REPORT

THE STATE OF COOKING ENERGY ACCESS IN SCHOOLS

INSIGHTS FROM AN EXPLORATORY STUDY

ESMAP
Energy Sector Management Assistance Program

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ABOUT ESMAP

The Energy Sector Management Assistance Program (ESMAP) is a partnership between the World Bank and 24 partners to help low- and middle-income countries reduce poverty and boost growth through sustainable energy solutions. ESMAP's analytical and advisory services are fully integrated within the World Bank's country financing and policy dialogue in the energy sector. Through the World Bank Group (WBG), ESMAP works to accelerate the energy transition required to achieve Sustainable Development Goal 7 (SDG7) to ensure access to affordable, reliable, sustainable, and modern energy for all. It helps to shape WBG strategies and programs to achieve the WBG Climate Change Action Plan targets. Learn more at: https://esmap.org.

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Contents

List of Boxes and Tables

Boxes

Case Studies

Tables

Acknowledgments

This report documents the findings and insights from an exploratory study that sought to understand the challenges and opportunities associated with cooking practices in the educational institutions of developing countries. A joint product of the World Bank's Energy Sector Management Assistance Program (ESMAP) and the World Food Programme (WFP), the report combines the expertise and knowledge of the WFP's school feeding programs and the World Bank's financing and technical assistance experience to governments for expanding schools' access to modern energy cooking solutions while reducing pressure on biomass. The study's findings are primarily from Sub-Saharan Africa, where the clean-cooking access deficit is highest and actions are most urgently needed.

The report was prepared by a team of the World Bank's ESMAP led by Yabei Zhang (Senior Energy Specialist) and the WFP led by Raffaella Bellanca (Energy for Food Security Advisor). The team comprised Alisha Pinto, Caroline Ochieng, Gina Fleurantin, Norma Adams, Zijun Li, Crispin Pemberton-Pigott, and Stephen Halloway. The team is grateful for the staff interviews facilitated with contributing organizations and agencies. In addition to the WFP teams in Burundi, Ethiopia, India, Kenya, Lesotho, Nepal, Rwanda, Uganda, and Venezuela; these include the Aera Group, Association pour le Développement de l'Energie Solaire Suisse-Madagascar (ADES), Clean Cooking Association of Kenya (CCAK), Climate Solutions, East African Wildlife Society, Ecobora, Emerging Cooking Solutions, Equity Group Foundation, FESE Works, Food4Education, German Agency for International Cooperation (GIZ), Hamerkop, International Lifeline Fund (ILF), Loughborough University—Modern Energy Cooking Services (MECS) Program, Masrcorp, Powerspot, Renetech, SNV Netherlands Development Organisation, UNITE for the Environment-North Carolina Zoo, Voice for Change Partnership (V4CP), Vuma Biofuels, and World Central Kitchen. The team expresses its sincere appreciation to Katrina Pielli of the WFP for initiating the project; Andrea Blanco Toro and Geoffrey Ndegwa from the WFP Western and Southern Africa regions, respectively; as well as Suzanna Huber, Maarten Kleijn, Joschka Jahn, Kathryn Milliken, and the many other WFP colleagues who contributed to the report.

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Acronyms and Abbreviations

ADES	Association pour le Développement de l'Energie Solaire Suisse-Madagascar
CCAK	Clean Cooking Association of Kenya
CESS	Centre for Economic and Social Studies
DANIDA	Danish International Development Agency
EPC	electric pressure cooker
FCS	fragile and conflict-affected situations
fNRB	fraction of non-renewable biomass
GBV	gender-based violence
GIZ	German Agency for International Cooperation
HAP	household air pollution
ICS	improved cookstoves
ILF	International Lifeline Fund
ISO	International Organization for Standardization
LMIC	low- and middle-income countries
LPG	liquefied petroleum gas
MECS	modern energy cooking services
MTF	Multi-Tier Framework
O&M	operations and maintenance
PAYG	pay-as-you-go
PSFU	Private Sector Foundation Uganda
RBF	results-based financing
SEforALL	Sustainable Energy for All
SNV	SNV Netherlands Development Organisation
TS	traditional stoves
V4CP	Voice for Change Partnership

Key Findings

School feeding programs outperform most other interventions to boost learning outcomes; however, in developing regions, polluting biomass stoves are often used to cook school meals. Major data gaps have kept the problem of traditional biomass cooking in schools and other public institutions "invisible." As a result, the development impacts (e.g., for health, education, finances, and environment) remain largely unknown. Without reliable estimates on the cost of inaction and benefits that would accrue from switching to modern institutional cooking energy, few investments have focused on clean cooking solutions for schools.

