Clean and modern energy for cooking

A path to food security and sustainable development

MECS Modern Energy Cooking Services

WFP World Food Programme

May 2022

WFP/Sayed Asif

Contents

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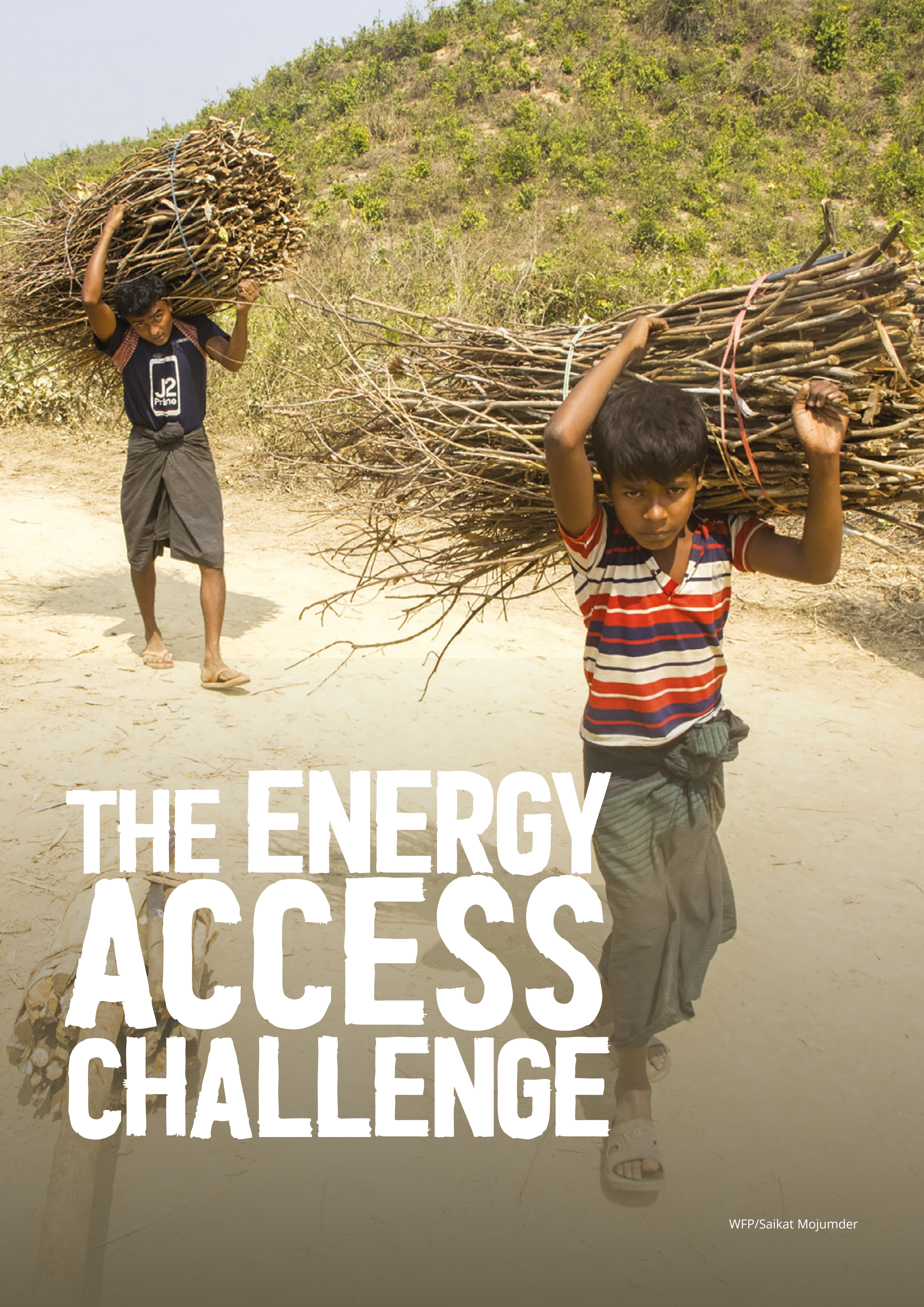


THE ENERGY ACCESS CHALLENGE

WFP/Saikat Mojumder

The energy access challenge

Energy poverty, defined by Bonan et al. (2017) (p. 492) as the "lack, scarcity or difficulty in accessing modern energy services by households," affects both urban and rural areas in much of Africa, Asia, and South America, regions where the World Food Programme (WFP) works in many countries (WFP, 2021). Access to safe, sustainable and accessible cooking fuels and technologies for households, institutions and businesses is an essential aspect of addressing both energy poverty and food security as without access to energy for cooking, many foods, including staples such as rice or potatoes, cannot be consumed.

The World Health Organization (WHO) estimates that around 2.6 billion people cook using open fires or simple stoves fuelled by kerosene, biomass and coal, attributing close to four million premature deaths annually to illnesses associated with using polluting stoves (World Health Organisation, 2021). Charcoal and other solid biomass fuels are used in 70% of households in sub-Saharan Africa (SSA) (DAI, 2019). Charcoal is one of the most important commodities in SSA (Haysom et al., 2021). Its production, which takes place in rural and peri-urban areas to satisfy urban demand, generates income for millions of people in SSA and in some rural areas as many as 6% of people are employed in charcoal production with few alternative employment options (FAO, 2021).

Fuel collection and meal preparation using biomass is time consuming, labour intensive and unsafe; a burden which disproportionately affects women and girls (Clean Cooking Alliance, 2014; Jagoe et al., 2020). The cost of cooking fuels can also be a financial stress (Batchelor et al., 2019) on households, businesses and institutions, particularly in areas with increased biomass scarcity due to overextraction, clearing and urbanization (Price, 2021). Rapid population growth over the next few decades will only exacerbate those challenges (DAI, 2019). Shifting away from burning of solid fuels and kerosene for cooking can significantly reduce carbon dioxide and black carbon emissions (Clean Cooking Alliance, 2019), contributing to climate mitigation and addressing environmental degradation (Bailis et al., 2015; Rob et al., 2017).

Cooking within the Sustainable Development Goals

Given its social, economic and environmental relevance, clean cooking is an issue which has attracted increasing attention from scholars, public institutions, private sector companies, energy financiers and development partners. Access to energy for cooking plays a critical role in WFP's mandate to achieve zero hunger by delivering food assistance in emergencies and working with communities to improve nutrition and build resilience. Energy access is not only needed to prepare the food that WFP distributes but is also a driver for socioeconomic transformation as it underpins the success of several other Sustainable Development Goals (SDGs). This is reflected in the commitments forming the *Compact to Unlock the SDGs and Net-Zero with Clean Cooking* (CCA, 2021), endorsed by WFP along with a wide range of stakeholders within the frame of the United Nations' High-Level Dialogue on Energy (UN, 2021). Research has shown that access to clean, modern, sustainable and affordable energy can help achieve 143 out of the 169 SDG targets (Fuso-Nerini et al, 2018).

Clean cooking impacts SDG3 on health by reducing or eliminating exposure to smoke (WHO, 2021); SDG4 on education creating cleaner study environments for children and reducing time-poverty resulting from fuel collection (Frempong et al., 2021; IEA et al., 2019); SDG8 on economic growth by saving time (UNESCAP, 2021) and money (Jagoe et al., 2020) that can be spent increasing productivity; SDG5 on gender; and SDG16 on peace by reducing the instances of conflict when collecting cooking fuel in situations of scarcity (GACC, 2016).

