoves as unsuitable for Ghanaian households due to the unstable fuel supply and high cost of living. This assessment indicates that LPG and improved biomass stoves are viewed as the most effective options for health improvement, provided the economic and distributional challenges can be addressed.

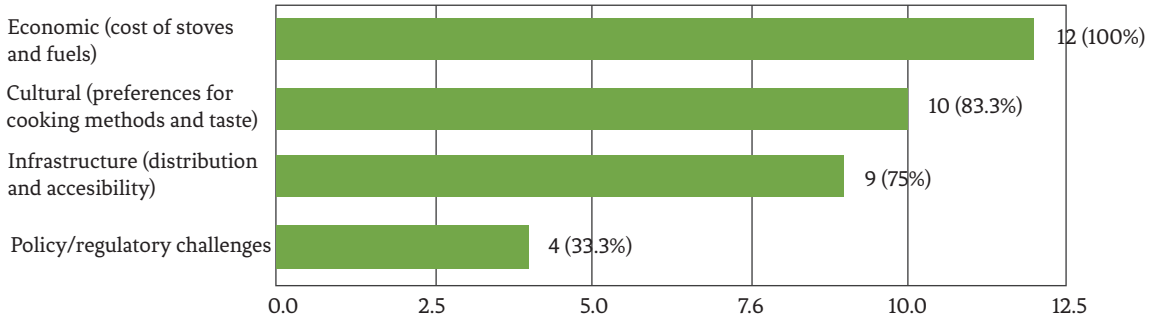
Figure 7: Drivers of clean cooking adoption in Ghana



3.1.4 Barriers to adoption and scalability

The experts identified several barriers that inhibit Ghana's adoption and scalability of clean cooking technologies. Economic barriers, such as high costs of stoves and fuels, limit accessibility for low-income households. Furthermore, limited access to LPG refilling stations and poor road networks impedes technology distribution. The absence of subsidies and supportive policies was noted as a critical barrier, as shown in Figure 8. A lack of awareness and information was also mentioned as a significant barrier to clean cooking adoption in Ghana. These insights underscore the need for policies and programs addressing economic and logistical challenges to make clean cooking technologies more accessible.

Figure 8: Scale of barriers to effective clean cooking adoption in Ghana

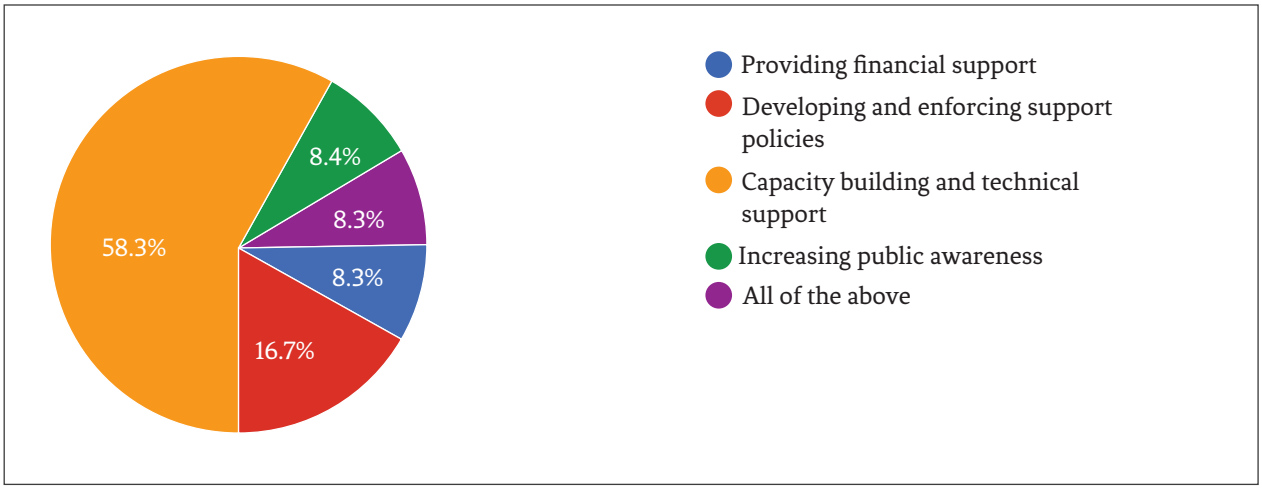


The production and distribution of these technologies also face several critical challenges:

1. High manufacturing costs and low automation: The production costs are compounded by a lack of automation in mass manufacturing processes, leading to complicated logistical operations.
2. Labour shortages and skill gaps: There is a notable reluctance among educated individuals to engage in artisanal jobs, creating labour shortages further exacerbated by limited expertise in linear production techniques.
3. Raw material expenses: The escalating costs of raw materials — especially metallic components — alongside the absence of distinctive product designs pose significant challenges to cost-effectiveness.
4. Local expertise deficiency: The scarcity of localized expertise and advanced technology contributes to high manufacturing costs.
5. Underutilization of machinery: Many facilities are not operating at total capacity due to underutilization of machinery. Coupled with low compliance with industry standards and regulations and weak distribution channels, this hampers operational efficiency.

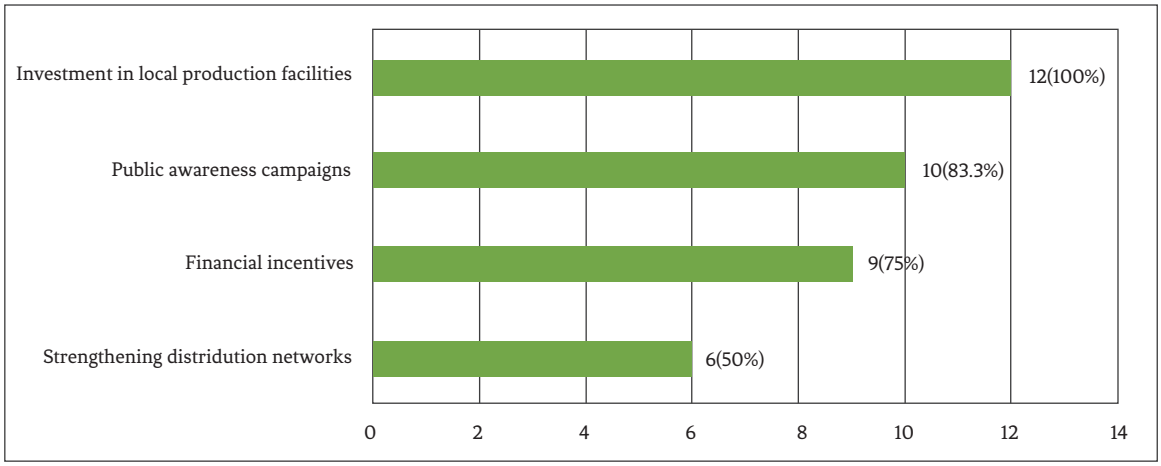
6. Financing barriers: Securing necessary financing often entails high costs and complex requirements, further stifling growth.
7. Inadequate R&D: There is a noticeable deficiency in the sector's research and development initiatives aimed at innovation.
8. Lack of production standards: The absence of well-defined production standards creates ambiguity and output inconsistency. It is important to point out here that Ghana has passed Legislative Instrument (LI 2454) Renewable Energy (Standards and Labelling) (Improved Biomass Cookstoves) Regulations 2022 to promote the efficient use of improved biomass cookstoves by enforcing standards and labelling models.
9. Weak distribution networks: Distribution infrastructure, particularly in rural regions, remains underdeveloped, limiting market access.
10. High transportation costs: Elevated transportation expenses contribute to the complexity of distribution logistics and inefficiency.
11. Expertise and funding limitations: The constrained availability of technical expertise and funding exacerbates production costs, ultimately leading to higher retail prices.
12. Regulatory financial load: Additional financial burdens, such as import duties, value-added taxes (VAT) on raw materials, and various local taxes, further escalate manufacturing expenditures.
These interconnected challenges represent significant barriers to advancing the production and distribution of these technologies. Respondents also highlighted the roles stakeholders, including government, NGOs, the private sector, and international organizations, play or could play in addressing these barriers, as summarized in Figure 9.