This exploratory study set out to examine and synthesize the available information on cooking energy access in schools, with a focus on regions with the highest access deficit. Using primary and secondary sources, the study team developed a database on clean cooking initiatives, most of which were implemented by international organizations in the context of school feeding programs in Sub-Saharan Africa—the region with the highest access deficit and greatest food insecurity. Experience from other regions, where available, was also assessed and synthesized in this report. The study is a joint product of the World Bank's Energy Sector Management Assistance Program (ESMAP) and the World Food Programme (WFP).

Survey results from Kenya, Rwanda, and Uganda showed that most initiatives were using improved cookstoves (ICS) fuelled by firewood or charcoal, and stacking was prevalent. Stove replacement has been the entry point for most interventions in schools. Except for gas and electricity, alternative clean-cooking fuels are still in the innovation, research, and development phases. Only a handful of implementing organizations have adopted pioneering technologies (e.g., LPG-powered steam cooking, heat-retaining volcanic rocks, solar thermal stoves, and electric stoves). The study findings show that many schools could not accurately estimate their cooking energy consumption or fuel expenditures, and field performance data was lacking.

The study team's analysis of delivery approaches found that larger-scale and independent initiatives differed in their preferred design and implementation models. Larger, government-controlled programs preferred a centrally designed, top-down model, whereby the implementing organization's role tended to span the value chain, with little engagement of stove users and a limited role for the private sector. In contrast, the decentralized model—adopted by virtually all initiatives that supplied cooking fuels—allowed schools to contract service providers directly, making it possible to customize solutions to the users' cooking needs and preferences.

Donors' role in financing initiatives has been vital yet inconsistent, oftentimes failing to earmark funds for cookstoves and related technical support. Interviews with sector practitioners highlighted the need for government to step up its role in developing better policies and legal frameworks. Specifically, they cited the need for regulation of processed biomass fuels, transparency in procurement systems and procedures, up-front financing, and space for private-sector providers. They also expressed the need for generating data on sector statistics, setting standards for institutional cookstoves, and mandating the use of fuel-efficient stoves in schools.

National policies that prioritize clean cooking in schools are needed to unlock new investment streams, spur innovation, and create jobs along the value chain. Rwanda's comprehensive national policy, approved in 2019, has made strides in this direction. The policy's school feeding guidelines account for fuelwood in the costing of school meals and specify the use of fuel-efficient stoves as minimum kitchen requirements. That said, the improved stoves promoted in Rwanda today (mainly Muvero models) face key issues related to durability, emissions performance, burning of food, wet fuel, and lack of user training—underscoring the need for minimum kitchen requirements to extend beyond efficiency to include such metrics as heat distribution, heat flux, and usability.

The study identified the need to adapt lessons from the household cooking sector's decades of experience to the institutional context of schools. Key players in the household cooking space have missed opportunities to expand their focus to institutional settings for cross-sector learning (e.g., in technology development, stove-testing protocols and standards, stove maintenance, data collection, advocacy, awareness raising, and financing). The study found that many implementing organizations had no prior experience in the household cooking space even though the most successful product developers for schools started off working with household stoves.

The study also found that schools have institutional advantages that can be harnessed to accelerate their transition to clean cooking solutions. Systems are in place for kitchen and stove inspection and enforcement, auditing of expenditures, and licensing requirements for operation. Moving forward, schools should consider integrating cookstoves into their infrastructure projects to ensure stoves are covered in their infrastructure budgets and inspection reports. That said, a whole system approach is required to ensure that the energy systems adopted are safe, efficient, reliable, affordable, and clean. Parents and teachers associations, who have firsthand experience sourcing fuels for schools, are well poised to champion clean cooking solutions and, working with administrators, advocate for policy reforms.