Energy as a critical component of WFP's work

WFP is the world's largest humanitarian organization working towards zero hunger; making food the centre of its focus. In 2020, WFP provided food assistance to over 100 million vulnerable people in 84 countries. It has six decades of experience supporting school feeding initiatives and working with more than 100 countries to set up sustainable national school feeding programmes. In 2020 alone, WFP reached 15 million schoolchildren with nutritious meals and snacks in some of the most food-insecure regions of the world. In the next 10 years, WFP is planning to provide school feeding to 35 million children in 30 of the most fragile and low-income countries.

However, most of the food distributed by WFP to schools needs to be cooked before consumption and given the high volume of meals prepared in schools, they are contributors to the negative impacts resulting from inefficient cooking processes. It is estimated that 80% of the school meals cooked in WFP-assisted schools are prepared on three stone fires, where fuel is often supplied by children and their parents. Further, schools' reliance on traditional biomass for the cooking of meals contributes to environmental degradation in the surrounding areas. WFP's ambition is to be the leading agency promoting alternatives to inefficient cookstoves and open fires in schools, building on interventions in 34 countries and the distribution of 28,932 improved institutional stoves between 2003 and 2021 (of which 612 in 2021 alone).

FIGURE 1.

Graph showing number of school stoves distributed in five countries with highest volumes of stoves in the period 2003-2021.

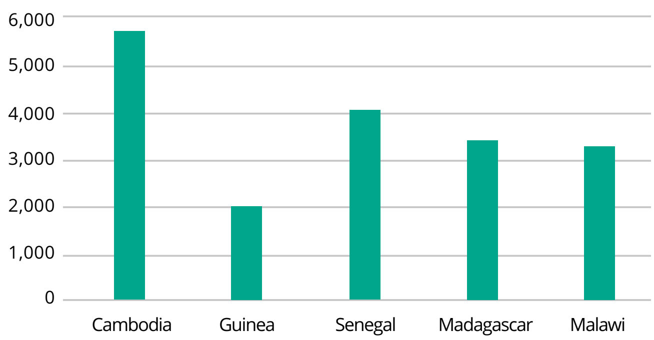


FIGURE 2.

Graph showing number of household stoves distributed in five countries with highest volumes of stoves in the period 2003-2021.

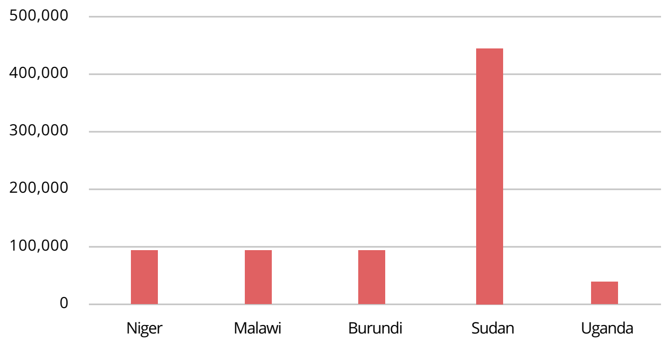
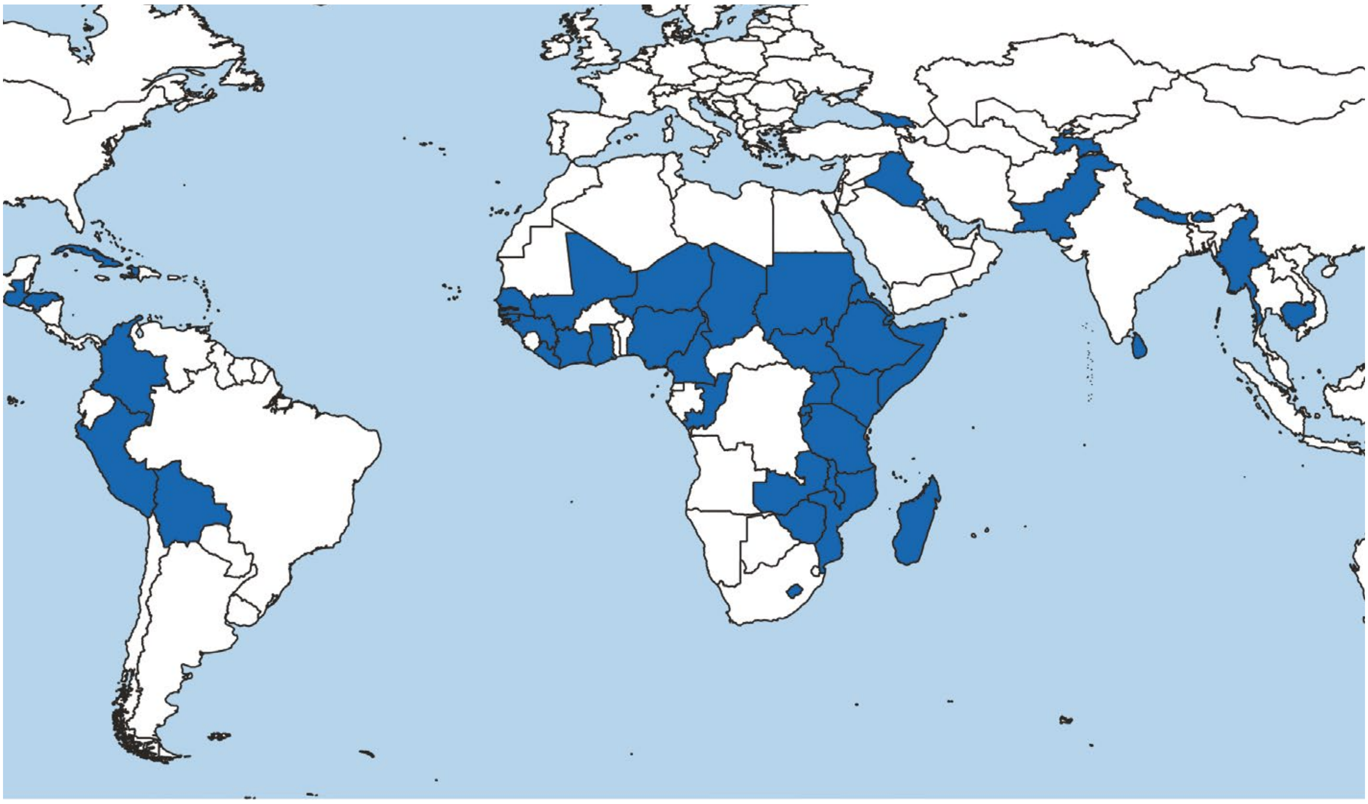


FIGURE 3.

Graph showing total number of household stoves and school stoves distributed per year in the period 2003-2021.

FIGURE 4.

Map showing countries with WFP-implemented cooking activities between 2003 and 2021.



Further, WFP is working towards zero hunger by delivering food, cash and other assistance in emergencies, where it supports both displaced people and host communities. WFP was tackling 10 emergencies by the latter half of 2021, fuelled by conflict, natural hazards, and climate change. To limit the environmental, health and socio-economic impacts that food assistance is indirectly causing due to cooking, WFP promotes alternatives to inefficient cookstoves and open fires in humanitarian and fragile settings, with interventions in 48 countries and distribution of over 880,000 household stoves between 2003 and 2021 (of which 171,000 in 2021 alone).

However, simply distributing improved cookstoves is not addressing the cooking challenge. WFP's experience shows that often schools and families who have received improved stoves quickly revert to previous cooking practices for reasons including malfunction and lack of repair and maintenance services, high fuel costs and low familiarity with the cooking solution. Permanently shifting toward clean and modern technologies requires comprehensive interventions that can address and prevent these issues, which requires long term planning.