Figure 9: Roles of stakeholders in addressing barriers to clean cooking adoption in Ghana



Experts provided several recommendations for overcoming the barriers to adoption as shown in Figure 10. This includes providing subsidies or microfinancing to make clean stoves affordable, increasing awareness efforts to educate households on the health and environmental benefits, boosting local manufacturing to reduce costs and dependency on imports, and improving infrastructure to facilitate access to clean cooking solutions, especially in rural areas.

Figure 10: Recommendations and scale of importance for overcoming clean cooking technology adoption in Ghana



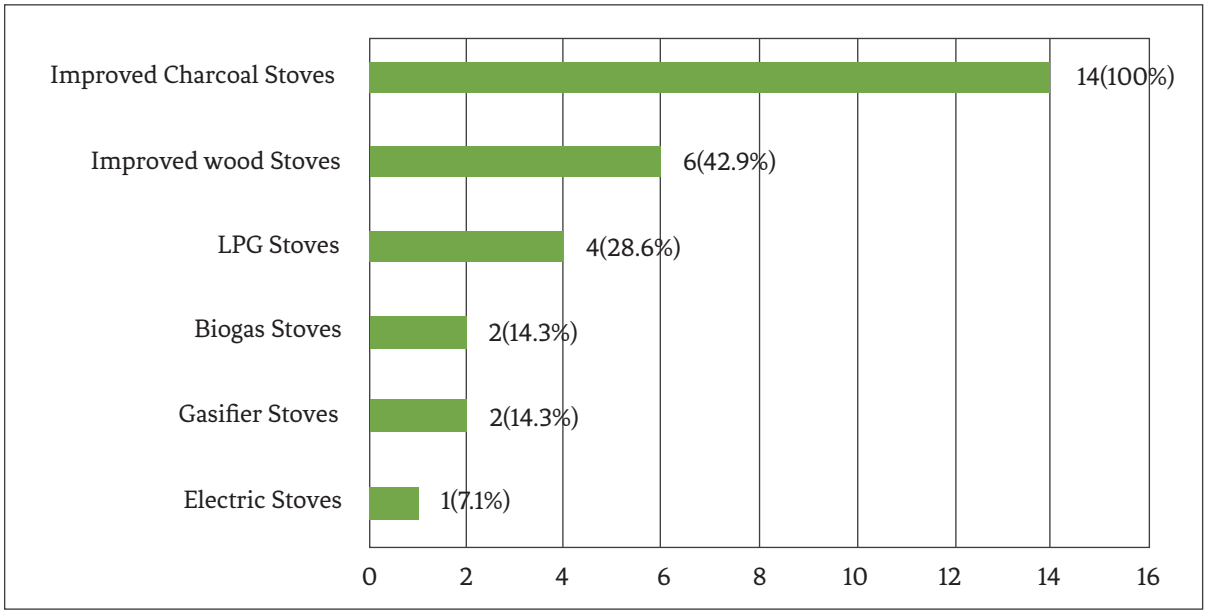
Policy interventions and financial mechanisms, such as duty and tax waivers and microfinancing, can effectively promote clean cooking technologies. While reduced taxes on imported products and materials for production can be beneficial, they might also hinder local manufacturing. Enacting a dedicated Clean Cooking Policy that includes results-based financing (RBF), concessionary loans, and business development support services is essential. The government has established a conducive environment by signing bilateral agreements with other countries to encourage investment in clean cooking technologies in Ghana. Additionally, the government has upgraded testing laboratories to meet international (ISO) standards, regulated the sector by setting standards and labels, and drafted guidelines to monitor activities within the carbon market. Ongoing efforts are to develop national policies, standards, and strategies for the clean cooking sector, including using carbon credits.

3.2 Perspective of entrepreneurs and manufacturers

This section provides insights into the clean cookstove market in Ghana by examining the perspectives of entrepreneurs and manufacturers who produce and distribute clean cooking systems. Fourteen key industry stakeholders were surveyed to understand their roles, the technical and economic challenges they face, and their outlook on the clean cooking sector in Ghana. Entrepreneurs and manufacturers highlighted a range of clean cooking technologies they deal in, as illustrated in Figure 11.

The efficiency ranges for some of the stoves are as follows: charcoal stoves (30-50%), wood stoves (20-50%), the Obaapa stove (38%), improved wood stoves (26% ISO), improved charcoal stoves (38% ISO), gasifier stoves (32% ISO, tested in Uganda by the Energy Commission), ethanol stoves (over 50%), and the Kenyan jiko type, branded as Holycook (31-32%).

Figure 11: Distribution of clean cooking technologies respondents manufacture, distribute or promote



3.2.1 Production capacity

Most respondents assessed Ghana's clean cookstove production capacity as insufficient to meet demand, with 43% reporting difficulties in satisfying market needs due to limitations in production scale, machinery, and facilities. Conversely, about 57% believed that the current capacity was adequate to meet demand in the clean cooking sector. Production capacity varies between 2,000 and 30,000 household cookstoves each month, while institutional stoves are generally produced on demand, with typical production capacities ranging from 20 to 50 units per month.
Entrepreneurs and manufacturers primarily target urban households, rural households, and commercial or institutional clients. Demand patterns vary across these markets depending on the type of stove being distributed and the specific region. In urban areas, LPG stoves are mainly favoured, while charcoal and wood stoves are more commonly used in rural and peri-urban regions. The demand for different cookstoves fluctuates: modern cookstoves tend to be in higher demand in urban areas, whereas clay-lined cookstoves are more sought after in rural areas.

However, the price point that end-users are willing to pay for these stoves is often quite low, making it challenging to cover production costs. Only manufacturers benefiting from carbon finance can adapt effectively to this market. In contrast, companies not involved in carbon finance face ongoing challenges with market prices.

