

Opportunities for transition to clean household energy

Application of the WHO Household Energy Assessment Rapid Tool (HEART)



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Opportunities for transition to clean household energy: application of the Household Energy Assessment Rapid Tool (HEART) in Ghana

ISBN 978-92-4-151402-6

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Suggested citation. Opportunities for transition to clean household energy: application of the Household Energy Assessment Rapid Tool (HEART) in Ghana. Geneva: World Health Organization; 2018. Licence: CC BY-NC-SA 3.0 IGO.

Cataloguing-in-Publication (CIP) data. CIP data are available at <http://apps.who.int/iris>.

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Printed in Switzerland

Design and layout: Paprika, Annecy

Cover photo: Heather Adair-Rohani (WHO)

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Abbreviations and acronyms

GDP	gross domestic product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GSA	Ghana Standards Authority
HEART	Household Energy Assessment Rapid Tool
HESA	Health and Environment Strategic Alliance
HAP	household air pollution
LEAP	Livelihood Empowerment Against Poverty
LPG	liquefied petroleum gas
NPA	National Petroleum Authority
SNV	Netherlands Development Organisation
USAID	United States Agency for International Development

Acknowledgements

This report was prepared by a team of consultants consisting of Kwaku Poku Asante, Kwesi Baffour Sarpong, Edith Clarke, Karin Troncoso and Rufus Edwards with input from the WHO Ghana Country Office, local organizations and government officials. The report was reviewed by Heather Adair-Rohani and Jessica Lewis (Technical Officers), WHO Department of Public Health, Environmental and Social Determinants of Health, Geneva,

Switzerland. Editorial assistance was provided by Elisabeth Heseltine.

WHO is grateful to Bloomberg Philanthropies for funding the project to identify opportunities for transition to clean household energy in countries by application of the Household Energy Assessment Rapid Tool (HEART).

Preface

Household air pollution (HAP) from inefficient fuel combustion is one of the most important global environmental health risks today. Almost 3 billion people, mainly in low- and middle-income countries, still rely on solid fuels (wood, animal dung, charcoal, crop wastes and coal) burnt in inefficient, highly polluting stoves for cooking and heating. Widespread use of polluting cookstoves causes almost 4 million premature deaths annually among children and adults from respiratory illness, cardiovascular diseases and cancer, as well as serious injuries from scalding, burns and poisoning.

The WHO guidelines for indoor air quality: household fuel combustion (2014) provide technical recommendations for policy-makers and specialists working on energy, health, environmental and other issues to ensure health benefits from the clean energy transition.

In support of the implementation of the guidelines, WHO has developed a tool, the Household Energy Assessment Rapid Tool (HEART), to identify relevant stakeholders, and map out a country's policies and programmes on household energy and/or related health impacts. The tool is being

pilot-tested as a guide to conducting rapid situational assessments of countries' readiness to address access to clean energy technologies. It is used to gather and synthesize information on household energy use and its public health impacts and to stimulate an informed dialogue on the impacts of household energy interventions, shared responsibilities and coordinated actions, country-specific barriers to implementation and opportunities for the public health sector to accelerate a transition to clean household energy.

The rapid assessment does not take the place of the detailed economic evaluation required in identifying national energy priorities, national and global mapping of disease prevalence associated with polluting fuels, nor the social and political considerations required for implementing major social interventions to support a transition to clean energy. It does provide a broad overview of the current household energy and health situation, identifies key stakeholders and will ultimately support intersectoral cooperation. This report presents the results obtained with HEART in Ghana.

Introduction

Household energy programmes in Ghana can be categorized into three intervention areas: clean cooking, electrification and energy efficiency. Initially, the primary rationale for programmes on household energy was to address issues of deforestation and climate change and, secondarily, socioeconomic development. Since 2010, the negative health impacts of the lack of clean,

efficient household energy have been increasing; however, these impacts are not yet integrated into national programmes or the national agenda for development. This report outlines the current household energy situation, including key stakeholders, programme implementation and potential areas for support.



Credit: Heather Adair-Rohani

Country context

2.1 Geographical data

Ghana is a lower middle-income country located on the west coast of Africa. The country covers an area of about 238 540 km², divided into 10 administrative regions, which are further divided into 216 decentralized districts.

Ghana has several distinct ecological zones, e.g. savannah areas and an evergreen area (Fig. 1). The country has a tropical climate throughout the year, with temperatures and rainfall patterns that vary according to distance from the coast and elevation.

Ghana has a dry season that corresponds to the winter period in temperate countries and is followed by a rainy season. The duration of each season generally depends on the ecological zone. The rainiest areas are the coastal evergreen areas, where precipitation is greater than 1500 mm per year, and even more rain falls on a small portion of the west coast, where it reaches 2000 mm per year. The driest areas are the northern savannah regions, where the rainfall is around 1000 mm per year, and the coastal savanna areas in the south, including the capital Accra (800 mm rainfall per year).

The ambient temperature is generally high, although it varies throughout the year. In the coastal area, daily temperatures range from 25 to 39 °C. The coldest months are from June to October. The temperature also varies across the country throughout the year.



↑ **Fig. 1.** Map of Ghana showing agro-ecological zones

Source: reference (1)

2.2 Demographic and economic data

Ghana's population was estimated to be about 27.41 million in 2015 (2); the annual population growth rate is 2.3%. A high proportion (35.7%) of the population live in Ghana's most urbanized regions (Ashanti and Greater Accra, Table 1). Around half the population lives in urban areas, the three northern regions being the least urbanized. About

39% of the population are children younger than 15 years. Life expectancy is 61 years, and Ghana's human development index (a composite statistic of life expectancy, education and per capita income indicators, which are used to rank countries into four tiers of human development) is 0.579.



*Ghanaians sit outside a building housing a stove for smoking fish that is designed to be more efficient than traditional methods (although emissions are still greater than those safe for health)
Credit: Jessica Lewis*

↓ **Table 1.** *Distribution of Ghana's population*

Region	% Of total pop.	% Urban	Average number of people in household	Average number of households per compound/ house	Average pop. per house/ compound	% Literate pop. out of total literate pop. aged 11 years +	% Literate pop. out of regional pop. aged 11 years +
Western	9.6	42.4	4.2	1.5	6.3	9.9	76.4
Central	8.9	47.1	4	1.5	6.4	9.3	78.1
Greater Accra	16.3	90.5	3.8	2.2	8.4	21.2	89.2
Volta	8.6	33.7	4.2	1.2	5.3	8.5	73.4
Eastern	10.7	43.4	4.1	1.5	6.1	11.7	81
Ashanti	19.4	60.6	4.1	2	8.3	21.9	82.6
Brong Ahafo	9.4	44.5	4.6	1.5	7	8.7	69.8
Northern	10.1	30.3	7.7	1.2	9.6	4.5	37.1
Upper East	4.2	21	5.8	1.6	9.2	2.6	47.5
Upper West	2.8	16.3	6.2	1.3	8.5	1.7	46.2
Total	100	50.90	4.4	1.6	7.3	74.1	

Source: reference (3)

Economic indicators have implications for the implementation of health programmes and progress towards the attainment of the Sustainable Development Goals. The Ghanaian economy has a diverse and rich resource base. It is recognized as the second largest economy in West Africa and the twelfth largest in Africa, and its economic status changed from developing country to lower middle-income country in 2011 after rebasing of its national accounts. The agricultural sector, services sector (including telecommunications) and the industrial sector are the main drivers of the economy. The gross domestic product (GDP) of Ghana, according to the World Bank, was US\$ 37.543 billion in 2015 (representing 0.06% of the world economy), and per capita income was US\$ 1367.70. The country's real GDP growth rate was projected to increase from 3.9% in 2016 to 6.3% in 2017.

Ghana's inflation rate remains in double digits owing to factors such as increasing fuel prices and the depreciation of the cedi against major trading currencies. However, inflation saw a sustained downward trend, from 17% in 2014 to 13% in April 2017. The country's debt to GDP ratio stood at 70% in 2016.

Ghana is regarded as one of the most attractive business destinations in Africa. The stable political situation coupled with Government implementation of policies that have considerably reduced the general cost of doing business in Ghana have boosted investor confidence. Ghana's prospects remain robust with high potential for long-term sustainable growth. This is anchored in its diverse economy, rich endowment of natural resources, a young, vibrant, skilled population and a strong institutional and legal framework.

Health sector data

3.1 Burden of disease from air pollution

Air pollution is one of the leading risk factors for premature death in Ghana. The combined effects of household and ambient air pollution are responsible for almost 23 000 deaths per year (Table 2). Household air pollution (HAP) from cooking mainly with polluting fuels and technologies alone is responsible for more than 14 000 premature deaths per year (4).

↓ **Table 2.** Risk factors for premature deaths in Ghana, 2015

Risk factor	Premature deaths/year
Child and maternal malnutrition	22 988
Air pollution	22 396
High systolic blood pressure	21 230
Dietary risks	16 633
Alcohol and drug use	15 434

Source: reference (5)

In particular, HAP from cooking with polluting fuels is estimated to have been responsible for 7796 deaths from stroke in adults and 4238 deaths from respiratory illnesses in children in 2012

(Table 3). In addition, there are a number of other disease outcomes for which there is a growing global body of evidence of linkage with exposure to air pollution. Thus, the total health burden is likely to be much larger than previous estimates suggest.