WFP recognises the opportunities for not only making energy access integral to its operations, but also shifting to modern cooking by leveraging global progress made on electrification and the development of market-based approaches to energy access. WFP intends to adopt such approaches and collaborate with private sector suppliers of cooking solutions to offer after-sale assistance, maintenance, repair and end of life substitution to end users. It will target households in displacement settings and fragile contexts, and schools but also commercial activities such as bakeries, restaurants and food street vendors. Given their large energy consumption and the potential to showcase innovative solutions, it is important to include commercial cooking activities as part of clean cooking interventions.

Developed through a partnership with the Modern Energy Cooking Programme (MECS), this paper provides an overview of the current landscape of energy for cooking and its role within food security, wider well-being and resilience issues. It outlines the main opportunities for WFP to adopt new approaches to address cooking energy challenges which are key in achieving food security.

COOKING CONTEXTS

WFP/Marwa Awad

Cooking contexts

WFP has been tracking cooking interventions in households and institutions (i.e., schools) since 2003. In both cases, the approach has predominantly been that of donating low-cost 'improved' cooking solutions to beneficiaries, where issues of quality and sustained adoption and use have remained challenging.
While many barriers to cooking transitions are global, there are no universal alternatives to biomass cooking due to significant contextual nuances in cooking practices, associated issues and relevant stakeholders. Even in the same context, solutions may vary according to the broad category of end users.

Household cooking

The majority of research, development and implementation on modern and clean cooking has focused on households. This has typically centred on cookstoves, often framing households as cooking with a single fuel on one stove (van der Kroon et al., 2013). In practice, multiple stoves are used with different fuels to cook different types of foods, to adapt to variations in the availability and affordability of fuels and to enable more convenient cooking for certain uses.

For several decades, cooking interventions have focused on the development, testing and provision of improved cookstove technologies (Abdelnour et al., 2020) neglecting to look at market value chains able to make these products sustainably available to end users. Over time, technology developments have advanced the efficiency, affordability and usability of improved stoves, but performance and safety remain an issue. Modern cooking solutions, including gas and electric cooking, have become increasingly viable across the Global South (World Future Council, 2019), with greater advantages to health, environmental implications, safety and convenience. However, in addition to affordability, challenges around awareness, availability and reliable fuel supply (whether LPG, LNG, ethanol or electricity) have contributed to the slow uptake of these solutions.

Delivery models have also evolved from direct distributions to market-based approaches. However, challenges remain in fostering enabling environments, supply chains and delivery models suited to the poorest and most marginalised groups (ESMAP, 2021). Many countries now have national policies to move away from biomass cooking by subsidising LPG, including India's ambitious Ujjwala scheme (Government of India, 2016). Electric cooking is also becoming increasingly economically feasible, even for poor households, aligning with electricity grid expansion and rollout of off-grid electrification systems (Batchelor et al., 2019). Notable examples are Uganda's 'cooking electricity tariff' (UMEME, 2022) or Kenya's strategy seeking universal access to modern energy for cooking by 2028, including electricity (Atela et al., 2021). Advances have also been made in off-grid solar based electric cooking (see Box 1).

WFP/Giulio d'Adamo

BOX 1
Off-grid solar electric cooking for urban households in Burundi

In Burundi, firewood covers about 94% of primary energy consumption. Population growth, in combination with land use pressure and rising demand for natural resources, have led to high levels of deforestation. Economic means for clean energy for cooking are very limited as 70% of the population live in poverty (World Bank, 2020). In Bujumbura- Burundi's capital city, charcoal is the main cooking fuel across all social layers of the population. Costing more than LPG, charcoal expenditure takes up a substantial share of the households' income.

However, rapid advances in solar PV technology have led to significant reductions in the price of solar PV panels. This has boosted the availability and uptake of small-scale off-grid solar systems for household electrification, including in urban settings where people have backyards to place the panels and suffer from numerous black outs.

Through its Innovation Accelerator, WFP has supported a pilot project to promote solar electric cookstoves (ECOCA), to urban end-users with the intention to ascertain their willingness to invest in such solutions. The ECOCA (made by Pesitho), is a compact, self-contained, multi-purpose home cooking unit consisting of an electric base hosting a lithium battery pack and regulation system, a 275W solar panel, two chargeable light bulbs and two highly insulated pots. Urban households in Burundi, already familiar with electric hotplates, could be attracted by a more efficient cooking solution.

So far, the outcomes of the project have been promising with many households showing interest in buying the ECOCA. However, future work will have to consider ways of reducing its price, for example through the utilisation of carbon credits to subsidise the price to the end-users (WFP, 2020).

Institutional cooking

Cooking in institutions such as schools, clinics, prisons, religious centres and in humanitarian settings, can mean catering for up to thousands of people at once. Cooking undertaken regularly in institutional settings constitutes a significant portion of the cooking fuel demand in a community. In the case of school cooking, some families collect the cooking fuel, which can be time-consuming. Others purchase it which can be an economic burden affecting school performance, attendance and the ability to meet other basic needs. When firewood is insufficient to cook school meals, children are forced to skip meals or eat undercooked food. For approaches to tackling the challenges of institutional cooking, there are similarities from a technical perspective with household cooking (though with adaptations for scale), however, many institutions have considerably less flexibility on the time and means by which meals can be cooked and higher risk aversion to technical breakdown issues with a supply chain or a power outage. Energy solutions for institutional cooking require engagement with a wide range of interconnected stakeholders, where financial models need to operate within often under-resourced public and community institutions.

Thus far, institutional cooking has been under-researched and under-acknowledged and has lacked a structured approach, including within in-country policies around energy access to institutions and the provision of meals. Greater evidence is required to understand institutional cooking within the context of local cooking practices and nutritional priorities and to develop scalable and sustainable financing strategies for the long-term. Recent policies have attempted to facilitate large scale rollout of LPG to public institutions, as seen in parts of Ghana (GhanaWeb, 2021) and Rwanda (Čukić et al., 2021). Options for electric cooking are emerging but require greater testing and uptake, as well as supporting enabling environments, to have impact at scale.

BOX 2
Innovative approaches to energy in school feeding

In many different contexts, innovative approaches are being trialled and adopted to improve the energy efficiency, cost, safety and cleanliness of school feeding programmes which work to ensure that children have access to good quality meals while attending school. This includes the adoption of new cooking fuels and technologies, alternative ways of cooking and adaptation of school menus. Baseline cooking technologies and energy supply systems present in WFP's supported schools vary considerably. While most schools, particularly in Sub-Saharan Africa, rely on fuelwood for cooking, other regions already cook with gas or electricity.

In urban Lesotho for example, the availability of on grid electricity has made it possible to introduce large scale electric pressure cookers (EPCs) that are being trialled to understand their technical feasibility, business viability and effectiveness as an alternative to biomass and gas cooking (WFP, 2020); pictures of this project are shown on pages 11 and 13. This will help to build evidence for wider scale implementation. In Armenia, school meals are already prepared using electricity, but the efficiency could be substantially improved with the substitution of hotplates with EPCs, reducing costs and cooking time. In places like Tunisia, where school cooking is outsourced to commercial kitchens with large operations, there are opportunities to achieve wider impacts for the community by addressing cooking practices in a few centralised facilities. Introducing pre-cooked foods, such as beans and other pulses, in school menus has the potential to reduce cooking times and consequently energy requirements and costs.

While these solutions are not universally applicable, as they rely on good electricity connections and well-developed supply chains, they demonstrate the breadth of different situations and solutions in WFP's supported schools.