3.2.2 Technical challenges in production and scalability

Respondents identified several technical challenges that affect the scalability of clean cooking technologies in Ghana. They highlighted quality control as a significant issue impacting the consistency and reliability of products. There is a strong need for improved production facilities and machinery to meet the increasing demand while ensuring quality.

Another challenge is accessing affordable, high-quality raw materials like clay liners and metal sheets. High transportation costs and the price of steel contribute to elevated production expenses, subsequently raising the stoves' end-user prices. Most production occurs manually, complicating the process and leading to finishing challenges and the inability to maintain standardization across the same model of cookstoves.

Additionally, there is a lack of promotion for improved cookstoves by the Energy Commission, the Ministry of Energy, and other relevant stakeholders. Currently, the testing fee for GS ISO 19867-1 for improved domestic cookstoves is GHS 6,000 per sample, which is prohibitively expensive for manufacturers. Furthermore, high import levies and taxes on raw material imports exacerbate these issues. These technical limitations lead to increased costs, resulting in lower product quality, ultimately affecting customer satisfaction and the adoption rates of clean cooking technologies.

Some respondents revealed they had tried various emerging technologies and innovations, such as wood stoves, biogas stoves, LPG stoves, and a combination of gas and charcoal stoves (2-in-1).

However, they faced challenges in scaling up these solutions. One manufacturer has developed an improved stove similar to the Jikokoa and Envirofit technologies called Ecochar. The challenge lies in obtaining the right tools and equipment to make it aesthetically comparable to modern stoves. As a result, the final product may not look as appealing, as they rely on local welding and artisanal moulding.

To reduce costs, thinner metal sheets have been used; galvanized and stainless-steel prices have risen significantly. Consequently, the end-user price has become unaffordable for both rural and urban communities. To meet the price points of end-users, manufacturers have reduced the thickness of materials from 1.5 mm and 2 mm to 0.6 mm and 1 mm.

Technical support or partnerships, such as those with research institutions like KNUST-TCC or CSIR-IIR, could greatly assist in overcoming these production challenges. Support schemes could include technical expertise to upgrade production facilities, training and capacity building, knowledge transfer, and product design improvements to enhance scalability.

3.2.3 Financial and economic barriers

Respondents have consistently identified financial barriers as significant challenges to scaling production. Among participants, 43% noted that access to financing represents the most critical financial obstacle. The limited availability of financing options creates difficulties for entrepreneurs aiming to expand their operations or invest in enhanced technologies.

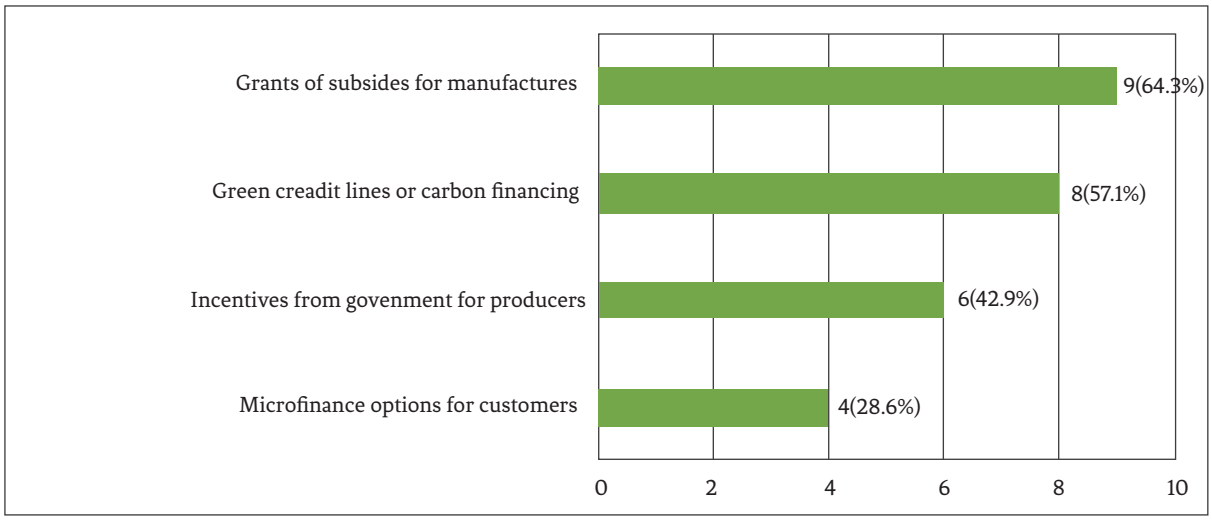
Additionally, 36% of those surveyed indicated that high production costs, including expenditures on materials and labour, restrict their capacity to offer competitive pricing. Demand fluctuations and uncertain market conditions further complicate the feasibility of scaling production, as highlighted by 21% of the participants.

Further economic challenges include the complexities associated with carbon credit financing, which can hinder pricing adjustments for some manufacturers who do not benefit from support due to the free distribution of cookstoves. This situation can adversely affect the quality of the stoves produced.

One respondent said, “Clean cooking startups face significant hurdles in securing financing from traditional banking institutions; instead, they rely on incubation hubs and donor agencies for support. This has led to difficulties in obtaining financial resources. The cost of quality materials for production and high labour expenses are substantial, compounded by theft and employee retention issues. Depending on the interplay between consumer willingness to pay and production and market costs, market risks often lead to distorted pricing. To quote from one manufacturer, “in my view, the cookstove business is currently not viable without donor or carbon finance support to create a more equitable environment. Absent such support, the prospect of sustaining clean cookstoves in Ghana is significantly compromised.”

Regarding financial assistance, 31% of respondents reported receiving support from governmental or non-governmental organizations. However, perspectives on the effectiveness of this support varied. Only 38% of respondents considered such assistance very effective, while 37% viewed it as moderately effective. Implementing financial mechanisms such as subsidies, microfinance, green credits, and tax incentives could prove instrumental in addressing these economic barriers, as shown in Figure 12.