↓ **Table 3.** Burden of disease attributed to household air pollution, 2012

Disease	DALYs	Deaths
Stroke	219 797	7 796
Cardiovascular disease	136 950	4 462
Acute lower respiratory tract infection (children under 5 years)	386 164	4 238
Chronic obstructive pulmonary disease	46 016	832
Lung cancer	4 257	134

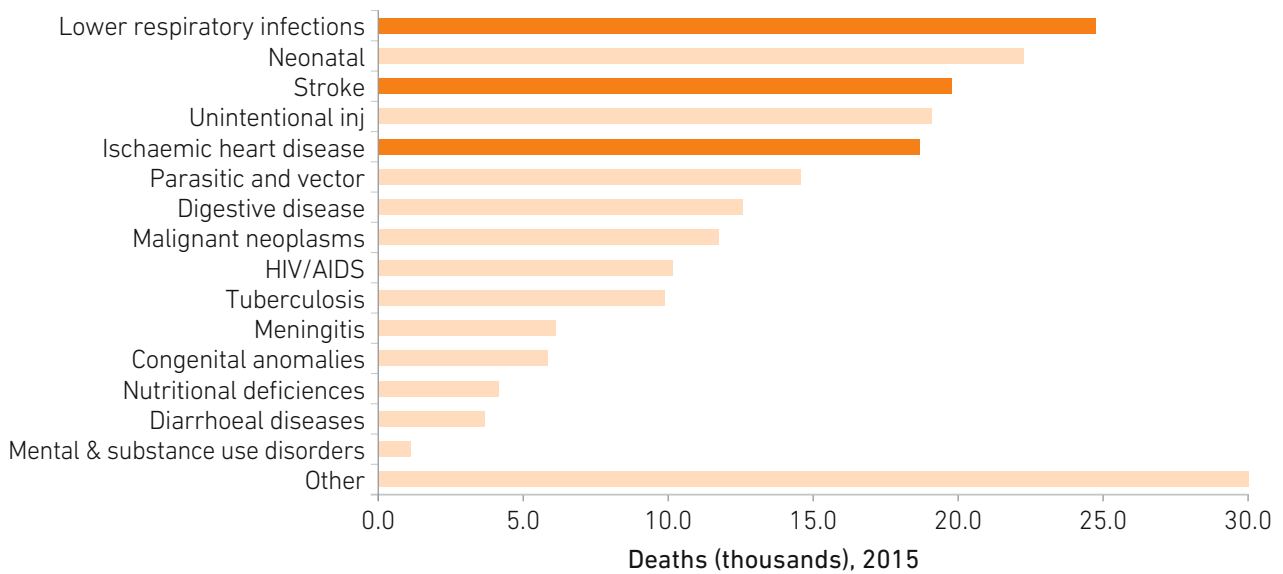
DALY: disability-adjusted life year.

Source: reference (2).

Lower respiratory infections, stroke and ischaemic heart disease, which are associated with HAP, are three of the 15 most important causes of diseases in Ghana (Fig. 2).



Smoke rises from a series of stoves used to smoke fish in a coastal community. Credit: Jessica Lewis



↑ **Fig. 2.** The 15 most important causes of death in Ghana, 2015

Source: reference (4).

In addition to these health outcomes, cooking with polluting fuels on simple stoves poses other risks in the home that are less well characterized. For example, polluting fuels and technologies used for lighting can pose significant risks to households. Kerosene poisoning is the most

common cause of childhood poisoning in the domestic setting in Ghana. Although the risk of burns and injury from household fuel use is high, these are not included in the estimates of morbidity associated with cooking reported above.



LPG cylinders used for cooking are often transported by motorbike in Ghana.
Credit: Heather Adair-Rohani

Household energy: the current situation

4.1 Use for cooking

4.1.1. Cooking fuel use

Solid fuels remain the main energy source for cooking in Ghanaian households. About 76% of households cook mainly with polluting fuels and technologies (mostly firewood, 41.3%, and charcoal, 31.5%). In rural areas of Ghana, primary use of polluting fuels for cooking is extremely high (94%) (Table 4).

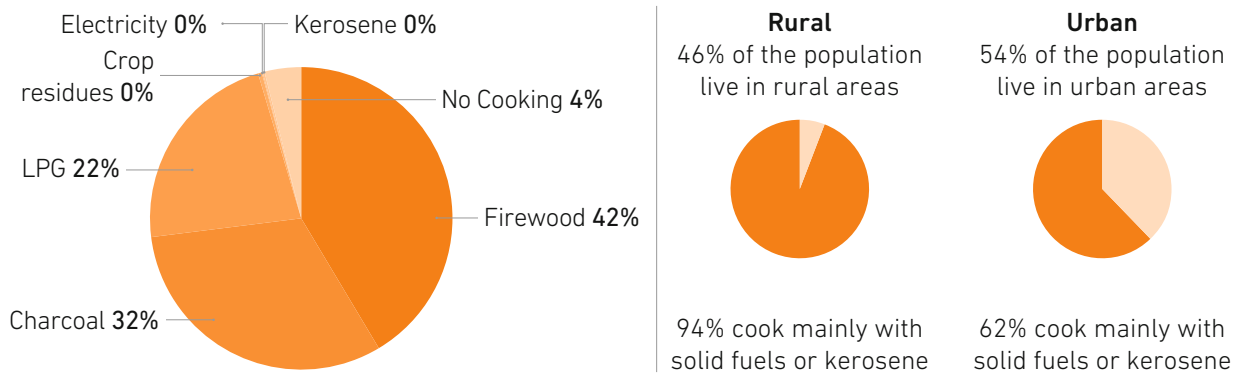
About 22% of all households in Ghana cook with liquefied petroleum gas (LPG). In Accra, the most

urban area in Ghana, charcoal and gas are the primary fuels. In all urban areas, around 35% of households cook with LPG. In urban areas other than Accra, there is significantly more use of fuelwood and charcoal included in the household fuel mix, and less LPG. Households often have a preference for food cooked with charcoal, even when there is no flavour difference compared to food prepared using LPG.

Electricity is used as the primary cooking energy source in a very small fraction of Ghanaian households (less than 1%) (Fig. 3).

↓ **Table 4.** Primary household cooking fuel (percentage of households)

	Fuel type	Urban			Rural				All Ghana
		Accra	Other	All urban	Coastal	Forest	Savannah	All rural	
Polluting fuels and technologies	Wood	0.8	20.5	14.3	57.6	72.4	87.4	74.8	41.3
	Charcoal	38.9	45.8	43.6	30	17.9	7.6	16.5	31.5
	Crop residue	0	0.2	0.1	0	0.1	2.2	0.7	0.4
	Kerosene	0.5	0.1	0.2	0.3	0.1	0.1	0.1	0.2
Clean fuels and technologies	LPG	52.7	28	35.8	9.8	6.7	1.3	5.5	22.3
	Electricity	0.6	0.5	0.5	0.1	0.1	0.1	0.1	0.1



↑ **Fig. 3.** Primary cooking fuels used by households in Ghana

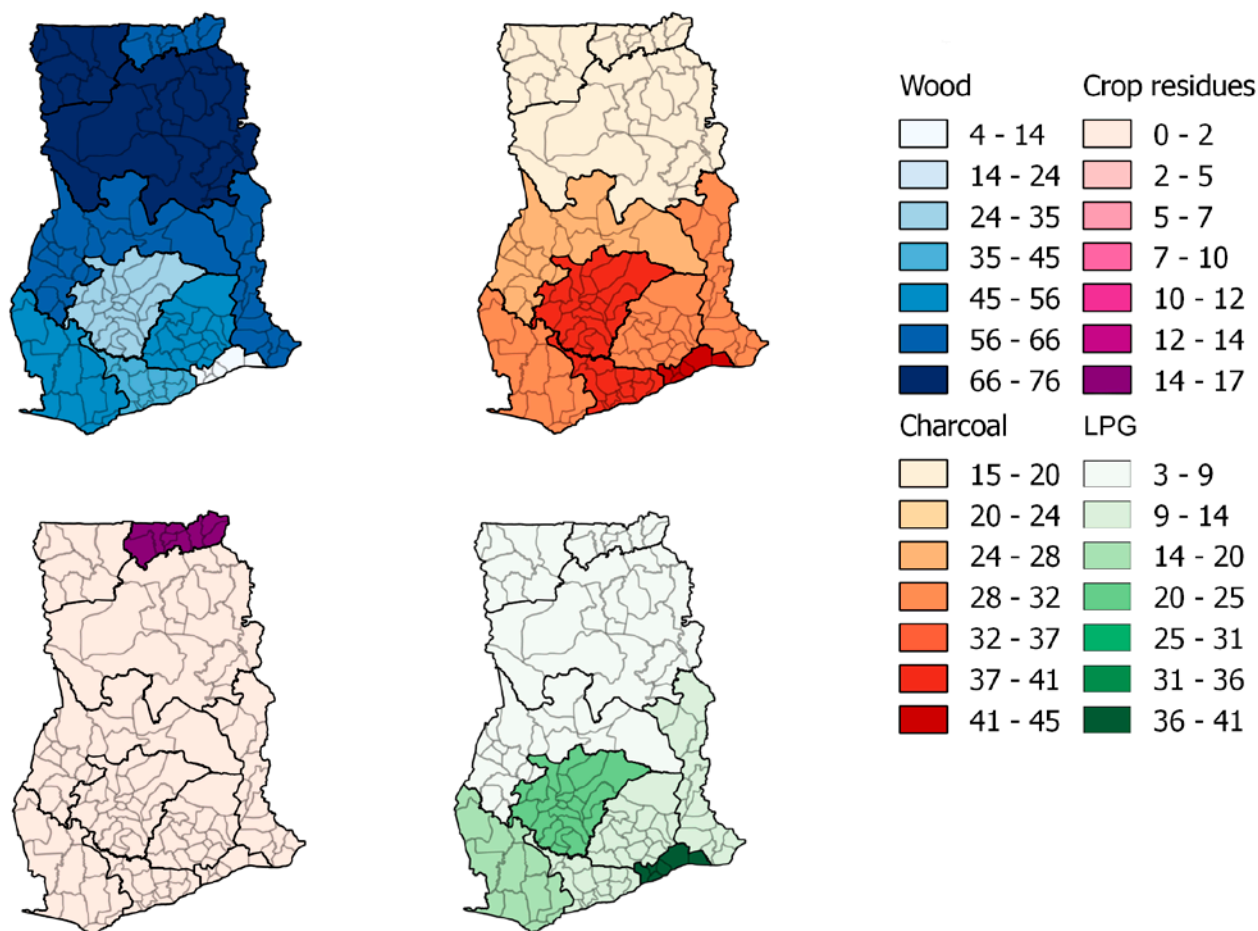
Source: reference (6).