Commercial cooking

Clean and modern cooking technologies also have a wide range of applications for commercial activities, with the potential to enhance livelihoods. In restaurants, hotels and food stalls, clean cooking improves working conditions and provides cost savings (Scott et al., 2020). Although commercial cooking is responsible for large fuel consumption, interventions addressing the need to increase its efficiency are much less common than those targeting households and institutions.

Post-harvest food processing requires combustion processes for conservation purposes, such as fish and meat smoking and drying, canning, milk pasteurising and parboiling of rice. Working to improve the efficiency of large-scale combustion processes (cooking, heating etc.) is easier than operating at household level because each intervention brings higher impacts and is more likely to be affordable for the end user who can track profits from lower fuel costs (Scott et al., 2020).

Displacement settings

Data on access to cooking energy in humanitarian settings, for refugees or internally displaced people (IDP), is currently scarce. However, available evidence shows that approximately 80% of displaced people in refugee camps have only minimal access to cooking energy (Lahn and Grafham, 2015). They also have significantly lower access than their surrounding host communities (IEA et al., 2021). Access to cooking energy is a crucial component of food assistance for refugees as most of the food supplied in refugee camps by WFP or partners is raw and must be cooked (Chatham House, 2016). Refugees in low- and middle-income countries rely primarily on firewood and charcoal for cooking (Gunning, 2014). Humanitarian organizations, such as UNHCR and others, distribute cooking fuels including LPG and firewood for free to many refugee households in camps across Sub-Saharan Africa and South Asia. However, the provided amounts are frequently insufficient which forces people to either buy or collect additional fuel. The cooking fuel deficit can also lead to negative coping strategies, such as survival sex, or selling and trading food rations for cooking fuel (SAFE, 2016). Further, refugees' reliance on traditional biomass for cooking can contribute to environmental degradation and tensions with host communities who depend on the same natural resources (Obradovic, 2015; Haselip and Rivoal, 2017; Tafere, 2018).

Historically, cooking solutions such as improved cookstoves (ICS) have been offered as free hand-outs, often short-lasting and ill-suited for meeting the needs of the displaced over the long term. The energy options used by most refugees in camp settings only meet tier 0/1 standards in the multi-tier framework (MTF). Recognizing the shortfalls of such approaches in reaching scale and doing so sustainably, market-based approaches where the provision of energy services is led by the private sector have been increasingly promoted (Whitehouse, 2019). Alongside other humanitarian and emergency response partners, WFP aims to implement market-based, sustainable energy approaches which include vouchers and cash-transfers for cooking fuels and technologies (WFP, 2021). The shift towards such approaches has also led to an increase in the number of interventions that include modern energy cooking solutions in displacement settings (Bisaga and To, 2021).

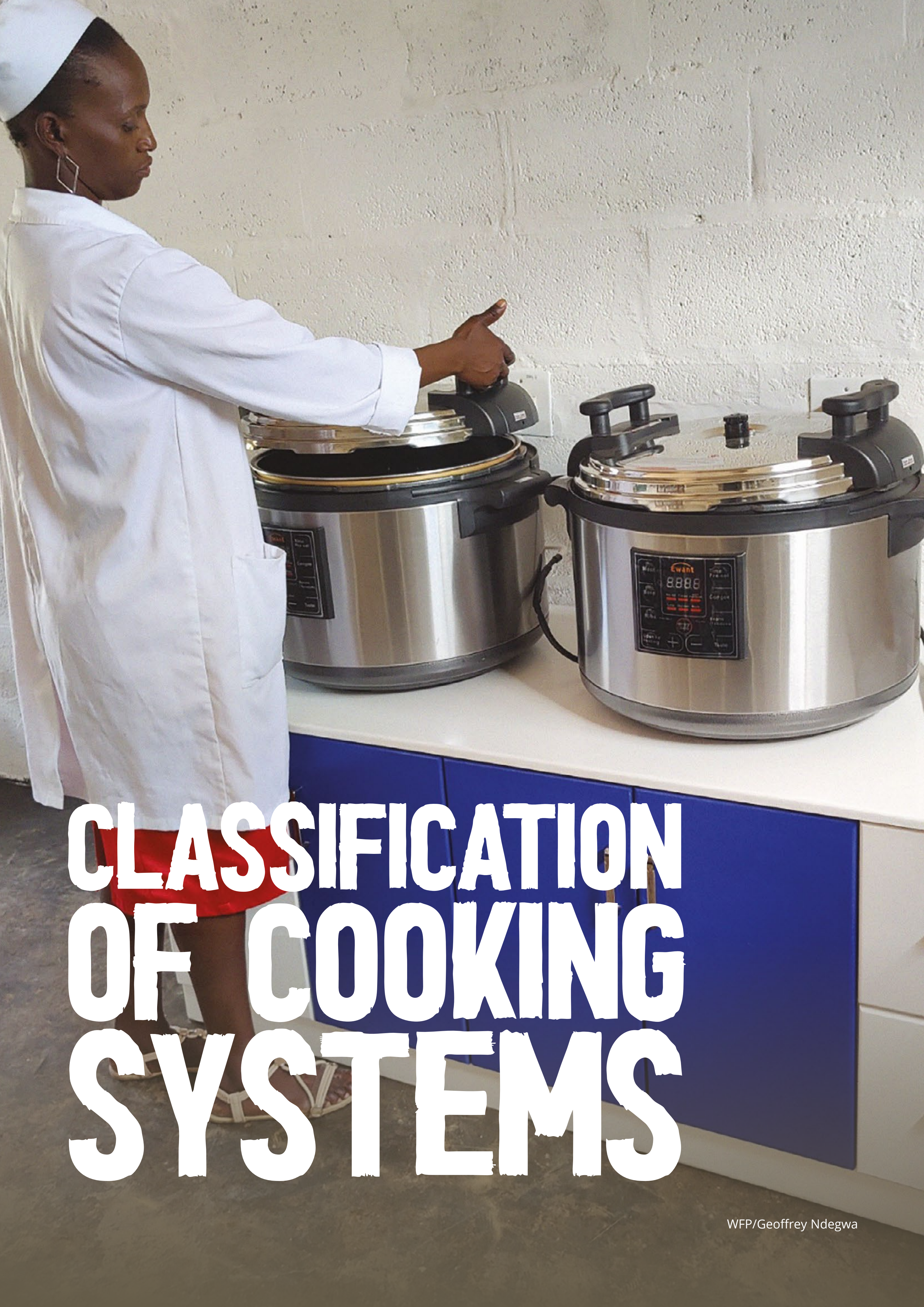
BOX 3
Modern cooking solutions in Chad and beyond

Led by WFP in collaboration with UNHCR and the UN Environment Programme (UNEP) / UN Office for the Coordination of Humanitarian Affairs (OCHA), the *Modern cooking solutions in Chad and beyond* project focuses on two provinces in North-Eastern and Eastern Chad – Ennedi East and Wadi Fira, which host six camps with a total number of Sudanese refugees exceeding 140,000. The aim of the project is to build evidence around the most appropriate energy-efficient cooking solutions in Chad and build the case for a transformation of humanitarian policy and programming mechanisms for cooking energy at the global level. The project is targeting both households and commercial activities such as street food vendors and restaurants. Through need assessments and market scoping, the project is identifying different suitable solutions for beneficiaries to choose from through a voucher scheme.

In this context, no single solution seems to be ideal. Biomass cookstoves are currently used but discouraged by the Government due to the increased scarcity of firewood and dire deforestation issues in the country. Solar cookers are not favoured by refugees due to their lack of convenient usability. LPG, while accepted by end users, is expensive to refill and difficult to transport to a landlocked country and to the targeted areas which are prone to flooding in the rainy season. LPG supply also depends upon the costly expansion of the distribution network by the Government, in collaboration with the private sector, to fully meet demand. Opportunities for solar PV for electric cooking could be promising but import and custom processes for solar PV technology are a barrier.