Figure 12: Distribution of financial mechanisms deemed effective in addressing economic barriers



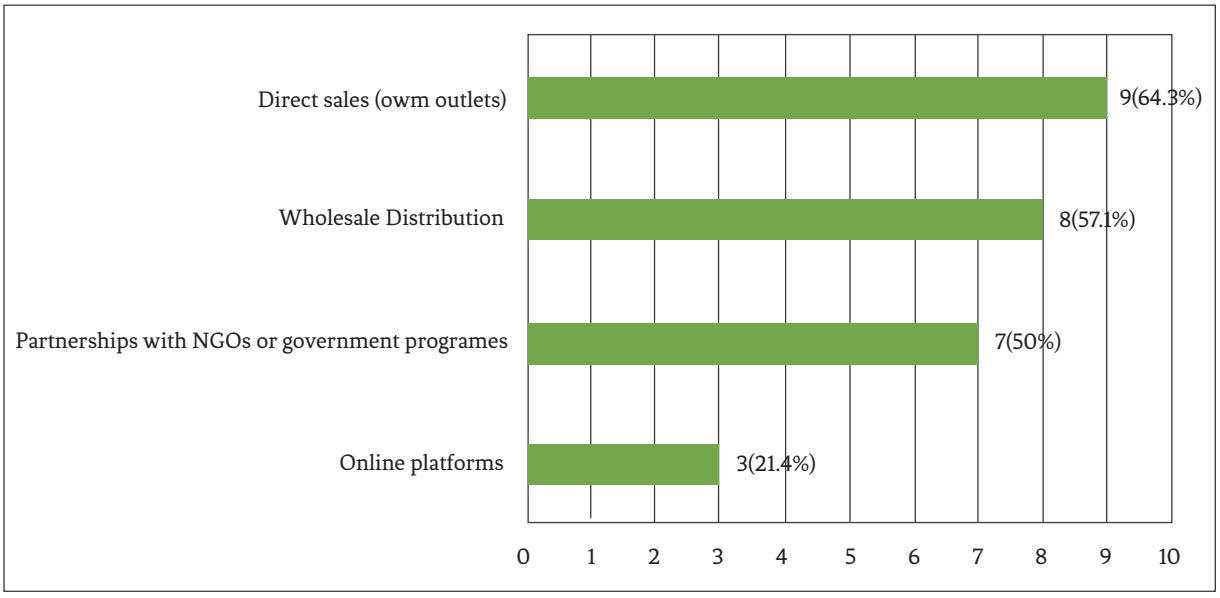
3.2.4 Policy and regulatory challenges

Respondents identified several policy-related barriers that hinder the production and distribution of clean cookstoves in Ghana. They highlighted that import duties on materials increase production costs, making clean cooking solutions less affordable. Additionally, many found that the certification standards are both costly and complex, which poses challenges for small-scale producers trying to compete. Some respondents also noted that government programs that distribute free cookstoves can inadvertently undermine local businesses, impacting their market share and revenue. To address these issues, respondents suggested that reducing import duties and simplifying regulatory processes would help lower costs and promote local production. Some also advocated for subsidies to support local manufacturers.

3.2.5 Market and distribution challenges

Distribution challenges significantly affect the scalability of clean cookstove technologies. Respondents identified transportation costs as a primary obstacle, particularly in reaching rural areas. Others mentioned that a lack of retail networks limits market reach, especially in regions where clean cooking solutions are most needed. Poor infrastructure was also highlighted as a barrier; it not only increases costs but also hampers the reliability of supply chains. The distribution channels used to bring products to market are illustrated in Figure 13. Most respondents emphasized the importance of partnerships with local businesses, NGOs, and government programs in overcoming these distribution challenges, with 50% describing these partnerships as very important.

Figure 13: Distribution channels frequently used to market products



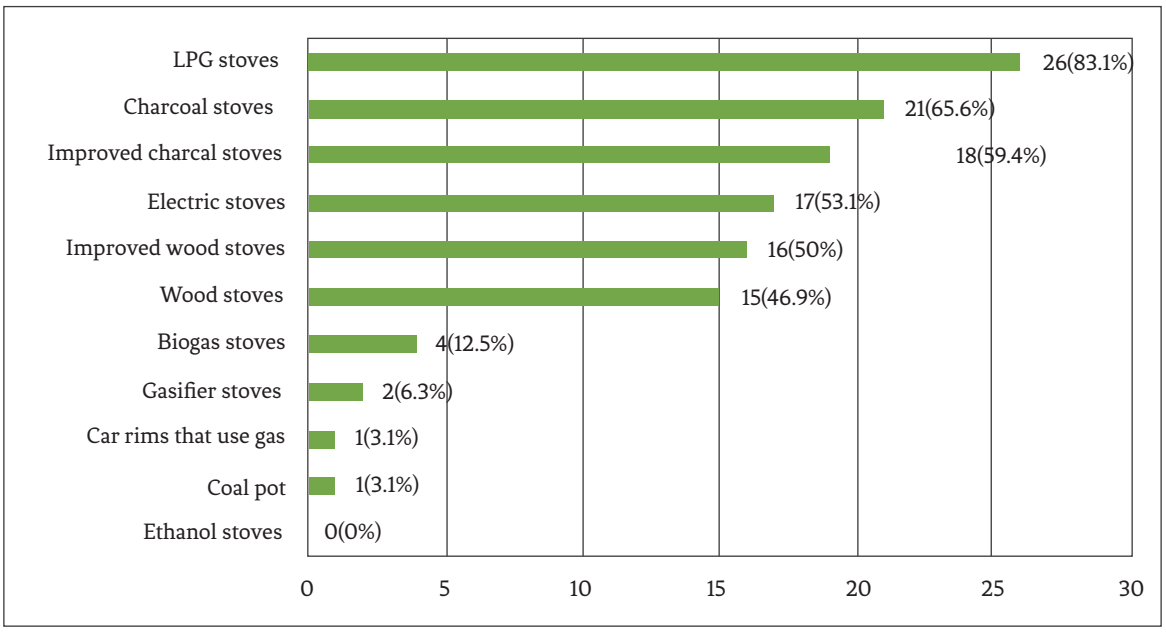
3.3 Perspective of cookstove retailers

This section presents insights from cookstove retailers regarding customer preferences, the most popular stove types, and common challenges in the market.

3.3.1 Types of cookstoves sold and customer preferences

Retailers offer a diverse range of cookstoves, as presented in Figure 14. Customers' most popular cookstove type is the improved charcoal stove (e.g., Gyapa stove), chosen for its efficiency and affordability. LPG stoves are also favoured in urban areas, where accessibility to LPG refilling stations is higher. Improved charcoal stoves were the most popular biomass stoves, combining the traditional cooking experience with reduced fuel consumption. Other types, such as electric stoves, biogas stoves, and ethanol stoves, are available in limited quantities.