Beyond simple urban and rural distinctions, there are additional geographical variations in cooking fuel use in Ghana. In particular, biomass and

agricultural residues are used more in northern regions, whereas charcoal and LPG predominate in the southern coastal regions (Fig. 4).



Wood being chopped in a coastal community in Ghana.
Credit: Jessica Lewis



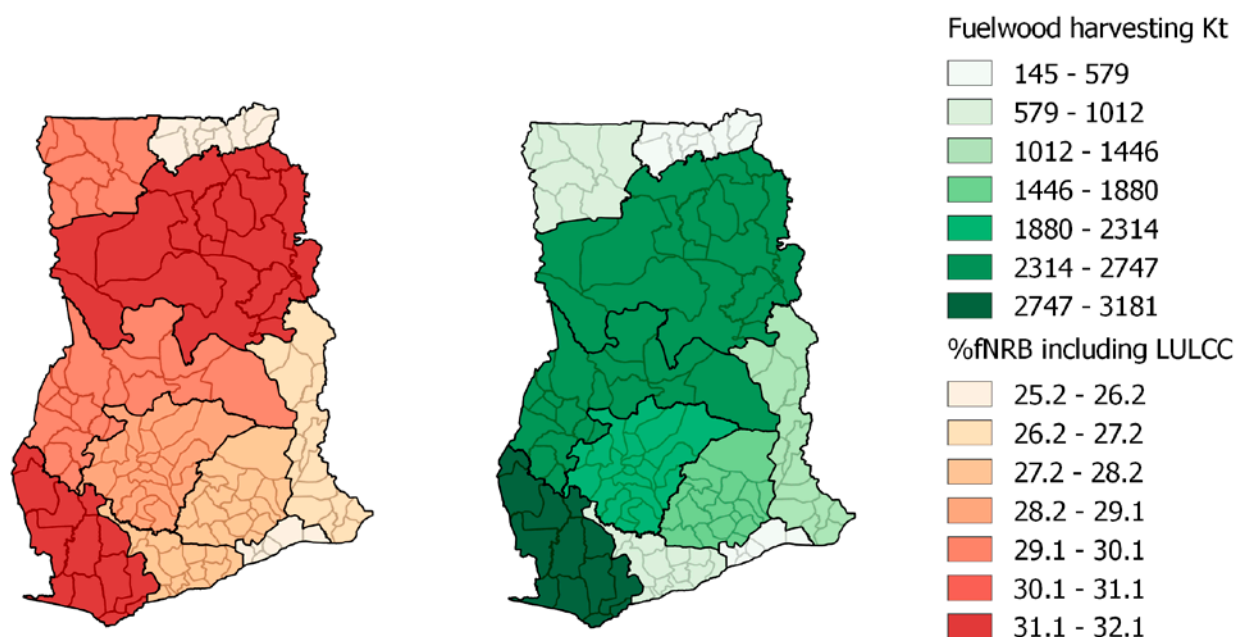
↑ **Fig. 4.** Geographical variation in main fuel used for cooking by households in Ghana, showing that northern households primarily cook with wood and crop residues, while households in urban and coastal areas rely more heavily on charcoal and LPG for cooking.

Source: reference (3).

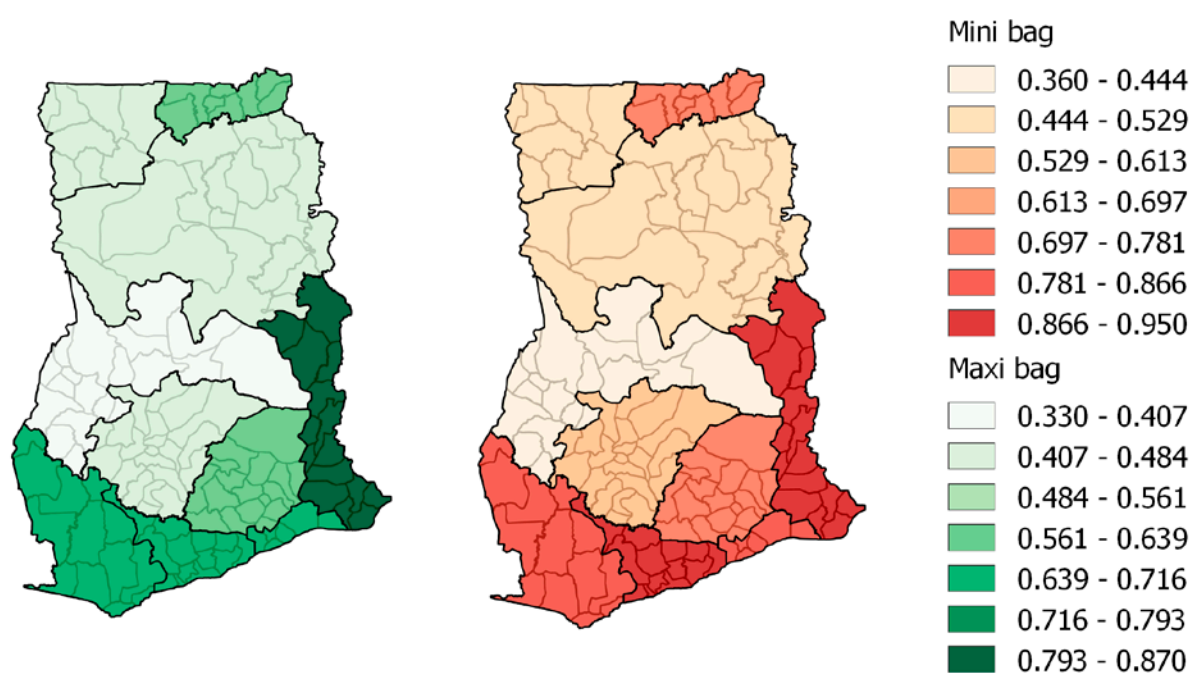
The availability of solid fuels is particularly limited in the south-west of the country. A larger fraction of the fuelwood harvested in this region is not

renewably harvested, therefore contributing to deforestation and environmental degradation (Fig. 5).

Fuelwood harvesting and renewability



Charcoal cost per Kg (Ghc)



↑ **Fig. 5.** Fuel wood harvesting and renewability (top panel) and charcoal cost (bottom panel)

fNRB: fraction of non-renewable biomass; LULCC: land use and land cover changes.

Source: reference (3).

Many households use multiple fuels or technologies for cooking (a phenomenon termed “stove stacking”). The particular mix of fuels and technologies used differs based on geography

and the available resources. Thus, the statistics reported here for primary or main fuel used are likely to be an underestimate of the total number of households using polluting fuels and technologies for cooking.

4.1.2. Clean cooking capacity

Clean household energy alternatives currently available for cooking in Ghana are LPG, electric cooking stoves and ethanol fuels.

Regarding LPG capacity, output from Ghana's only oil refinery, the Tema Oil Refinery, with a capacity to produce 45 000 barrels a day, was shut in January 2017 after an explosion at a newly installed, € 5.8 million crude oil heating unit due to damper failure, which destroyed the furnace. The refinery, however, has performed below capacity for decades, reportedly due to underinvestment, lack of maintenance and debt. Tema Oil Refinery will complete studies next year on building a 200 000 barrel-a-day plant. In the meantime there are proposals to restart the plant after reconfiguration through a second furnace, but with reduced capacity.


Given the significant investment required to increase LPG supplies through imports and to build new plants in order to increase local capacity, rapid scaling up to provide LPG for household energy is unlikely. The Government of Ghana is, however, committed to ensuring an increase in local capacity.