The project partners will reach 4,410 individual households and 3,120 commercial activities with clean cooking solutions with the intent to expand the choice and scale up in a second phase.

CLASSIFICATION OF COOKING SYSTEMS



WFP/Geoffrey Ndegwa

Classification of cooking systems

There are numerous ways to discuss, define and measure different types of cooking systems and their impacts on surrounding environments, the health and wellbeing of those in and around kitchens and on wider supply chains and ecosystems.

The ESMAP multi-tier framework (Bhatia and Angelou, 2015) is a multi-dimensional tool to measure and categorise access to cooking solutions across six attributes: cooking exposure to harmful pollutants; cookstove energy efficiency; convenience of acquiring and preparing fuel and using the stove; safety; affordability as a percentage of household income; and availability, i.e., readiness of the fuel when needed by users (Bhatia and Angelou, 2015). Scores range from Tier 0 (no access) to Tier 5 (full access). Key terminology commonly used to indicate different levels of energy access are found in Table 1.

FIGURE 5

Multi-tier framework (source: ESMAP, 2020)

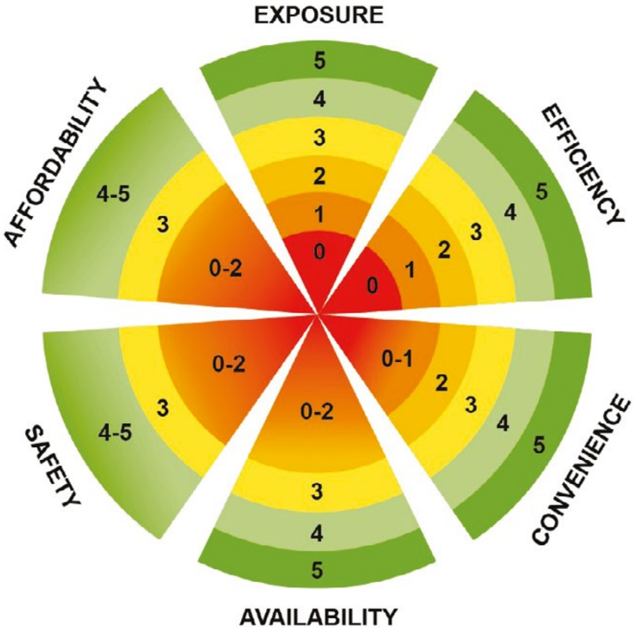


TABLE 1.

Common definitions of cooking systems

POLLUTING/ TRADITIONAL	Polluting cooking methods, often referred to as traditional cooking systems, are the combination of high emissions fuels such as firewood, charcoal and kerosene, burned inefficiently on open fires or simple stoves. These do not meet the international standards for health or emissions
IMPROVED	Improved cooking systems act as an intermediary solution between polluting cooking systems and clean and modern alternatives. Included here are a wide range of improved cookstoves which control the combustion of biomass to improve efficiency and reduce the pollution output. These have varying levels of effectiveness in reducing emissions, as well as challenges in the usability and adoption on a wide scale. Although improved cookstoves (ICS) (typically tier 0-3) reduce the amount of biomass fuel consumed to prepare a meal, they do not offer the same social, health, and environmental impacts as higher-tier cooking solutions (Rosenthal et al., 2018).
CLEAN	The term clean cooking refers to a measurable criterion classified by meeting the standards for particulate and carbon monoxide emissions laid out under the WHO guidelines and following the ISO/TR 19867-3:2018 Voluntary Performance Targets (VPTs) (WHO, 2014), which are of critical importance for health. Solar, electric, biogas, natural gas, liquefied petroleum gas (LPG), and alcohol fuels including ethanol are all classified as clean at the point of use, as well as biomass cooking systems which meet the required criteria in laboratory testing (e.g., mini-gasifiers).
MODERN	Modern energy for cooking refers to fuels, technologies and approaches which fall under tier 4 or higher on the MTF framework across all six attributes and provide the greatest benefits to users. These are commonly referred to as the BLEENS, consisting of biogas, LPG, electricity, ethanol, natural gas and direct solar cooking. These are also classified as being clean. Modern energy for cooking excludes any type of improved cooking system.

FUELS AND TECHNOLOGIES

WFP/Geoffrey Ndegwa

Fuels and technologies

The most common options for cooking technologies, each with advantages and disadvantages and varying by context and circumstances, are summarised in Table 2.