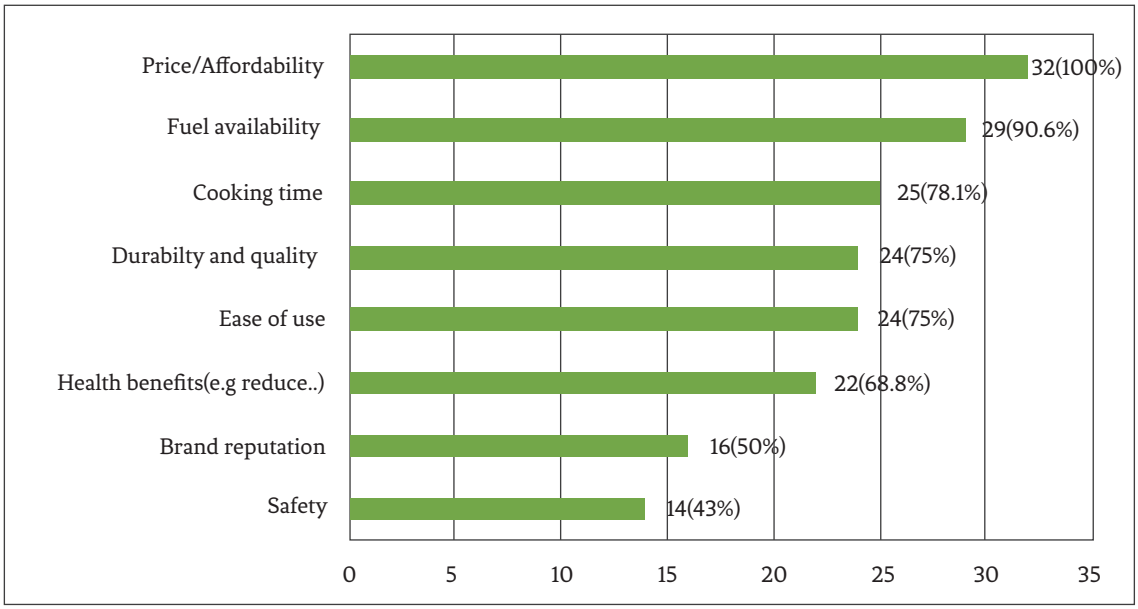
Figure 14: Common and widely sold cookstoves on the market



Retailers identified several key factors that influence customers' choice of cookstoves. Respondents noted that affordability is a significant factor, especially for low-income households. Others suggested that fuel availability is crucial, with charcoal and firewood being preferred due to easy access, particularly in rural areas.

Many retailers also observed that customers are increasingly interested in stoves that emit less smoke, indicating a growing awareness of health benefits. In contrast, others cited durability as an important consideration, as customers are likely to choose stoves with longer lifespan. The distribution of priority of these factors has been shown in Figure 15.

Figure 15: Priority factors influencing customers' choice of cookstove



3.3.2 Price range of cookstoves

Retailers have reported a variety of price ranges for cookstoves. Basic charcoal and wood stoves are typically priced below GHS 100, making them affordable for low-income customers. Improved biomass stoves, such as the Gyapa stove, usually fall within the price range of GHS 100 to GHS 250. In contrast, higher end cookstoves, such as LPG and electric models, are priced above GHS 500 and are generally preferred by urban households with higher incomes. The price range for improved stoves indicates that while they are more expensive than traditional stoves, they remain accessible to middle-income households

3.3.3 Customer feedback and common complaints regarding cookstoves

Retailers have reported several recurring customer complaints related to cookstoves. One notable concern is the durability of less expensive models, where the ceramic or clay lining is prone to breakage. Customers have also expressed dissatisfaction with fuel consumption rates in certain stoves and health-related issues stemming from smoke emissions, particularly with traditional biomass stoves.

Additionally, customers have indicated challenges with slow cooking speeds in basic wood and charcoal stoves. Most complaints are associated with traditional charcoal and wood stoves due to their elevated smoke emissions and extended cooking times. Conversely, improved stoves tend to receive fewer complaints about durability and performance.

Further issues have been noted with local gas stoves. Glass gas stoves have also been criticized for the fragility of the glass components. Customers have raised concerns regarding the limited number of burners available on stoves manufactured in China and issues with the lining of improved charcoal stoves and foreign cookstoves.

Moreover, certain brands and models, including Binatone, Philips, and Lefon, are frequently returned or avoided due to perceived quality concerns. It has been observed that many customers do not thoroughly read the product manuals, which can lead to improper handling and operational difficulties in stove usage

3.3.4 Changes in customer preferences

Retailers have observed several notable trends in customer preferences over the past year. Customers are increasingly opting for foreign brands, leading to a rise in the purchase of international products. The popularity of the Mexican stove has surged as customers now prefer cleaner options due to their ease of use and lower emissions.

Customers are also shifting from traditional coal pots, like the Gyapa, to liquefied petroleum gas (LPG) stoves, which are simple to operate and can be used indoors. Design changes and price trends influence these preferences, and consumers rely more on recommendations from acquaintances and social media when selecting a specific brand. These trends indicate a gradual shift towards cleaner, more efficient stoves, particularly among urban consumers with better access to alternative fuels.

4. CASE STUDIES FROM SELECTED AFRICAN COUNTRIES

In the quest to accelerate the transition to clean cooking technologies in Ghana, there was the need to explore and assess relevant lessons from other African Countries that have successfully implemented clean cooking technologies.

4.1 Rwanda

The government of Rwanda has defined what clean cooking is for the country and has also outlined standards and minimum performance requirements for both fuels and clean cooking technologies. Several policies have been developed, including the National Forestry Policy, Rwanda Energy Policy, Rwanda Biomass Strategy and the Ministerial Guidelines for Clean Cooking Technologies to tackle biomass fuel use from 77.7% of households to 42% by 2024 and establish clear pathways to clean cooking technologies.

The National Forestry Policy outlines measures to curb the issue of biomass supply/demand imbalance, such as promoting green charcoal production, using improved cookstoves, using LPG, and using other alternative energy sources. The Energy Policy recognizes the need to shift consumption from biomass-based fuels to cleaner fuels like electricity and LPG. In contrast to this the Biomass Strategy recommends developing biomass since it is a local source of energy, renewable and sustainable, provides substantial rural income, is a cheap source of energy for urban population, and doesn't depend on global and geopolitical influences. The strategy's main objective is to provide a sustainable supply of affordable wood fuels.

The specific objectives are to (i) Increase the sustainable supply of woodfuel, (ii) Increase the energy use efficiency, (iii) increase the use and production of substitute fuels, and (iv) Create the institutional capacity to implement the Biomass Energy Strategy.

The Strategy further outlines that the relationship between deforestation and charcoal production no longer exists in Rwanda, as charcoal is produced entirely from purposefully grown plantations. Country-wide, cutting of young trees is not allowed and a permit is needed for cutting a matured tree. A permit is also needed for the transportation of wood fuels. The strategy also focuses on reducing the use of wood energy resources through the promotion and adoption of alternative clean and efficient cooking solutions: LPG, biogas, liquid fuels, pellets, briquettes, electricity and improved clean-burning cookstoves.

One of the recommendations of the Biomass Energy Strategy was the development of instructions and guidelines to promote clean cooking technologies. This led to the development of the Ministerial Guidelines for Clean Cooking. These guidelines provided guidance for shifting from low-performance cooking technologies burning woody biomass to modern high efficiency and low-emission technologies. These guidelines apply to households in rural and urban setups, restaurants and hotels, and public and private institutions. Clean cooking technologies are defined in the guidelines as those that reduces emissions to an acceptable level when fed with a defined fuel with emission performance parameters below Tier 3 of the ISO/TR 19867-3. The guidelines and minimum requirements for fuel for clean cooking are outlined in Table 2.