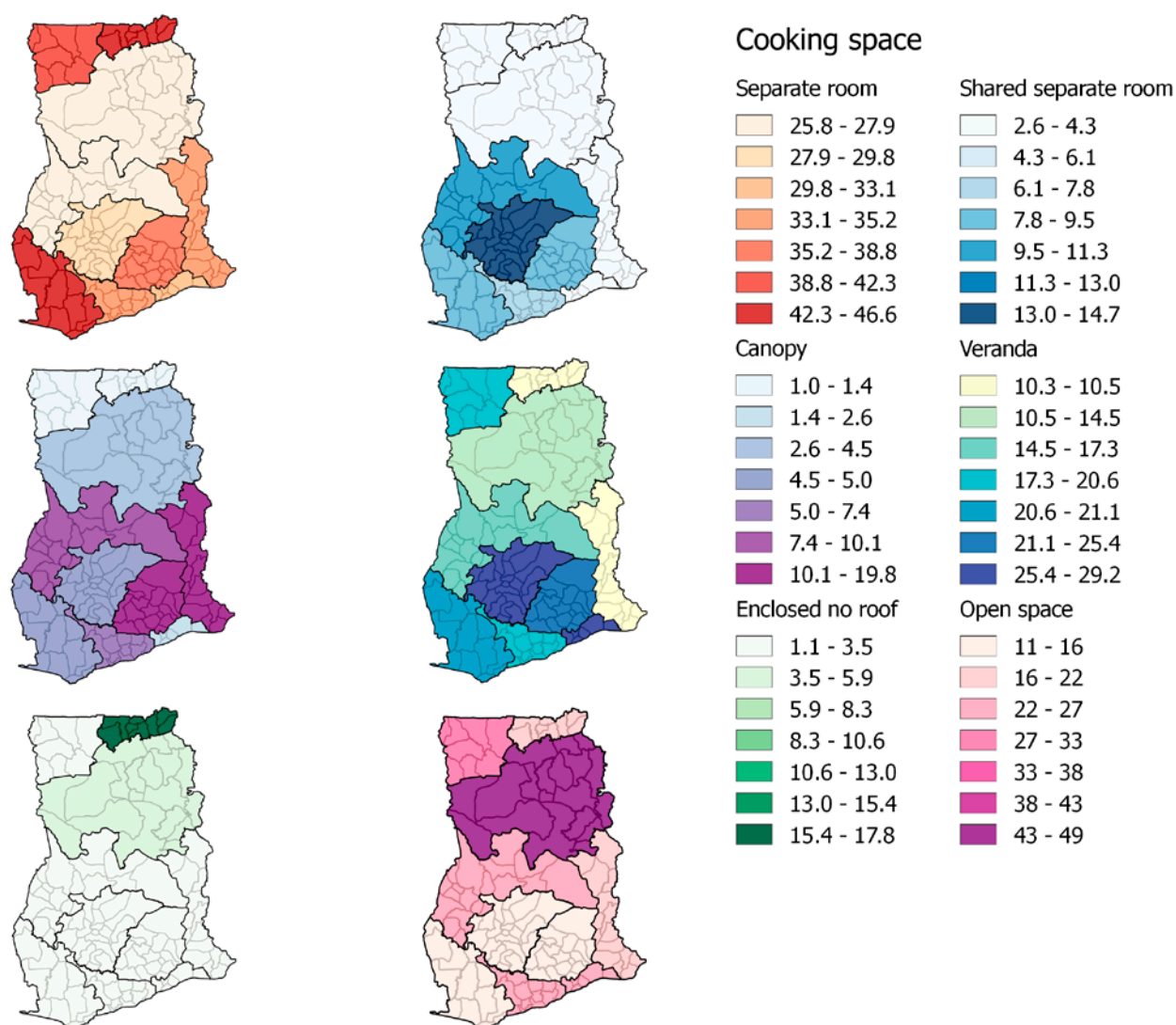
4.1.3. Cooking behaviour

Cooking location can affect the level of exposure and the suitability of interventions for different regions.

In Ghana, households located in coastal regions tend to cook in separate rooms or under canopies and verandas. In areas with higher population density, such as southern urban areas, cooking spaces tend to be shared or under verandas. In contrast, cooking in northern regions tends to be done in a separate room or an enclosure without a roof, and, in the upper eastern and the upper western regions, under a veranda. In the northern region, cooking is done in an open space adjacent to the home (Fig. 6).



 Wood collection in Accra, Ghana.
Credit: Getty images



↑ **Fig. 6.** Regional differences in cooking spaces in Ghana

Source: reference (3).

4.1.4. Programmes on household cooking

Ahibenso Coalpot Programme

Ghana has viewed the issue of household energy use, particularly for cooking, from the point of view of the environment, especially with regard to deforestation. Cookstoves began to be produced in the late 1980s, with the Ministry of Energy's "Ahibenso coalpot programme", with the objective of providing improved cooking devices to decrease

the demand for wood and slow deforestation. The programme was planned and implemented by the National Energy Board in collaboration with the Energy Sector Management Assistance Programme of the World Bank. After several viable improved charcoal stove models had been tested, the Ahibenso coalpot was chosen as the most appropriate for the Ghanaian market. Mass dissemination of the stove began in 1992.

National LPG promotion programme

Ghana has had one of the highest levels of deforestation in the African region. In 1989, the Ministry of Energy introduced a national LPG promotion programme to reduce deforestation and the dependence of households, catering services

and small-scale food sellers on wood. It provided free LPG cylinders to the public and improved LPG distribution and delivery. The programme was later extended to provide free cylinders and installation to educational institutions, hospitals and prisons.

Although this programme was successful in increasing the demand and consumption of LPG in Ghana, the infrastructure for greater LPG distribution was inadequate. The one national refinery and storage facility for LPG, the Tema Oil refinery, was able to meet only a fraction of the demand of commercial and domestic users. Consequently, there were shortages in the LPG supply, and many domestic consumers reverted to traditional fuels, particularly charcoal. The programme had an unexpected benefit for the transport sector. Owing to the subsidy for LPG, it cost less than gasoline; accordingly, by 1998, over one third of all LPG consumption was in the transport sector.

Sustainable Energy for All and the Global Alliance for Clean Cookstoves National Action Plans

Promotion of cleaner cooking solutions was a prioritized intervention in the country's Action Plan of the United Nation Secretary General's Sustainable Energy for All Initiative and served as catalyst for the Global Alliance for Clean Cookstoves' Country Action Plan.

The Government has worked to promote improved biomass cookstoves in collaboration with research institutions (for example, the Centre for Scientific and Industrial Research) and to develop national standards for cookstoves. The Ghana Alliance for Clean Cookstoves and Fuels organizes programmes to promote biomass fuel use in improved cookstoves, including awareness-raising campaigns for community members and health professionals, support to stove manufacturers and support for policy development.

More than 96 companies in Ghana manufacture biomass cookstoves. The design of clean stove technologies must be well suited to preparing the staple foods eaten in Ghana. For example, many dishes require long cooking times over a low flame.

The Energy Commission, which is the technical regulator of Ghana's electricity, natural gas and renewable energy industries and advises the Government on energy matters, is working with various partners to introduce a system of woodlot management for sustainable charcoal production. It will extend its activities to increase the regulation and efficiency of the sector within Ghana.

Ghana's Rural LPG Programme

The link between health and HAP became an issue during development of the Sustainable Energy for All Initiative and the Global Alliance's clean cooking country action plans. Since then, the Government has encouraged clean household energy primarily through LPG subsidies and electrification.

In 1990, the Government introduced the National LPG Promotion Programme to ensure wider use of LPG as a substitute for charcoal and firewood. The subsidy was discontinued in 2013 and replaced with a rural LPG programme in 2014.



*Different improved stove and clean fuel models are demonstrated.
Credit: Heather Adair-Rohani*

The rural programme is an extension of Ghana's National Liquefied Petroleum Gas Promotion Project, which started in 1990 to substitute

LPG for wood in houses, schools and small businesses. LPG was promoted as having health and environmental advantages over other fuels. Although the earlier national LPG programme had some success in terms of increased tonnage of LPG consumed nationwide – from a little over 5000 megatonnes (mT) per annum in 1989 to more than 50 000 mT in 2000 – the programme focused mainly on urban areas and therefore had little impact in rural areas. Under the newer programme, LPG is also being introduced in poor rural areas, where the majority of Ghanaians live and the reliance on biomass fuel is higher.

The Rural LPG Programme was launched in early 2014 to mainstream LPG use into rural households. The Ministry of Petroleum coordinates various stakeholders to implement the programme.

At its inception, the Rural LPG Programme was introduced only in the northern district; by 2016, however, the programme had been extended to about 40 districts. In each district, 2000–4000 LPG cylinders are distributed for free, and residents are responsible for procuring LPG from local vendors in their districts.

To increase LPG use in rural areas, LPG was initially subsidized for domestic use. Then, commercial vehicles and taxis started using LPG as a fuel, and the subsidy was scrapped, as the intended beneficiaries (i.e. households) were not the beneficiaries.

At present, the Rural LPG Programme has no systematic monitoring and evaluation strategy, and no data are available on the number of LPG cylinders provided through the programme.

4.2 Household energy use for lighting

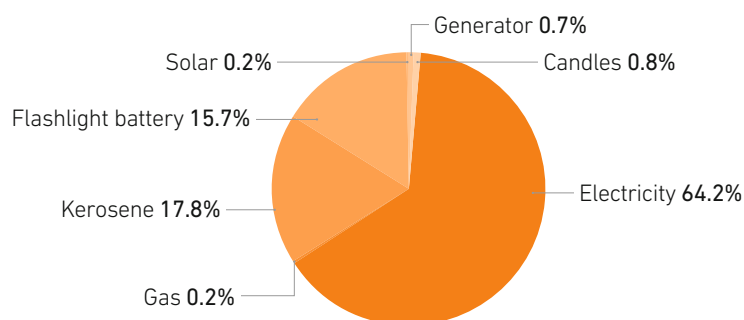
4.2.1. Lighting fuel

The national grid is the main source of lighting for about 65% of all households in Ghana (2). Use of this source is greater in urban areas (84%) than in rural households (40%).¹ In rural areas, access to the national grid is lowest in the northern belt of Ghana. Battery-operated torches and other portable lighting devices often serve as the main lighting source for about 15% of all households in

Ghana (Figs 7 and 8). This figure is even higher in rural areas, where 30% of households use torches to light their homes.