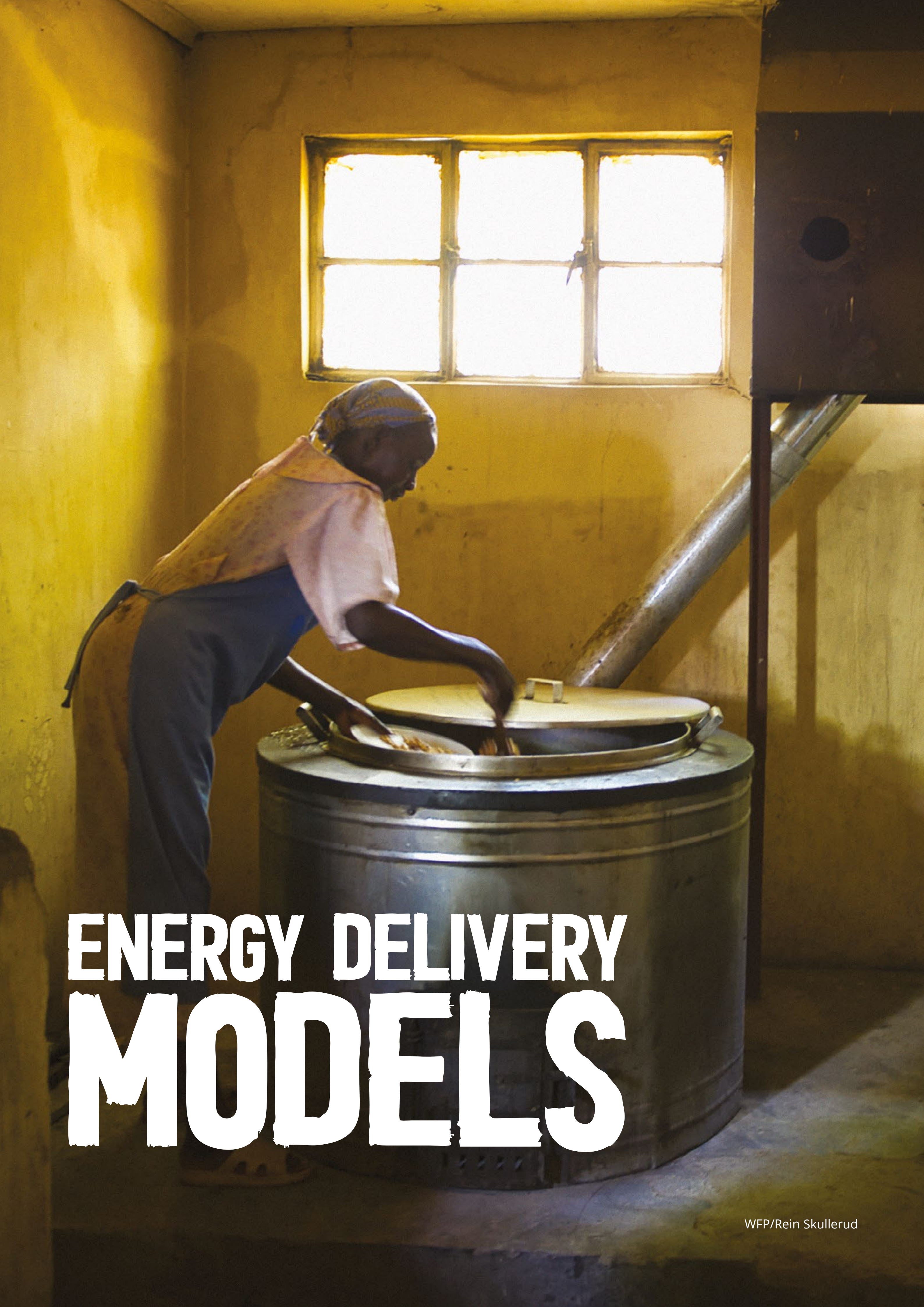
TABLE 2.
Types of cookstoves

TECHNOLOGY	SUMMARY	OPPORTUNITIES	LIMITATIONS
Improved cookstoves (ICS)	ICSs come in many different varieties and utilise a range of biomass fuels, including firewood, charcoal, agricultural and forestry residues, pellets and briquettes.	• ICSs usually have low manufacturing costs and are affordable to users • ICSs are widely available in most contexts • Fuels for ICSs are, in many rural contexts, widely available and accessible • Many commercially made ICSs are more efficient than three-stone fires and some also meet most of the international quality standards	• Most ICSs do not meet the standard for clean cooking, particularly if used improperly • ICSs are dependent on biomass fuel sources, many of which are unsustainably collected and cause environmental degradation • ICSs can cause burns and give origin to fires • Handcrafted ICSs cannot guarantee quality standards, and consequently it is impossible to quantify impacts • As most biomass is non-renewably collected, ICSs contribute to climate change
Liquid petroleum gas (LPG) stoves	LPG, a by-product of natural gas extraction, can be supplied to kitchens in cylinders, providing a convenient cooking fuel which increasingly features in government policies to transition from biomass fuels.	• LPG is a clean fuel, which emits lower GHG emissions than biomass or coal • LPG stoves are convenient to use, efficient and fast • LPG is easy to store and transport	• LPG stoves have associated safety concerns if not stored or used correctly • LPG is dependent on a reliable distribution network, which is a challenge in remote and rural areas • In many contexts, LPG can be prohibitively expensive for low-income households, especially without subsidy • LPG is a finite, fossil fuel resource • LPG contributes to climate change
Electric cooking appliances	Cooking with electricity, using energy-efficient appliances such as electric pressure cookers and rice cookers, has become increasingly feasible in parts of the Global South, and remains a key potential solution to move to entirely renewable cooking systems. This can be facilitated through both grid connected and off-grid systems.	• E-cooking is clean • If generated from renewable sources, this method emits very few GHG • It is fast, safe, convenient and, very efficient with appliances such as electric pressure cookers (EPCs)	• E-cooking often depends upon reliable and accessible grid or off-grid electricity infrastructure • While in some contexts it is cheaper than charcoal (ESMAP, 2020), it can be expensive in rural locations, especially compared to collecting free biomass

TECHNOLOGY	SUMMARY	OPPORTUNITIES	LIMITATIONS
Ethanol stoves	Ethanol is an alcohol fuel distilled from a variety of biomass feedstock, usually produced in liquid or gel form.	• Ethanol stoves are clean and mostly safe • Ethanol can be affordable in contexts with appropriate supply ecosystems (SEI, 2015) • Ethanol can be produced from a variety of feedstocks – When produced from organic matter (biofuel) it can be a renewable fuel	• Large scale cultivation of ethanol feedstock can be environmentally and socially damaging, requiring fossil fuel for its production and occupying land for food and biodiversity • Ethanol requires production and dedicated supply chain infrastructures
Biogas systems	Biogas is produced from agricultural, food and/or human waste through processes of anaerobic digestion. It is particularly viable in rural areas where feedstock is available.	• Biogas is clean and, if feedstock processes are managed correctly, safe for users • Biogas systems can contribute to circular economies and can incorporate sanitation management strategies • Biogas produces fertiliser as a by-product which is a sought-after co-benefit	• Biogas systems require intensive upkeep and maintenance, which is labour intensive and requires skilled local operators • Biogas systems need additional water to work • Biogas systems require a continuous supply of suitable feedstock, which is a challenge to procure or produce • Such systems have high investment costs
Direct solar systems	Solar cookers are containers whose walls are covered with reflective material that concentrate solar rays on the pot raising the temperature inside. Concentrated Solar Power, using concave reflecting dishes, can reach higher temperatures.	• Solar cooking is highly efficient • There is no cost for fuel	• Can only be used when the sun is high enough, so is a potential option to prepare midday meals in some institutions, but is impractical on a household level • The cook needs to be in the sun to operate the appliance, often unpleasantly hot • Not all types of foods can be cooked in solar cookers (it boils but cannot fry, roast etc) • It takes a long time to cook • Parabolic systems are faster but quite expensive, particularly the most effective ones that rotate with the sun • Cannot be used in rainy places or rainy seasons

It is important to look beyond the specific cooking fuels and technologies, however, to take a system-wide viewpoint. There are many considerations for the choice of cooking solution including, but not limited to, the cultural context and acceptability of a solution, the availability and cost of fuels and technologies (and in the case of electric cooking, the status of electricity access), the surrounding ecosystem for technology supply and upkeep and the varying support from policy makers, private sector actors and community organizations.

ENERGY DELIVERY MODELS



WFP/Rein Skullerud

Energy delivery models

How modern energy services are delivered to households, businesses and institutions plays a critical role in ensuring the longevity and sustainability of the offered solutions. Cooking sits within wider systems, relating not just to food and fuel delivery, but also to the flows of goods and materials, networks of stakeholders and the socio-cultural factors which dictate who cooks and how. Approaches for the design and delivery of modern cooking programmes vary from donor-led, based either on procurement and in-kind distribution as well as training beneficiaries on manufacturing cookstoves and/or fuels, to market-based models and public service delivery. Delivering energy services to the most vulnerable people is particularly challenging given the complex set of factors that hinder supply and demand including lack of a conducive enabling environment (Bellanca and Garside, 2013).

Regardless of the mode of delivery, cooking technologies need to be relevant to end users, presenting additional convenience over the existing ways of cooking, to encourage uptake and long-term adoption. Identifying relevant solutions is however complex and often context bound as cooking practices are deeply rooted within cultural, political and social contexts. This means that technologies need to be suited to available foods and localised preferences for taste (Vigolo et al., 2018). Equally, it is important to acknowledge cooking diversity, where households, institutions and businesses often use different appliances and fuels for different purposes and at different times (e.g., cookstove/fuel stacking) as they are available, affordable and convenient, even if they are not clean or modern (van der Kroon et al., 2013). If not socially and culturally fit, cooking technologies will not be sought after (Ruiz-Mercado et al., 2011). The introduction of new or disrupting technologies also requires awareness raising among end users and training on the use of appliances and fuels to ensure appropriate functioning and consequently lasting adoption (Foell et al., 2011). Often overlooked, due to a focus on technologies and to the challenges in changing fast routed behaviors, are cooking habits that substantially increase cooking efficiency and maximise socio-economic benefits. This varies from pre-soaking ingredients, to drying fuel, reducing the energy influx while simmering and utilising lids on pots.