Table 2: Standards and Minimum Requirements for Clean Cooking Fuels

SN	Type of Fuel	Standard (Test method and Minimum requirements)
1	Biogas	ISO 20675: Biogas production, conditioning, upgrading and utilization. Term, definitions and classification scheme.
2	Pellets	RS ISO 17225-1 Solid biofuels - Fuel specifications and classes - Part 1: General requirements RS ISO 17225-2 Solid biofuels - Fuel specifications and classes - Part 2: Graded wood pellets. RS ISO 17225-6 Solid biofuels - Fuel specifications and classes - Part 6: Graded non-woody pellets
3	Briquettes	RS ISO 17225-3 Solid biofuels - Fuel specifications and classes - Part 3: Graded wood briquettes. RS ISO 17225-7 Solid biofuels - Fuel specifications and classes - Part 7: Graded non-woody biomass.
4	Ethanol	ISO 1338:1981, Multiple parts
5	Ethanol gel	SANS 448
6	Methanol	ISO 1387:1982
7	Electricity	Meeting national supply voltage, frequency and power factor.
8	Liquefied Petroleum Gas	RS 140: Liquefied Petroleum Gases (LPG) - Specification

The guidelines further outline the performance and specifications of the clean cooking appliances to comply with existing national and or applicable international standards. The applicable standards and minimum performance requirements are captured in Table 3.

Table 3: Specific standards that apply to different Cooking Technologies

Item	Product Description	Minimum Performance Benchmarks		Test Method
		Metric	Value	
1	Cooking stoves burning unprocessed woody and non-woody biomass fuels	Efficiency CO g/MJ$_d$ PM mg/MJ$_d$ Maximum firepower Safety score Durability score Pictographic Instructions Labelling requirements	≥ 30% ≤ 7.2 ≤ 218 ≤ 20kW ≥ 77 ≤ 20 Pass / Fail Pass / Fail	ISO 19867-1[ab] ISO 19867-1[ab] ISO 19867-1[ab] ISO 19867-1[c] ISO 19867-1[a] ISO 19867-1[a] SANS 2233:2022[c] ISO 19867-1[f]
2	Cooking stoves burning processed woody and non-woody biomass fuels such as pellets, briquettes and torrefied materials	Efficiency CO g/MJ$_d$ PM mg/MJ$_d$ Maximum firepower Safety score Durability score Pictographic Instructions Labelling requirements	≥ 30% ≤ 7.2 ≤ 218 ≤ 20kW ≥ 77 ≤ 20 Pass / Fail Pass / Fail	ISO 19867-1[ab] ISO 19867-1[ab] ISO 19867-1[ab] ISO 19867-1[c] ISO 19867-1[a] ISO 19867-1[a] SANS 2233:2022[c] ISO 19867-1[f]
3	Cooking stoves burning lump charcoal and charcoal briquettes	Efficiency CO g/MJ$_d$ PM mg/MJ$_d$ Maximum firepower Safety score Durability score Pictographic Instructions Labelling requirements	≥ 30% ≤ 7.2 ≤ 218 ≤ 20kW ≥ 77 ≤ 20 Pass / Fail Pass / Fail	ISO 19867-1[ab] ISO 19867-1[ab] ISO 19867-1[ab] ISO 19867-1[c] ISO 19867-1[a] ISO 19867-1[a] SANS 2233:2022[c] ISO 19867-1[f]
4	Stoves burning liquid or gel fuels	Efficiency CO g/MJ$_d$ PM mg/MJ$_d$ Maximum firepower Safety score Durability score Pictographic Instructions Labelling requirements	≥ 40% ≤ 7.2 ≤ 218 ≤ 20kW Pass / Fail ≤ 15 Pass / Fail Pass / Fail	ISO 19867-1[hb] ISO 19867-1[hb] ISO 19867-1[hb] ISO 19867-1[c] SANS 666, SANS 1906,SANS 1243 ISO 19867-1[h] SANS 2233:2022[c] ISO 19867-1[f]
5	Stoves burning bottled or piped gas that are freestanding, built-in or table-top and are intended to be used indoors; applies to cooking stoves, working tables, ovens and similar appliances; cylinders and accessories.	Efficiency CO g/MJ$_d$ PM mg/MJ$_d$ Maximum firepower Safety score	≥ 40% ≤ 7.2 ≤ 218 ≤ 20kW Pass / Fail	ISO 19867-1[hb] ISO 19867-1[hb] ISO 19867-1[hb] ISO 19867-1[c] ISO/TS 21364, ISO 23550+ISO 23551[i]
6	Biogas, Digestors and appliances	Design and Construction Portable Digestors Biogas Biogas burning stoves		RS 306 RS 349 ISO 20675 IS 8749 Indian Biogas stove standard
7	Electric cooking appliances	Efficiency Safety Durability	≥ 70% Pass / Fail ≤ 10	CAN/CSA-C358-03 IEC 60350-1:2013 IEC 60335-2-6:2015
8	Batteries supplied with cooking appliances	Safety: Lithium batteries Safety: Lead-acid batteries	Pass / Fail Pass / Fail	RS IEC 62133-2, RS IEC 61960 RS IEC 60986, RS IEC 61056 Other battery types are also present in the market, and different standards may apply.
9	Electric components of non-electric stoves	Electrical component safety	Pass / Fail	IEC 60335-2-6:2014

4.2 Uganda

The Ugandan government has developed a third National Development Plan (2022-2027) intending to increase household incomes and improving the quality of life of Ugandans. The plan has set a target to among other things:

- Increase the share of clean energy used for cooking from 15% to 50%
- Reduce the share of biomass for cooking from 88% to 50%
- Increase LPG from 1% to 8% of the energy use

All these targets are to be achieved by 2025. At the same time, the government is piloting the distribution of 1000 Electric Pressure Cookers (EPCs) and developing an e-cooking strategy and implementation plan for the country. Additionally, the government has established various incentives to encourage private-sector involvement and make stoves more affordable. Some of these include the following.

- VAT waivers on LPG and ethanol for cooking;
- zero import tax on stove parts required for local assembly;
- biogas tubular digesters and solar panels to support solar cooking;
- introducing a lifeline tariff for cooking with electricity; and
- reduced import tax on stoves from 25% to 10%.

Further, the Stockholm Environment Institute, together with their research partners and the Clean Cooking Alliance, is working with Uganda's Ministry of Energy and Mineral Development (MEMD) and the Ministry of Water and Environment (MWE) to develop a National Integrated Clean Cooking Strategy (NICCS). The objectives of this strategy are to:

- Equip Uganda's government with a coordinated, integrated National Clean Cooking strategy
- Achieve clean cooking targets with a clear process to measure and monitor how these interventions meet Uganda's Third National Development Plan Target by 2025.