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EXECUTIVE SUMMARY

Executive Summary

Schools are the second largest consumer of biomass energy after households. It is estimated that 418 million children worldwide receive at least one school meal per day, and that number is expected to grow in the coming years. However, in developing countries, most school meals are prepared in large quantities using rudimentary biomass stove technologies and fuels, with unknown costs to the health of students and personnel, school finances, and the local environment. Scant data on the scale of the problem has limited the sector's visibility, resulting in few investments being designed to meet the clean cooking needs of schools.

Study context and objective

To date, the issue of clean cooking access has focused mainly on households. The estimated cost of inaction in the household cooking sector is staggering, at US$2.4 trillion per year. The adverse health and economic consequences of fuelwood collection and traditional biomass cooking disproportionately affect women and girls, while young children are the group most affected by smoke exposure. In the institutional context, hired cooks—both male and female—may be at risk of cooking-smoke exposure. Whether female cooks suffer a double burden of occupational and household cooking-smoke exposure remains unknown. Parents and students, particularly those in rural or conflict-affected areas, may also be at risk since they routinely collect fuelwood as in-kind contributions to school feeding programs. However, purchasing woodfuel from private contractors often results in unsustainable harvesting and raiding of community resources. Addressing the uncertain security of supply, especially in countries where trade in wood or charcoal is illegal, requires the development and enforcement of appropriate national policies.

This exploratory study examines and synthesizes the available information on the status of cooking energy access in schools where urgent action is needed. The study is a joint product of the World Bank's Energy Sector Management Assistance Program (ESMAP) and the World Food Programme (WFP). The World Bank's Clean Cooking Fund, which has a US$500 million funding target, was launched at the 2019 UN Climate Summit. It is the largest dedicated fund for galvanizing political commitment, scaling up public and private investment, and catalyzing innovation in the clean cooking sector. The WFP is the largest humanitarian agency providing food assistance in emergencies and through school feeding programs. Through its Energising School Feeding approach, it aims to provide meals to 73 million children in primary schools over the next decade.

Study method and results

The study has a global scope with a focus on regions with the highest deficit in access to clean cooking energy. Using primary and secondary data sources, the study team undertook extensive research on the status of clean cooking access in schools of low- and middle-income countries. It used the information gathered to develop a database on clean cooking initiatives and conduct interviews with organizations associated with them. Owing to the large concentration of initiatives in Sub-Saharan Africa—the world's most food insecure region with the highest access deficit—the study focused strongly on that region; however, experiences from other regions, where available, were also assessed and their findings are synthesized in the report. Most initiatives were implemented by international organizations in the context of school feeding programs. The majority were located in Kenya (21) and Uganda (11), with two each in Ghana and Malawi and the remainder in Chad, Ethiopia, Madagascar, Nigeria, Rwanda, Senegal, Sudan, Tanzania, and Zambia.

Estimated impact of inefficient cooking practices

The study estimated that schools in Sub-Saharan Africa consume 8 million tons of firewood per year, with resulting emissions of 12–14 million tons of carbon dioxide equivalent (tCO_2e). The study team undertook a back-of-the-envelope calculation to better understand the scale of impact from schools' lack of access to clean cooking solutions. School population estimates were based on country-level data from the 2021 Global Survey of School Meal Programs, which covered 38 countries in the region, accounting for meals provided to some 45.2 million pre-schoolers and elementary school children and about 3.7 million students in secondary schools. Assuming that half of the schools relied on traditional stoves and the other half on improved cookstoves (ICS), the total fuel consumption was estimated at 8 million tons of firewood annually. The resulting emissions from inefficient burning of this fuel was estimated at 12–14 million tCO_2e per year. When the emissions are monetized, the resulting cost of inefficient cooking practices totals US$575–668 million per year. For a school that consumes 360 tons of firewood per year, switching from a traditional, low-performing biomass stove (equivalent to Tier 0 or Tier 1) to a more efficient biomass stove with a thermal efficiency greater than 30 percent (Tier 3 and above) would result in emission reductions of 135–160 tCO_2e per year. If switching to liquefied petroleum gas (LPG) or biogas stoves, the emission reductions would be 140–180 tCO_2e per year.