Donor-led models

Free distribution of energy products, such as cookstoves and firewood, has been common in emergency settings where other approaches are not feasible, at least in the short-term. Here, goods are procured and distributed by aid agencies to beneficiaries. For example, the recent conflict in Tigray, Ethiopia, has displaced thousands of people, forcing them to flee into neighbouring Sudan where they have settled mostly in temporary refugee camps. With limited access to local markets and limited resources, humanitarian agencies have provided food assistance and free energy solutions to ensure refugees' food security. However, outside of emergencies, where free distribution has been conducted by aid agencies, NGOs or other development partners, issues of product relevance and ownership have too often led to cookstoves being abandoned or sold to pay for other urgent needs (Bellanca, 2019). Where relief organizations have promoted the manufacturing of Tier 1 stoves by beneficiaries, despite a range of artisanal stoves of similar and often better quality being already available in local markets (Bellanca, 2019), absence of quality control, professionality and business acumen have largely led to unsatisfactory outcomes (Boiling Point, 2014).

Public sector-led models

Public sector led delivery of energy is typical for centralised grid networks (e.g., electricity, water, natural gas) that require extensive infrastructure, which tends to be limited in the poorest and most vulnerable communities. In these locations, where centralised grid networks do not reach, both cooking appliances and fuels are supplied by private companies and their costs borne by end users. However, given the scale and urgency of the challenge, there could be an increased public engagement in supporting the cooking sector to gain societal co-benefits such as protecting the environment, investing in health and reducing global carbon emissions.

BOX 4
Leveraging access to modern energy cooking for school feeding programmes

It is estimated that 80% of meals cooked in schools supported by WFP globally are still prepared on inefficient three-stone fires. For six decades, WFP has been working in more than 100 countries to set up sustainable national school feeding programmes. As much of the food distributed to schools by WFP requires cooking, it is critical to include clean and modern energy as part of school-based programme design.

Depending on the context, shifting to modern cooking solutions ranges from biomass stoves in rural locations, to electric pressure cookers (EPCs) in areas where electricity is already available (on-grid, from mini-grids or stand-alone photovoltaic PV systems). As many as 31% of primary schools in Sub-Saharan Africa and 55% in Southern Asia already have access to electricity (IEA, 2021) but many of them still use firewood for cooking.

Efficient stoves can reduce greenhouse gas emissions with each prepared meal. This opens up opportunities for school feeding programmes to benefit from carbon credits as one metric tonne of CO2 equivalent (tCO2e) saved is worth one carbon credit in the international market. The monetization of carbon emission savings could bring additional resources into those programmes, while at the same time enabling continuous monitoring of innovation uptake and performance. WFP is well-positioned to coordinate such interventions in schools under one global umbrella to increase simplicity and efficiency of designing carbon credit schemes, thus enabling a strong global narrative for a range of interested stakeholders, such as donors, national governments and other partners.

WFP/Elio Rujano

WFP/Paola Solis

Market-based models

As a result, the last decade has seen market-based approaches being increasingly promoted in the energy access sector. Markets are an important part of people's and communities' lives, offering the principal means of accessing goods, services and incomes. They can provide access to quality goods faster and more efficiently as private sector providers are incentivized to reach scale as quickly as possible in order to become profitable and be able to continue serving their customers (Bisaga and Huber, 2020). By accessing markets, end-users have the agency to make their own choices regarding what technologies and fuels they wish to use. The sense of ownership, resulting from the value that is attached to the purchased goods and services, increases the chances of the chosen solutions being used over the long term. Using private sector distribution networks to reach beneficiaries also injects resources in the local community ultimately contributing to its recovery. However, adopting a market perspective requires the donor community to shift from focusing solely on technology, procurement and distribution, to designing integrated and systemic energy delivery models, that consider value chains, the socio-cultural context and the enabling environment surrounding the cooking solution (Bellanca and Garside, 2013).

BOX 5
Cash-based Transfers (CBT) as an example of a market-based approach to energy access

CBT is "money given to vulnerable people who can use it to buy what they most need in their local markets" (WFP, 2020). They offer an alternative modality to in-kind distribution or direct service provision. Cash transfers tend to be offered unconditionally, meaning that recipients can choose what they want to spend the resources on, based on their most urgent needs. Vouchers, also known as coupons, can be exchanged for a set quantity or value of goods, denominated either in cash value (e.g., USD 15), or pre-determined commodities or services (e.g., 5kg of maize or milling of 5kg of maize). They are typically redeemable with pre-selected market vendors or at fairs organized by the agency providing CBT support. Delivery mechanisms for CBT include immediate cash disbursement (either in cash or through an agent); cash accounts (e.g., pre-paid cards, mobile money or bank accounts); and paper or mobile vouchers (e-vouchers) (WFP, 2017). In 2009, WFP transferred US$10 million of purchasing power in 10 countries, rising to US$2.1 billion to almost 28 million people in 64 countries in 2019. CBTs can contribute to positive outcomes for people, markets and governments by contributing to individuals' empowerment, boosting markets and supporting governments to strengthen country systems, help poverty alleviation and support socio-economic growth (WFP, 2020). WFP already uses energy vouchers to cover (a part of) the cost of cooking for end users, for example in Cox's Bazar refugee camp in Bangladesh.

WFP/Fredrik Lerneryd

WFP/Elio Rujano

Demand, supply and enabling environment

Demand for energy products is essential to ensure the viability of energy markets. The challenge is therefore to stimulate demand among end users. Affordability remains one major barrier together with scarce availability of relevant solutions and knowledge of their existence. Access to financial services, including micro-finance schemes and loans, financing options, such as PAYG (pay as you go) payment plans or purchase on credit with pay back in instalments can help to address the affordability barrier, particularly for capital-intensive biogas, solar PV or solar thermal home systems (either for direct or indirect cooking).

While high demand is a fundamental factor for the development of reliable supply, it is also true that adequate supply is needed to develop demand. Breakdowns in supply chains can hinder or compromise the development of local markets (Benka-Coker et al., 2019). In addition, whether products are imported or locally manufactured, after-sales services such as repair and maintenance, are essential to ensure longevity and sustainability. This implies a local presence of supply actors and therefore the availability of local skills and capacity, as well as resources and materials.