To achieve these objectives, the NICCS will:

- Consolidate the strategies currently being developed for biogas technology, LPG, electric cooking, ethanol, and other clean cooking technologies to provide targets on how all these clean technologies can achieve Uganda's Third National Development Plan target to increase the share of clean energy used for cooking from the baseline 15% in 2018/19 to 50% by 2025. The Third National Development Plan aims to 'Promote uptake of alternative and efficient cooking technologies including rural areas (electric cooking, domestic and institutional biogas and LPG).'

- Provide clear targets for all clean cooking technologies such as electric pressure-cooking, LPG, ethanol, and clean and modern biomass to meet the 50% clean cooking target by 2025.
- Assess the adequacy of these government incentives for achieving these clean cooking targets by 2025.
- Develop robust results, monitoring, evaluation and learning framework with SMART standard indicators for decision support.

4.3 Kenya

Kenya, similar to Uganda, has already established a National Cooking Transition Strategy to harmonize various subsectors and a diverse set of actors, providing coherence to Kenya's clean cooking sector. The strategy integrates existing fuel-specific strategies, such as the Bioenergy Strategy, the Bioethanol Masterplan, the LPG Growth Strategy, and the Electric Cooking Strategy, to create a cohesive enabling environment where all solutions, both transitional and truly clean, can thrive. The strategy aims to transform the cooking sector in Kenya into a sustainable and profitable sector, aligning with the target of achieving universal access by 2028. The KNCTS defines clean cooking as cooking with fuels and stove combinations that meet the WHO guidelines for indoor air quality standards.

Ghana can learn from Kenya's completion of its National Cooking Transition Strategy to help accelerate the transition to clean cooking technologies. An assessment of the strategy provides various guidelines that Ghana can follow while preparing its National Cooking Transition Strategy. Among the benefits outlined in the strategy are:

- The definition of the policy, key players, and institutional frameworks
- Barrier analysis that identifies certain challenges and opportunities
- Establishing a baseline to determine the current status of clean cooking technologies in the country
- Assessing the current state of cooking transitions in the cooking sector
- Understanding the market size, attributes, and potential
- Identifying barriers to access and use
- Determining the most binding constraints
- Highlighting emerging opportunities
- Setting targets and simulating possible pathways
- Defining the logic of intervention to achieve these targets
- Bridging the supply gap for clean cooking solutions
- Bridging the affordability gap on the demand side
- Leveraging carbon financing
- Promoting local manufacturing and fuel production for local use and export
- Reframing and raising awareness of the role of clean cooking
- Ensuring institutional accountability, planning, and continuous tracking of progress
- Identifying capital requirements
- Exploring potential sources of funding for the strategy
- Assessing risks associated with implementing this strategy

Considering all the above elements, this strategy would create an enabling environment to accelerate the transition to clean cooking technologies.

4.4 Adapting lessons from case study to Ghana's unique context

a) Rwanda: Integrated biomass management and policy frameworks

Rwanda has established a comprehensive framework for sustainable biomass management and clean cooking technologies, which Ghana can adapt to accelerate its clean cooking transition. The country's Biomass Energy Strategy emphasizes the sustainable production of woodfuel through community-managed plantations and regulated charcoal production. Charcoal in Rwanda is sourced exclusively from

purposefully cultivated plantations, with strict permits required for tree cutting and transportation. This approach ensures that biomass is both renewable and sustainable, providing an affordable energy source while protecting forest resources. In addition, the country has introduced Ministerial Guidelines for Clean Cooking, which define clear standards for cooking technologies, including emissions thresholds aligned with international benchmarks (ISO Tier 3). These guidelines support the transition to cleaner technologies, such as LPG, biogas, and improved biomass cookstoves. Ghana can adopt Rwanda's model by establishing sustainable woodlot plantations and implementing a permit system for biomass production. Developing clear standards for cookstoves and fuels will also ensure product quality, improve adoption, and enhance consumer trust in clean cooking technologies.

b) Uganda: Financial incentives and integrated strategy development

Uganda's clean cooking initiatives emphasize financial incentives and a cohesive policy framework that supports innovation and adoption. To make clean cooking technologies affordable, Uganda has introduced tax waivers and subsidies, such as VAT exemptions for LPG and ethanol and reduced import duties on stove components. These measures help reduce production and purchase costs for both manufacturers and consumers. The country has also launched pilot projects, such as distributing 1,000 electric pressure cookers and introducing lifeline tariffs for cooking with electricity, to promote the adoption of alternative clean cooking technologies. Furthermore, Uganda has developed the National Integrated Clean Cooking Strategy (NICCS), which consolidates plans for various clean cooking solutions, including LPG, biogas, and electric cooking, with clear adoption targets and monitoring systems. Ghana can adopt Uganda's strategies by introducing tax waivers on clean cooking equipment and fuels, such as LPG cylinders and ethanol stoves, and piloting new technologies like induction stoves and electric pressure cookers in urban areas. Developing a unified strategy similar to the NICCS, which integrates Ghana's policies and programs for clean cooking technologies, will provide a coordinated framework to achieve national targets and improve efficiency.

c) Kenya: Comprehensive national cooking transition strategy

Kenya's National Cooking Transition Strategy (KNCTS) is a model for integrating diverse clean cooking efforts into a cohesive framework, aligning various fuel-specific plans under a unified national goal. This approach has transformed Kenya's cooking sector into a sustainable and profitable industry, intending to achieve universal access to clean cooking technologies by 2028. The KNCTS includes detailed market analyses, barrier assessments, and pathways for scaling clean cooking solutions. It also emphasizes the importance of local manufacturing and carbon financing. Local production of clean stoves and fuels in Kenya has created jobs, boosted economic growth, and reduced the reliance on imports. At the same time, carbon financing has provided additional revenue streams to subsidize clean cooking technologies for low-income households. Ghana can adopt this strategy by harmonizing its policies, such as the Renewable Energy Master Plan and National Energy Transition Framework, into a single, actionable roadmap. Establishing carbon credit systems for clean cooking projects, as seen in Kenya, can help subsidize the cost of clean cooking technologies and fuel. Furthermore, promoting local manufacturing with financial incentives, technical training, and partnerships will boost domestic capacity and ensure long-term sustainability.

5. OUTCOME OF ROUNDTABLE DISCUSSION

The roundtable provided critical insights into barriers, opportunities, and actionable strategies to accelerate the adoption of clean cooking technologies in Ghana. The outcome of the discussions at the roundtable is presented below.

a) Expand Access to Affordable Financing

- Develop innovative climate financing models, such as results-based financing or carbon credit programs, to incentivize adoption.
- Engage local and international banks to create concessional loan schemes with low-interest rates tailored for clean cooking technologies.
- Partner with financial institutions to design flexible payment structures for consumers of clean cooking technologies and SMEs engaged in the clean cooking technologies business, such as installment-based plans or microfinancing options.

b) Enhance the Role of Local Governments

Local governments and Metropolitan, Municipal, and District Assemblies (MMDAs) can play a pivotal role in promoting clean cooking adoption through policies and community engagement.