The third most common source of lighting is kerosene, which is used by close to 18% of the national population, especially in the northern and eastern regions.

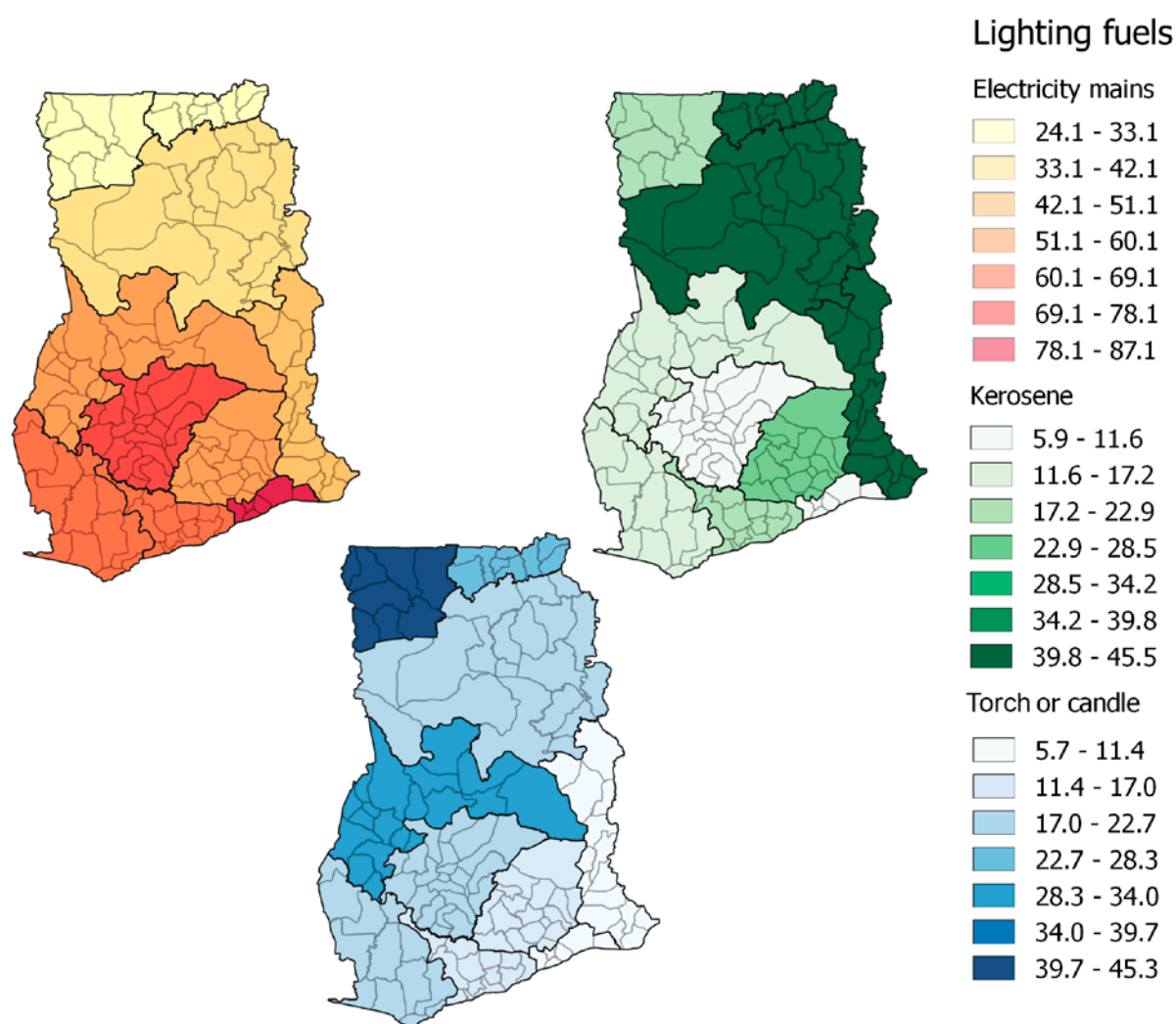
Solar energy is used as a source of lighting by very few households (0.2% nationally, 0.1% in urban homes, 0.3% in rural homes).



↑ **Fig. 7.** Primary lighting fuels used in households in Ghana

Source: reference (3).

¹ The Ghana Living Standards Survey Round 6 (conducted in 2013), which provides updated statistics from the 2010 national census, showed a decrease in national use of kerosene; however, the sample size of the survey was much smaller than that of the census, and thus the census findings are presented here.



↑ **Fig. 8.** Geographical distribution of primary fuels used for lighting by households in Ghana

Source: reference (3).

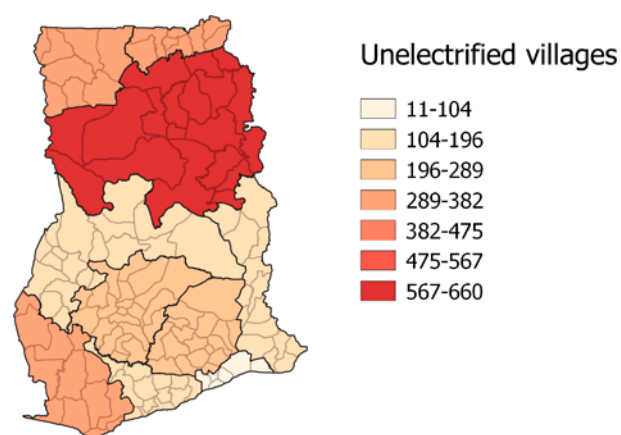
↓ **Table 5.** Main source of lighting in households in Ghana (percentage of households)

	Fuel type	All Ghana	All Urban	Urban: Accra	All Rural
Polluting fuels and technologies	Kerosene	17,8	8,4	5,9	29,5
	Candle	0,8	1,1	1,9	0,3
	Torch	15,7	5,5	3,9	28,6
	Firewood	0,2	0,1	0,1	0,4
	Crop residue	0,1	0	0	0,1
Clean fuels and technologies	LPG lamp	0,2	0,1	0,1	0,2
	Solar energy	0,2	0,1	0,1	0,3
	Electricity	64,2	83,8	87,1	39,5
	Generator	0,7	0,6	0,6	0,7
	Other	0,2	0,2	0,2	0,3

Source: reference (3).

A number of villages in Ghana still do not have an electricity supply (Fig. 9). Although Ghana has made notable progress, about 7 million people still lacked access to electricity in 2012.

Electrical outages have a significant impact on businesses, reducing sales by over 5% in 2014 (7).



↑ **Fig. 9.** Villages in Ghana without electricity

Source: reference (2).

4.2.2. Programmes on household lighting and electrification

National Electrification Scheme

A rural electrification programme was initiated in Ghana in 1970 to bring electrification to rural areas as a means of reducing urban–rural inequalities and increasing economic activity in rural areas. In 1989, a national electrification scheme was instituted to replace the 1970 policy. A national electrification levy was instituted, and the levies collected were paid into a national electrification fund established to support introduction of the rural electrification programme.

Self-Help Electrification Programme

In 1990, Ghana instituted a complementary “self-help electrification programme” to accelerate the national electrification scheme in communities located within a reasonable distance of a medium-voltage network and that had already shown commitment by installing low-voltage poles for national grid connections. In these communities, the Government provided additional financial and technical support.

The aim of the present electrification scheme is to extend electricity power lines to connect about 59 000 new customers in 530 communities in 26 districts in the operating areas of the Electrical Company of Ghana, with the ultimate goal of making electricity accessible to people in every part of the country by 2020. This will entail enhancing the generation, transmission and distribution of electricity throughout the country.



A traditional biomass cookstove outside a home. Soot from use of the stove has blackened the walls. Credit: Heather Adair-Rohani

4.3 Household energy use for heating

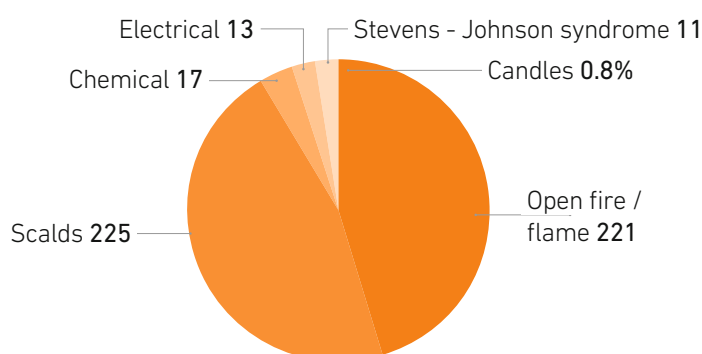
There is reportedly limited demand for heating in the northern areas, although no data are available

to quantify the extent of household heating or fuels used.

4.4 Perceptions of safety of household energy

Perceptions of the risks of different household fuels and technologies are a barrier to the uptake of clean household energy in Ghana. Data from studies on the safety of individual energy sources are generally scarce, however, the Komfo Anokye Teaching Hospital has been collecting data on household burns for some time. An analysis of

data on burn cases from 2009–2013, showed that open fires were the main causes of burns and scalds, and children less than 10 years old were the most commonly affected group (Fig. 10) (8), and the number of burns caused by fire or flames from solid fuel was almost double that caused by flames from LPG in these children (9).



↑ **Fig. 10.** *Etiology of burns at Komfo Anokye Teaching Hospital, 2009-2013*

Source: reference (8).