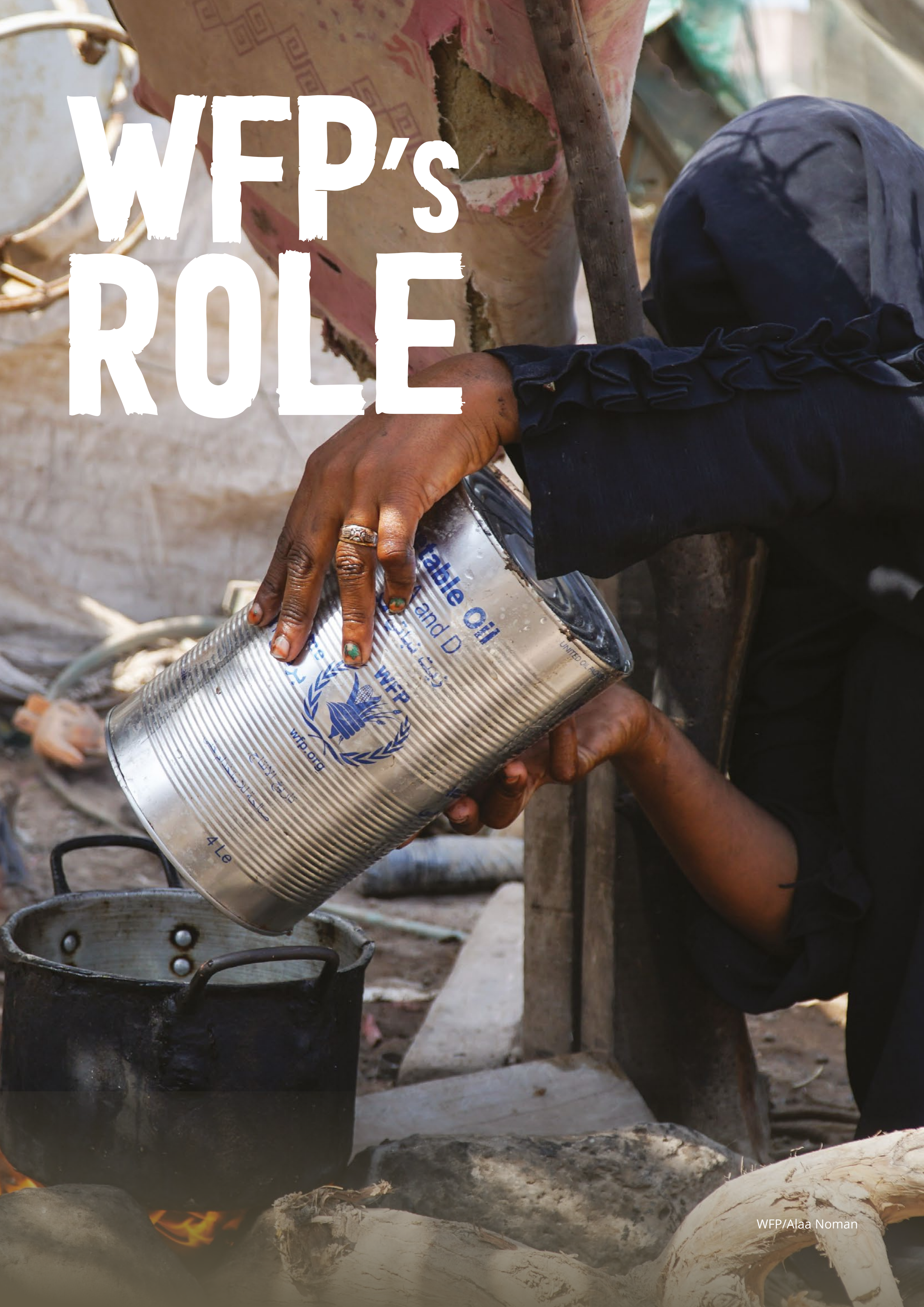
The enabling environment is also critical. This is made up of the set of economic policies and laws, national and international institutional and regulatory frameworks and arrangements that can support or hinder the cooking sector; the status of infrastructure that plays a role for example with good transport channels to reach end users and communications systems to allow awareness and to enable digital payments; the stability of local and international energy markets, driven by geopolitics as well as consumer trends and tendencies that influence prices (Garside and Wykes, 2017) and all those elements that despite being important cannot be substantially influenced by cooking programmes.

Need assessments and market scoping

Critical to identifying programme opportunities are need assessments. A thorough understanding of end-users' needs, aspirations, preferences, practices, cooking habits, ability and willingness to pay and daily struggles is essential to design technology that is relevant to end users and delivery models that make adoption possible. Market scoping helps to gauge the market size, identify existing market players who can supply energy products and services, examine the landscape of available fuels and technologies, and access to infrastructure needed to facilitate modern energy cooking, such as electricity connections if e-cooking is considered, water access for biogas solutions, or a steady supply of fuel to ensure continued uptake of Liquid Petroleum Gas (LPG) or ethanol stoves. Assessments are the basis to design robust delivery models and ensure buy-in from end users and other key stakeholders, such as governments and host communities (Bellanca, 2019).

WFP/Guillermo Galdos

WFP's ROLE



WFP/Alaa Noman

WFP's role

WFP is well placed to promote clean and modern energy for cooking, for households, institutions and commercial activities. Proximity to energy underserved communities allows WFP to play an important role in raising awareness around modern cooking solutions and their benefits and build end users' capacity to increase adoption. WFP also provides CBT assistance to cover the affordability gap. Piloting new technologies and energy delivery models through the Innovation Accelerator, WFP strives to reach a leading position in the sector.

A wide-scale presence including in some of the most remote locations gives WFP the ability to support end-users to access appropriate energy solutions thereby strengthening demand. Raising awareness, ensuring proximity and connection with fuel and appliance distributors and access to after-sales services or financing schemes for cooking equipment is necessary to ensure continued uptake of the solutions available in the market (Quinn et al., 2018), and a matching role for WFP. Cooking solutions should be available to all, including the poorest and those in displacement contexts. Poorer households requiring financial support to transition to modern cooking solutions, such as in displacement or crisis-affected contexts, can be facilitated by inclusive financial models (Barnard-Tallier et al., 2021) that use CBT modalities (Stritzke et al., 2021). In settings where communities have access to income generation and are able to pay at least a minimum amount for energy services, supporting the development of local markets by helping the existing private sector providers, or those willing to enter the market, is a valuable contribution to the setup of energy products value chains. This can, for example, consist of strengthening the supply chain of LPG suppliers to ensure the timely availability of cylinders refills, to avoid the reversion of adopters to their previous cooking practices, or ensuring steady ethanol supply chains. Results-based finance (RBF) mechanisms correspond monetary premiums to suppliers tied to pre-defined performance criteria based around agreed outputs (Mumssen et al., 2010). RBFs have been increasingly deployed across the energy sector over the last decade, including in humanitarian settings (Stritzke et al., 2021).

While supporting the supply side requires expertise and time commitment that go beyond WFP's typical engagement capacity in the energy field, WFP is perfectly positioned to help its beneficiaries to access the energy products and services made available by the private sector. In doing so, WFP follows its policy on gender inclusion and Leave No One Behind (WFP, 2022) making those key elements of designing modern and clean cooking programmes (Barnard-Tallier et al., 2021). Interventions need to be cognizant of the intra household dynamics and particularly engaging with women and girls to understand the intersection with energy, cooking and empowerment (IEA, 2017). They also have to be inclusive of different groups and their needs. Inclusion can mean addressing the affordability barrier, for example, setting up voucher schemes or enabling displaced people to be part of government subsidy schemes regardless of their status (MECS & Energy 4 Impact, 2021). Inclusion also means to consider the potential disruption caused by the introduction of innovation on marginalised groups across the entire supply chain. For example, charcoal making often generates important income for rural people (Haysom et al. 2021; Ndegwa, 2021).

The increased scarcity of supply, seen acutely in many regions, as well as the need to switch to more sustainable practices, jeopardises these livelihoods. Therefore, it is important to include these groups where possible into the new value chains. New localised supply options, as is the case for renewable energy sources such as biogas, waste to energy, small scale biofuels and solar PV, are conducive to creating green employment and local economic development. Finally, the needs of people with disabilities should be considered in making sure that solutions are convenient and safe for all users (iDE, 2021). Opportunities to impact the energy transitions required to achieve food security present an increasing need to widen the scope and scale of efforts by harmonising interventions across geographies, diffusing best practices and implementation approaches, promoting modern technologies, and focusing on impacts that are sustainable for the medium to long term. These are essential to galvanise the full potential for clean and modern energy uptake within WFP operations.

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The Modern Energy Cooking Programme (MECS) is funded by UKAid through the Foreign, Commonwealth and Development Office*. It is a partnership between researchers, innovators, and policy makers, drawing on their expertise and relevant work from around the world to co-construct new knowledge with practitioners and the private sector. It is led by Loughborough University, UK in partnership with ESMAP. Further details can be found at www.mecs.org.uk.

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