- Introduce assembly by-laws in well-resourced MMDAs to restrict the sale of inefficient stoves while incentivizing clean alternatives.
- Facilitate partnerships with CSOs to launch awareness campaigns and advocate for clean cooking adoption at the community level.
- Support the inclusion of clean cooking solutions in local development plans and budgets, ensuring alignment with national energy policies.

c) Strengthen Policy and Regulatory Frameworks

Stakeholders emphasized the need for a stronger regulatory environment to support clean cooking technologies.

- Establish clear technical standards for all clean cooking technologies to ensure safety, efficiency, and consumer trust.
- Implement mandatory certification and labeling aligned with ISO standards to promote quality assurance and market transparency.
- Reduce testing fees or provide subsidies for testing, enabling local manufacturers to meet certification requirements affordably.

d) Leverage Local Manufacturing Capabilities

To ensure long-term sustainability, clean cooking technologies should be locally produced whenever possible.

- Invest in technical training and skills development for local artisans and SMEs.
- Provide access to modern production tools and equipment to improve efficiency and product quality.
- Facilitate technology transfer partnerships with international stakeholders to introduce advanced manufacturing techniques and designs.

e) Address Livelihood Concerns in the Transition

The transition to clean cooking technologies must account for the socio-economic impacts on traditional biomass producers, such as charcoal sellers.

- Develop programs to retrain and integrate charcoal producers into the clean cooking value chain, such as briquette and pellet production.
- Ensure that woodfuel production adheres to sustainable practices, sourcing from designated woodlots rather than conservation zones.

f) Pilot and Scale Innovative Technologies

To accelerate adoption, pilot programs for innovative clean cooking technologies should be prioritized.

- Adopt a phased approach to test and scale solutions such as electric and solar cookstoves.
- Collaborate with development partners to identify region-specific technologies and assess their performance in different socio-economic contexts.
- Use pilot programs to gather data and refine strategies before national rollout.

g) Integrate Robust Monitoring and Evaluation Frameworks

Monitoring and evaluation (M&E) mechanisms are essential for tracking progress and adapting strategies.

- Use data-driven decision-making to assess adoption rates, the performance of interventions, and their socio-economic impacts.
- Develop a national M&E framework to identify high-impact areas and reallocate resources as necessary.
- Engage stakeholders, including CSOs, in the review and monitoring of clean cooking policies and programs.

h) Improve Public Awareness and Education

Awareness campaigns should address cultural resistance and build consumer confidence in clean cooking technologies.

- Partner with CSOs and community groups to educate households on the health, environmental, and economic benefits of clean cooking.
- Focus on rural and underserved areas with tailored campaigns that align with local cooking practices and traditions.
- Leverage retailers and community leaders to demonstrate the usability and durability of clean cooking technologies.

These recommendations reflect a multi-stakeholder consensus on how Ghana can accelerate its clean cooking transition. By addressing affordability, enhancing local capacity, and fostering policy alignment, Ghana can achieve its clean cooking targets while fostering socio-economic and environmental sustainability.

6. RECOMMENDATIONS FOR ACCELERATING THE CLEAN COOKING TRANSITION

Based on insights from industry experts, manufacturers, retailers, and case studies from other countries reviewed in this study, these recommendations offer a multi-faceted approach to enhance adoption rates and support small and medium-sized enterprises (SMEs) involved in clean cooking initiatives.

a. Expand Financial Mechanisms and Industrial Scaling Support

Financial solutions like microfinancing, subsidies, and Results-Based Financing (RBF) are essential to transition from artisanal to industrial-scale production. Manufacturers will need support through government-backed low-interest loans, targeted subsidies, and duty waivers on advanced components for industrial-scale manufacturing. These measures will help make locally produced stoves more affordable, efficient, and competitive. Carbon financing projects should be introduced in partnership with international organisations to unlock funds for clean cooking initiatives. Key industry associations, such as GHACCO, should help facilitate access to funding opportunities, such as the Private Financing Advisory Network, USAID Climate Finance for Development Accelerator, and the West Africa Clean Cooking Fund, by organising manufacturers into cooperatives or consortia. This approach can help them prepare more substantial funding proposals. The carbon credits generated by these projects can provide vital funding for SMEs, reduce consumer costs, and support Ghana's broader climate goals.

b. Enhance Public Awareness and Education

Cultural preferences and misconceptions about clean cooking technologies remain significant barriers. Intensive awareness campaigns, particularly in rural and underserved areas, are essential to promote the benefits of clean cooking technologies. Stakeholders, including government agencies, NGOs, and community-based organisations, should collaborate to highlight the health, environmental, and economic benefits of transitioning to cleaner alternatives. Practical demonstrations and hands-on training should also be incorporated to build user confidence and acceptance.

c. Strengthen Distribution Networks and Infrastructure

The limited accessibility of clean cooking technologies in rural and peri-urban areas hinders adoption. Investments in transportation infrastructure, regional distribution hubs, and last-mile delivery networks are critical to ensuring widespread accessibility. Improved logistical frameworks will reduce costs and enable clean cooking technologies to reach remote communities more efficiently.

d. Leverage Technology and Innovation

Promoting innovative clean cooking technologies like biogas and solar cookstoves will diversify options and meet specific regional needs. Clear adoption targets for these alternative technologies should be established to guide research, investments and policy support. Research and development (R&D) should also be incentivised to create cost-effective and culturally appropriate technologies for local use. This can be achieved in close collaboration with international technology providers to facilitate the transfer of advanced manufacturing techniques and equipment.

e. Establish Technical Standards and Reduce Testing Costs

Developing and enforcing clear technical standards for clean cooking technologies will ensure safety, efficiency, and consumer trust. The government should subsidise testing costs for local manufacturers, enabling them to meet certification requirements without financial strain. Aligning standards with international benchmarks, such as ISO standards, will enhance product competitiveness and consumer confidence.

f. Facilitate government-private sector collaboration

Enhanced collaboration between the government, private sector, and NGOs is vital for creating a supportive ecosystem for clean cooking technologies. Joint initiatives could involve co-designing financing schemes, policy advocacy, and investment in infrastructure to support the sector. Such partnerships can also facilitate public awareness campaigns and support distribution expansion strategies that meet local needs and preferences.

g. Promote Gender-Inclusive Approaches

Gender-sensitive strategies are essential to ensure equitable benefits from clean cooking transitions. Training and funding opportunities should target women entrepreneurs in the clean cooking value chain. Awareness campaigns should also focus on empowering women as primary decision-makers in household cooking practices.

h. Integrate Monitoring and Evaluation Frameworks

A robust monitoring and evaluation (M&E) framework is essential for tracking progress and ensuring accountability. Data-driven assessments should evaluate the effectiveness of interventions, identify high-impact areas, and guide resource allocation. Stakeholder reviews should be conducted periodically to adapt strategies based on emerging challenges and opportunities.

By integrating these strategies, Ghana can create a supportive ecosystem to accelerate the adoption of clean cooking technologies while fostering environmental sustainability, public health, and economic growth.

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