These data suggest that awareness should be further raised in the community about the risk of children for burns from household energy sources and the greater safety of clean household fuels and technologies, like LPG. In addition, improper use of LPG (including faulty cylinders) can incur a significant risk of explosions. The Government has therefore mandated regulatory measures, including use of a recirculation model of distribution at LPG bottling plants (10,11). In this module, LPG bottling plants will be sited away from

congested commercial and population centres and will procure, brand, maintain and fill empty cylinders to be distributed to consumers and households through retail outlets. Existing stations will be classified into low or high risk on the basis of their proficiency in meeting the required safety standards in continual risk assessments. Those found to be high risk will be converted into filled cylinder retail and distribution outlets, and those found to be low risk will supply gas for vehicles only, with improved safety standards.

Stakeholder organization and coordination

Household energy use is a cross-cutting issue, related to environment, health and social development, among others. The key roles and

programmes of some stakeholders in the provision of clean household energy are presented below.

5.1 Government agencies

5.1.1. Ministry of Health

The Government of Ghana and its Ministry of Health consider HAP a critical health problem, in view of the high burden of disease attributed to HAP.

Since 1998, the air pollution agenda has been addressed by the Occupational and Environmental Health Unit of the Ghana Health Service, an agency of the Ministry of Health. This unit collaborates with other ministries through interministerial committees and with academic institutions in conducting research.

There are currently no health sector policies to address HAP; however, the sector is working to ensure health protection within the policies and programmes of the Ministry of the Environment and Ministry of Energy. The following programmes are being or have been implemented by the health sector in collaboration with other institutions:

- *Determination of the associations between air quality parameters and respiratory diseases reported by outpatient departments in Accra (12).*
- *Study on the occurrence of acute respiratory infections among children under 5 years old (13).* Data collected over 1 year were analysed for links with air quality. The results were used in educational materials and for advocacy to change attitudes with regard to regular servicing of vehicles, avoiding cooking with firewood and charcoal indoors and keeping children (especially those under 5 years) out of smoky cooking environments.

- *Training of health personnel.* A course on HAP and its effects on health was organized by the Ghana Health Service in 2016, sponsored by Global Alliance for Clean Cookstoves and the United States Agency for International Development. Another course was organized by WHO in May 2017 to pilot-test materials on HAP and health.

The health sector supports research within the Ghana Health Service, including an assessment of the effects of HAP on health outcomes such as low birthweight, pneumonia and pulmonary function among children by the Kintampo Health Research Centre's Environmental Health Research Platform; and research on emissions, air quality, climate and cooking technologies in northern Ghana at the Navrongo Health Research Centre in an interdisciplinary randomized intervention study in Kassena-Nankana District.

5.1.2. Ministry of Energy

Ghana's household energy policies and programmes are led mainly by the Ministry of Energy and implemented through directorates and agencies. The Ministry of Energy is responsible for policies to promote household energy. Currently, Ghana's working document on household energy is the Ghana Sustainable Energy for All (SE4ALL) Action Plan, which was launched in May 2013 with technical support from the United Nations Development Programme and the Global Alliance for Clean Cookstoves. All policies related to

household energy contribute to achieving the indicators for Ghana SE4ALL. The three high-impact objectives for immediate action are:

- provision of off-grid, renewable energy-based power solutions for remote communities;
- access to modern energy for productive uses (such as generating income); and
- access to modern energy for cooking.

The key implementing agencies are:

The Energy Commission. The Commission was set up by an Act of Parliament, the Energy Commission Act, 1997 (Act 541) to regulate, manage and develop use of energy resources in Ghana. The Commission is the technical regulator of Ghana's electricity, natural gas and renewable energy industries and advises the Government on energy matters.

The National Petroleum Authority (NPA). The NPA is responsible for regulating importation and refining of crude oil and the sale, marketing and distribution of refined petroleum products, including transport and industrial fuels and LPG. In the area of household energy, the NPA is responsible for plans to support any LPG policy directive of the Ministry.

Several sector policies, master plans and action plans have been or are being implemented for the promotion of access to household energy. They are described below and in more detail in the Annex.

5.1.3. Ministry of Environment, Science, Technology and Innovation

Among other responsibilities, the Ministry leads, coordinates and regulates science and technology activities and the environment related to sustainable development. The Ministry is also the national coordinating agency for Nationally Appropriate Mitigation Actions on access to clean energy through establishment of market-based solutions. The aim of the project is to enable the private sector to participate in the manufacture and distribution of clean energy technologies in Ghana and to create a market environment that encourages the distribution of

clean energy technologies to users, supported by an appropriate financing model. About one million energy cookstoves (stoves with greater fuel efficiency than traditional options but probably not good for health) and 250 000 LPG cookstoves are expected to be distributed in Ghana in this way.

One of the agencies of the Ministry of Environment, Science, Technology and Innovation is the Environmental Protection Agency, which is responsible for regulating environmental emissions and for initiatives such as ambient air pollution monitoring and training. In terms of household energy, the Agency is the coordinating agency for a programme to install 200 biogas digesters in public boarding schools, prisons and hospitals with the goal of establishing a viable market. Biogas digesters capture the gas released during anaerobic digestion, and this is piped to a cookstove for use as a clean cooking fuel. One of the six thematic areas of the Graduate Entry Medical Programme is "Energy resources management", which has a particular focus on the effects of wood use as fuel, sustainable charcoal production and the use of improved stoves.

5.1.4. Ministry of Land and Natural Resources

This Ministry is mandated to ensure the sustainable management and use of Ghana's lands, forest and wildlife, as well as efficient management of its mineral resources. The Forestry Commission, an agency of the Ministry, is responsible for the regulation of use of forest and wildlife resources, conservation and management of those resources and coordination of policies related to them. Since 2012, the Commission has been implementing the REDD+ strategy to reduce emissions from deforestation through sustainable use of biomass fuel.

5.1.5. Ministry of Trade and Industry

The role of this Ministry is to provide advice on policy to the Government on trade and to formulate

and implement policies for the promotion, growth and development of domestic and international trade and industry.

Ghana Standards Authority is an agency of the Ministry of Trade and Industry with a mandate to ensure system certification and to develop national standards. The Authority has adopted the International Standards Organization's (ISO) standard GS ISO 22991 for gas cylinders for LPG and GS ISO 13341 for valving, regulators and tubing. The Standards Authority conducts various tests on random samples of imported gas cylinders to ascertain their conformity with ISO 22991. It is preparing a set of standards and a labelling system for cookstoves, in line with the work of ISO's Technical Committee 285, which is preparing standards for various performance attributes of cookstoves (i.e. overall emissions, indoor emissions, fuel efficiency and safety).

5.1.6. Ministry of Food and Agriculture

This Ministry focuses on sustainable agriculture and research and technology for agribusiness. Renewable power derived from biomass, the sun and wind are particular interests. Current work on renewable energy includes activities such as use for irrigation, post-harvest infrastructure and agro-processing. Other opportunities include use of sustainable production and use of biofuels, such as alcohol, for cooking.

5.1.7. Ministry of Finance

The Ministry of Finance is the key ministry in preparing budgets, mobilizing and allocating external and internal resources and planning and

implementing fiscal policies. The Ministry tends to view household energy from the point of view of the environment and not necessarily health or socioeconomic effects.

5.1.8. National Development Planning Commission

The National Development Planning Commission advises the President on development planning policy and strategy. It prepares a national development policy framework and medium-term development plans. Interest has been shown in including HAP in national medium-term plans.

5.1.9. Ministry of Gender, Children and Social Protection

The mandate of the Ministry of Gender, Children and Social Protection is to coordinate and ensure gender equality and equity and promote the survival, social protection and development of children, vulnerable people and those with a disability. In Ghana, women and children are traditionally responsible for collecting firewood and preparing meals. Consequently, they are disproportionately affected by polluting fuels and technologies in the home, and use of clean, safe, efficient household energy, particularly clean cookstoves, could greatly benefit their health, safety and livelihoods by reducing their exposure to harmful smoke. It would also free time that would otherwise be used in collecting firewood, resulting in more opportunities for education, income-generation and other activities. This Ministry could be an important advocate for clean household fuels and technologies because of their benefits for women and children and for men.

5.2 Nongovernmental organizations (selected examples)

5.2.1. Global Alliance for Clean Cookstove

The Alliance is a public–private partnership hosted by the United Nations Foundation to save lives, improve livelihoods, empower women and protect the environment. The Alliance works with public, private and non-profit partners to create a thriving global market for clean, efficient household cooking solutions. In Ghana, the Alliance is:

- building the capacity of local stove manufacturers,
- educating students and health professionals about the advantages of clean cookstoves and
- helping to develop local policies, standardization, labelling and modern testing centres.

These activities will encourage the use of cleaner cookstoves in Ghana, a country in which the Alliance also supports research. The second lady of Ghana, Mrs Hadjia Samira Bawumia, is an Ambassador for the Alliance and is raising awareness about HAP and encouraging the adoption of clean cooking solutions.

5.2.2. Ghana Alliance for Clean Cookstoves and Fuels

This nongovernmental organization is a local implementing partner of the Alliance. Its aim is to support the Alliance by creating better understanding of the needs and preferences of cookstove users in Ghana and the durability and performance of local cookstoves and to facilitate access to finance for stove manufacturers and consumers. It strengthens the awareness and knowledge of local actors and the broader community about the importance of efficient, clean cooking fuels and technologies. The organization also supports the Government's renewable energy policy and climate change programme goals for clean cooking.

5.2.3. Ghana Girl Guides Association

The objective of the Association is to provide opportunities for girls and young women to grow and lead while also empowering them to be agents of change in the world. The Association could provide a platform to educate girls on the benefits of clean cooking and build their capacity to serve as agents of change for clean cooking in Ghana.

5.3 Bilateral and multilateral organizations (selected examples)

5.3.1. Netherlands Development Organisation (SNV)

SNV is the development organization of The Netherlands. It equips communities and local stakeholders with the tools, knowledge and connections they require to improve their livelihoods and access basic services. Up to now, SNV has primarily focused on cookstoves for income-generating uses, such as for roasting cassava, brewing local beer or smoking fish.

According to research conducted by the SNV in the coastal area of Ghana, about 120 000 traditional and Chorkor fish smoking stoves are used for preparing smoked fish, a local staple and an important export for Ghana. The Chorkor Smoker kiln, although fast and economic, presents health risks to producers and consumers because of the high levels of polyaromatic hydrocarbons emitted into the environment and food. To mitigate such health risks, SNV and the Food and Agriculture Organization of the United Nations (FAO) worked with researchers to develop a more efficient technology, the Thiaroye technique (14). Other SNV initiatives to improve access to energy include work with local stove builders to make three improved cookstoves for fish smoking, *gari* processing and parboiling of *pita*, *shea* and rice. The aim is to minimize some of the barriers to production and adoption of large-scale improved stoves by providing local producers with specifications and quality requirements.

In terms of household energy, SNV through EnDev and in collaboration with the Ghana Alliance for Clean Cookstoves and Fuels has launched a project to provide strategic support to the clean cooking sector, by strengthening the Alliance's secretariat so that it is more operational and financially

sustainable, organizing annual forums for local cookstove and household energy actors and analysing the penetration of different cookstoves in Ghana.

To date, much of the work of these organizations has been on more efficient cookstoves rather than on clean fuels or technologies that protect health.

5.3.2. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

Ghana has been a partner country for German international cooperation for over 30 years. In Ghana, GIZ, the German development agency, has focused on agriculture, governance and sustainable economic development (15).

Interventions within the GIZ "energising development" programme in Ghana have been primarily for electrification for productive uses in micro-, small and medium-sized enterprises through grid extension or renewable energy (16).

5.3.3. United States Agency for International Development

USAID is responsible primarily for administering civilian foreign aid. With the Alliance, USAID has supported training of health professionals on the health impacts of household energy through a project for translating research into evidence for programme implementers and policy-makers.



Inside a shop for refilling cylinders in Accra, an old newspaper article warns that cylinders should not be used for more than 10 years.
Credit: Heather Adair-Rohani

Social interventions

Ghana has a number of social intervention programmes. Social welfare programmes can be an effective channel for transferring resources to vulnerable populations. Thus, knowing which programmes are in place can indicate a country's capacity and willingness to achieve equity.

As such programmes are targeted to specific populations, additional objectives and incentives for the adoption of clean household energy could be integrated.

Selected examples of social intervention programmes are described below.

6.1 Livelihood Empowerment Against Poverty

The Livelihood Empowerment Against Poverty (LEAP) programme, led by the Ministry of Gender, Children and Social Protection, works to reduce poverty and improve the lives of the poorest and most vulnerable populations in Ghana, including young children (< 5 years old), the elderly (> 65 years old) without productive capacity, people with severe disabilities, extremely poor people and vulnerable pregnant women (17). The objectives of the programme are to improve basic household consumption and nutrition,

increase access to health care services, increase school enrolment, attendance and retention and facilitate access to services like welfare among beneficiary households. To meet these objectives, social cash grants are provided to households in extreme poverty and those with one or more members in the above-mentioned vulnerable populations. LEAP has grown to cover all 216 districts of Ghana and could be a useful entry to making clean household energy available to the populations at the most risk from HAP.

6.2 Ghana School Feeding Programme

The Ghana School Feeding Programme of the Ministry of Social Protection is a pilot project for reducing hunger and malnutrition, increasing school enrolment and increasing local food production in poorer communities (18,19). The Programme provides one hot, nutritious meal each day made from locally grown foodstuffs and prepared by local caterers for children attending public nurseries and primary schools.

The Programme, which reaches nearly 40% of all children in public pre-primary and primary institutions, is implemented in all 216 districts by a multidisciplinary team.

Currently, firewood is the fuel most commonly used for preparing meals. Institutionalizing the use of cleaner fuels for food preparation could reduce HAP and encourage local chefs to advocate in the community for clean cooking.



Community members inspect a newly constructed cookstove that is designed to operate with greater fuel efficiency (although emissions may not achieve safe levels for health).
Credit: Heather Adair-Rohani

6.3 Free Maternal Health Services Initiative

The Ghana Health Service provides free health care to pregnant women and newborns and subsidies to all pregnant women for the National Health Insurance Scheme premium and other fees. Enrolment includes six antenatal visits, care during childbirth, postnatal visits, newborn care and other primary health care benefits. This policy has led to contact with over 80% of all pregnant women

and their newborns in the country. The system has also been used to deliver insecticide-treated nets to almost all pregnant women in Ghana for malaria control. There is no programme to inform pregnant women about access to clean household energy, and one means of reaching this population would be collaboration with midwives, who work in all health facilities in Ghana.

6.4 Health and environment information sharing system and other data sources

The Health Information Exchange, which is overseen by Ghana Health Services, is a versatile platform for accessing health, environment and

related data from various sectors. Other health and energy data sources in Ghana include the Living Standards Survey, the Demographic and

Health Survey and the Ghana Statistical Service and other partners including Ghana Health Service for general data on morbidity and mortality. Although these data are infrequently collected,


they could be used in modelling the health impact of HAP as part of monitoring and evaluation of all programmes.

6.5 Ghana Rural LPG Programme

The Ghana rural LPG programme is described fully in section 4.1.2. Its aim is to increase use of LPG in rural areas. It is currently working to overcome geographical and financial challenges

of households in accessing LPG. The programme also provides opportunities to test innovative approaches to overcome these barriers.



 An LPG tank is weighed before being sold.
Credit: Heather Adair-Rohani

Discussion

7.1 Barriers to adoption of clean household energy

Charcoal production: Charcoal is still commonly used for cooking, even when cleaner alternatives (e.g. electricity, LPG and ethanol) are readily available. The production of charcoal is often a source of additional income for Ghana's farmers, who consider it a form of insurance in case of crop failure. Thus, anything that affects the charcoal value chain may affect the livelihoods of people who rely on charcoal production for income. Finding more efficient methods of charcoal production or alternative sources of income from household energy use, such as production and sale of ethanol, could facilitate the phasing out of charcoal.

Financial and geographical barriers to increasing use of LPG: The cost of LPG and of the cylinder play a critical role in the willingness of households to use LPG regularly for cooking. To encourage use of LPG, the cost should be reduced.

Other barriers to wider scale adoption of LPG, particularly in rural areas, include the availability of filling stations. If household members must travel long distances to refill their LPG cylinders, they are less likely to use LPG regularly, particularly if there are freely available biomass fuels nearby. Increasing the number of filling stations in rural areas would facilitate access to and use of LPG in communities. Innovative approaches for LPG delivery (e.g. by tricycle) could also enhance the accessibility of LPG in areas with few filling stations and also provide an income-generating activity for community members.

Barriers to use of other clean fuels: Biofuels like ethanol and biogas are other clean renewable fuel options in Ghana. As for LPG, the widescale adoption of biofuels faces challenges both upstream and downstream. Currently, most ethanol is not produced locally, which may limit its availability and increase fuel costs for households. Caltech, the only ethanol producer in Ghana, recently

opened a facility with a capacity of producing 3 million litres of ethanol annually from cassava. This output, however, represents only a small fraction of the 70 million litres currently imported. The availability of stoves and cultural practices also present barriers to wider use of ethanol.

Biogas has had mixed success in Ghana (20). Over 100 biogas digesters installed across Ghana supply clean cooking fuel and electricity; however, household maintenance of biogas digesters, investment costs, insufficient available waste and other problems have limited wider adoption of this clean fuel.

Perceptions of the safety of LPG: LPG is perceived by many households to be an unsafe fuel. To reduce the perceived risk of explosions, regulations that adequately cover this industry should be enacted and enforced. For example, a regulation that requires a safety valve on all LPG cylinders, as in other countries, such as Brazil, could be introduced. This could not only reduce the number of LPG explosions in homes but also increase users' perception of its safety. The NPA could provide training for consumers on the safe use and storage of LPG in the home.

In the current system in Ghana, LPG cylinders are the property of individuals, and it is therefore difficult to ensure that they are kept in safe and usable condition. Another problem is that when household members consider it is time to replace a cylinder, they may not have the means to do so. A potential solution would be to transfer ownership of the cylinders to LPG companies and oblige them to adhere to a schedule of maintenance, repair and cylinder replacement.

Injuries from burns: Although there is an injury register in Ghana, the descriptions of burns are not sufficiently detailed, and it does not include minor injuries that are not reported to health facilities. In addition, the data on burn injuries are

not representative of the whole country. A more structured injury register coordinated by the health sector is required, which records the severity and causes of burns, including those associated with household use of biomass, kerosene and LPG for cooking and lighting. This could be done in partnership with the Ghana National Fire Service, which supports the collection of data on the sources of fires.

Lack of awareness of links between household energy and health: HAP due to use of polluting household energy sources is a widespread problem in Ghana and leads to high rates of morbidity and mortality. There is, however, limited

awareness of the health risks of kerosene and solid fuel use in the home, even among medical professionals. This is particularly true with regard to non-respiratory health outcomes such as heart disease, stroke and adverse pregnancy outcomes.

Inadequate coordination: During a country visit by WHO, the United States Centers for Disease Control and Prevention and Bloomberg Philanthropies, the Ministers of Health and of Energy acknowledged that stronger collaboration was required to tackle the burden of HAP. Other stakeholders also suggested that the health sector should have a greater role in setting policies and programmes related to household energy.

7.2 Opportunities for introducing clean household energy

The Government and its development partners recognize that the risk associated with polluting household energy should be addressed and have identified several means to address the problem.

National prioritization: In 2010, a needs assessment and an analysis of priorities and policy adjustments were conducted for Ghana. Several policy options were identified for environmental sustainability and for strengthening the links between health and the environment. The needs identified included:

- adequate financial resources to formulate or update national policies;
- relevant regulatory frameworks, strategies and plans;
- a more multidisciplinary approach to issues related to the environment and health; and
- evaluation of national frameworks, strategies and plans for clean household energy.

To fill these gaps in the legislative framework, it was recommended that the country address governance structures to integrate environmental and health issues in a “health and environment strategic alliance”. A committee was established jointly by the Ministers of Health and of the Environment in 2012 to implement the 11 action points of the Libreville Declaration (21). One of

the main activities of the committee was to set up a system for sharing data and information for all stakeholders working on environment and health issues. There has, however, been no funding support for the initiative, so that it has been unable to take action. Although HAP was identified as a priority in Ghana’s situation and needs assessments, little concerted effort has been made to address HAP as a household energy issue. It will be important to fund this initiative.




*A stack of wood for fueling cooking fires.
Credit: Karin Troncoso*

Mitigate climate change: The contribution of household energy use to climate change is an important consideration, as the total impact of inefficient household energy use, although uncertain, is likely to be substantial (22). For example, in 2012, the total emissions of CO₂, CH₄ and N₂O from fuel combustion in the residential sector exceeded that from the commercial and agricultural sectors. Shifting to cleaner fuels and technologies like solar lamps, ethanol and LPG would have significant benefits for climate. The national greenhouse gas inventory for Ghana in 2014 already cited shifts from traditional biomass use to LPG in the residential sector, and the reduction expected from the current shift from fuels that emit high volumes of climate-forcing pollutants like black carbon (such as kerosene and inefficient biomass stoves) towards cleaner options like LPG and electric stoves have already resulted in a reduction in emissions of methane and significantly reduced the near-term effect on the climate. Use of clean household fuel would therefore be a step towards meeting Ghana's commitments to mitigating climate change.

Standardization: Clean cookstoves should be standardized to ensure that they have the requisite performance for fuel efficiency, emissions and safety. In order that emission standards result in a health benefit, they should be aligned with the emission rate targets of the WHO guidelines for indoor air quality (23). The standards and labelling would clearly indicate whether the stove benefits health by reduced emissions and the fuel efficiency of the stove. A labelling system is being prepared by the Energy Commission and Ghana Standards Authority.

Increase clean fuel use: Efforts are under way to increase the supply and adoption of LPG, including better distribution models and understanding of the social and cultural factors that would encourage long-term use of LPG. Clean transitional options, such as highly efficient biomass stoves, could also reduce the impacts of polluting household energy systems on health and livelihoods, particularly if the solutions are affordable, reliable and convenient for household use, such as ethanol gels. Further research is required on other clean alternatives that could be widely used in Ghana to complement LPG.



 View of a destroyed house near the site of a gas explosion that wounded 130 people in Ghana's second largest city, Kumasi, in 2007. The incident occurred as a gas tanker was discharging LPG at a filling station. Credit: Getty Images/AFP/Ato Kwamena Dadzie

7.3 Recommendations to the health sector for accelerating the transition

Monitor and evaluate national programmes: More rigorous monitoring and evaluation of household energy policies and programmes is required. The Ministry of Health and the health services could convene an intersectoral working group

that would be responsible for developing and adapting tools (e.g. WHO's harmonized household energy and health survey questions) for a robust, intersectoral national household energy and health monitoring system.

Raise awareness and build capacity among health professionals: Training and reference materials on the health impacts of household energy use will build knowledge among health professionals and empower them to “prescribe” clean household energy to protect health. Furthermore, using “champions” identified in various health disciplines to act as trainers would ensure that training is broadly disseminated throughout the health community.

Wider communication: Awareness of the link between household fuels and health should

also be raised beyond the health community. A set of targeted communication materials should be prepared, in consultation with local stakeholders, to bring about the changes in behaviour and attitudes necessary for adoption of clean household energy. People in other sectors (such as energy and the environment), household members and the community should have a good understanding of the impacts of household energy use on health and on livelihoods and the benefits of clean household energy. Increasing awareness of the benefits of clean home energy in government agencies could also result in broader cooperation.

Conclusions and recommendations

The health sector could encourage adoption and sustained use of clean fuels and technologies for household energy in four areas.

Convening and coordination

- Strengthen collaboration between the health and energy sectors.
- Establish injury registries across the country to monitor burns associated with household energy use, including the fuels and technologies responsible.
- Review current policies in all sectors, and make recommendations about household fuels and health.
- Convene leaders in health and energy to promote a policy for clean household energy.

Assessment, monitoring and evaluation

- Establish and support an interministerial working group to design a robust system for monitoring national household energy use and health.
- Draw up scenarios for policy on household energy and conduct health impact assessments.
- Assess capacity for surveillance of household energy-associated disease, injuries and incidents.
- Identify a peri-urban clean fuel demonstration project to be evaluated.

Communication and education

- Prepare campaigns and training in the health sector on the effects of household fuels on health.
- Raise awareness about the effects of household fuels on health for Government leaders and staff.
- Evaluate the impact of training and awareness-raising.

Policy advocacy

- Promote adoption of WHO standards for clean household energy.
- Support the Presidential initiative on LPG.
- In order to meet the national target for LPG use, make LPG cost-competitive with charcoal by introducing subsidies, especially around urban centres.
- Modify the regulatory framework for LPG to allow smaller volume, lightweight cylinders that can be variably filled and are easily transportable. Government willingness to improve access to LPG could offer an opportunity for multiple sectors to work together to improve safety through regulation and enforcement.
- Promote use of renewable electricity in the upper east and upper west regions to decrease use of kerosene, and extend the national grid to replace candles and torches.

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Annex

LPG-related regulations in Ghana

Various regulations govern the supply and use of LPG in Ghana. The Act that established the National Petroleum Authority (NPA) (2005, Act 691) sets out these regulations, which include provisions on licensing (e.g. importation, exportation, shipment, transport, refining), pricing and market monitoring (see Appendix 3 of the NPA Act 691). Legislation that has been enacted is listed below:

- *Petroleum pricing formula regulations* (Legislative Instrument (L.I). 2186, Appendix 4). This regulation governs the pricing of petroleum products including LPG and is enforced by the NPA.
- *Road Traffic (Use of LPG) Regulation, 1994* (LI 1592). This instrument regulates the use of LPG in vehicles and requires, among others, for examination, issue of a certificate and registration in respect of suitability of LPG fitting in vehicles. In addition, a sticker, which is renewable every 6 months, is required.
- *Local Government Act, 1993* (Act 462). Section 49 of Act 462 mandates district planning authorities to grant permits for siting LPG facilities in a district. The installation of LPG facilities requires a development permit from the local authority. The procedure and manner for securing a permit are to be prescribed by regulations that are not yet available.
- *Environmental Assessment Regulations, 1999* (LI 1652). These regulations stipulate that undertakings involving refined petroleum products and construction relating to products, as well as storage facilities, be registered with the Environmental Protection Agency and an environmental impact assessment provided in respect of such undertakings.
- *Export and Import (Prohibition of Importation of Used LPG Cylinders) Instrument, 2001* (LI 1693). This subsidiary legislation prohibits the importation of used LPG cylinders into Ghana.
- *Fire Precaution (Premises) Regulations, 2003* (LI 1724). These regulations require that a fire certificate be obtained for the establishment and use of LPG facilities. The regulation includes a provision for setting guidelines for the classification and registration of fire protection service contractors, and the Ghana Fire Service is authorized to enforce the code of practice on means of escape, firefighting and fire warning systems determined by the Fire Service Council.
- *Code of Standard on LPG*. This document serves as a guide to investors who intend to set up LPG filling plants in the country. It also assists operators of LPG filling plants who are already established to conduct LPG refilling activities in a safe, environmentally friendly manner (Appendix 5, Guidelines for the Establishment and Operation of Liquefied Petroleum Gas Filling Plants in Ghana, 2010).
- *ISO 22991 (on Gas cylinders – transportable refillable welded steel cylinders for liquefied petroleum gas (LPG) – Design and construction)*. This international standard specifies minimum requirements for material, design, construction and workmanship, procedures and testing at manufacture of transportable refillable welded steel LPG cylinders of water capacity up to and including 150 L, exposed to ambient temperatures (Appendix 6).
- *Ghana Standard ISO 13341:1997 (Transportable gas cylinders – fitting of valves to gas cylinders)*. This standard specifies the essential procedures to be followed when connecting cylinder valves to cylinders. It applies to all valves and cylinder combinations connected to screw threads but excludes breathing apparatus, diving gas cylinders and fire extinguishers. It defines the routine for inspection and preparation prior to valving both for taper and parallel screw threads (Appendix 7). Appendix 8 provides cylinder specifications.



 Rural Ghanaian students study with the help of a kerosene lantern in the evening.
Credit: Taylor Weidman/ LightRocket via Getty Images



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ISBN 978-92-4-151402-6



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