Survey findings

Based mainly on large-scale surveys, the study found that most schools have been using biomass-fuelled ICS, with negligible use of alternative fuels. In 2018, 80 percent of Kenya's secondary schools and colleges and 60 percent of its primary schools reported

using ICS, which exceeded the rates reported by households. Similarly, in 2020, a majority of Rwanda's schools said they used some form of ICS, fuelled by either firewood (more than 50 percent) or charcoal (nearly 34 percent). That same year, a World Bank–supported institutional cooking study in Uganda found that schools had the highest prevalence of institutional firewood use, at 90 percent. These surveys also revealed a high prevalence of fuel and stove stacking. In Kenya, a fuel mix of firewood and charcoal was reported by 14 percent of primary schools and 11 percent of secondary schools. In Uganda, supplementary cooking fuels included charcoal, briquettes, and biogas.

Many schools were unaware of their cooking-energy consumption and fuel expenditures. Most past surveys overlooked critical metrics (e.g., number of students, number of meals served, average meal mass, and number of days the school operates per year) that would allow for making comparisons across institutions. Estimates of daily fuel consumption were often based on proxies; for example, the 2006 survey in Kenya found that less than half of the institutions surveyed could estimate the weight (in kilograms) of daily firewood consumption. Survey-reported costs of cooking fuel expenditures were often derived from highly uncertain fuel-consumption estimates. Also, the estimated fuelwood savings from adopting improved cooking solutions varied widely. Most initiatives lacked field performance data, making it difficult to estimate performance of the clean cooking technologies relative to the baseline.

Entry points for interventions

Stove replacement has been the entry point for most clean cooking initiatives; however, some programs have been unique in their motivation, technological solutions, and target groups. For example, an ICS evaluation supported by SNV Netherlands Development Organisation (SNV) in Kenya's Kakuma camp school found that many stoves targeted for replacement could be repaired, resulting in significant cost savings. In Ghana, the Voice for Change Partnership (V4CP) successfully advocated for high-level support of clean cooking in schools using strategic, evidence-based messages. A WFP-supported study conducted by Loughborough University in Rwanda's schools developed fuel-efficient menus using a combination of recipes, cooking behavior, and fuel-and-stove combinations. An Equity Bank initiative in Kenya helped schools retrofit their woodfuel infrastructure to accommodate liquefied petroleum gas (LPG) and offered loans to cover the up-front cost of fuel switching. In Madagascar, ADES (Association pour le Développement de l'Energie Solaire Suisse-Madagascar), a climate protection project, has long engaged in integrated cooking solutions (e.g., stove design and manufacture, kitchen building, and education and awareness raising). Still other projects have focused on building students' capacity in natural resource management and conservation.

Except for LPG, biogas, and electricity, which are already established in household settings, clean alternatives to traditional biomass cooking solutions are in the innovation, research, and development phases. Most fuel-replacement programs in schools have focused on briquettes, while cleaner forms of biomass cooking (e.g., pellets burned on

gasifier stoves) have been rare. Pioneering technologies—LPG-powered steam cooking, heat-retaining volcanic rocks, solar-thermal stoves, and electric stoves—have been adopted by only a handful of implementing organizations. One of these, Food4Education, discovered through its internal research that school meals could be made more affordable by switching from briquettes to gas-driven steamers. The organization financed the added cost of importing the cooking system through its program budget as part of infrastructure investments. In 2023, preliminary testing data from an advanced biomass developed by the German Agency for International Cooperation (GIZ) and ESMAP in Rwanda, shows ISO Tier 5 performance.

Key policy issues

Collectively, donors have played a vital role in financing cookstove programs in schools; however, their funding approaches have lacked structure and coordination. Many national school-feeding programs did not earmark funds for cookstoves; the few that did had no budget for associated technical support, repair, and maintenance, which are vital elements in well-designed projects. As a result, additional fund-raising was required. In the case of private-sector initiatives, many received only one-off donations with no long-term planning. The World Bank has contributed to financing institutional cooking initiatives through lending and non-lending support to national stove programs in Burundi, Ghana, Kenya, Rwanda, and Uganda. The GIZ and SNV have also played major roles in financing interventions and sector studies in East Africa.

Government-aided programs have fared worse than private-school initiatives owing to a lack of supportive policies and incentives. The study found that governments control public-school budgets, placing tight restrictions on expenditures and fund-raising. School inspections and annual licensing are missed opportunities for assessing the state of school kitchens and enforcing requirements for institutional stoves, as well as staff (i.e., skill in operating the stoves is required to sustain potential benefits). In the case of mature feeding programs that have transitioned to national government, no direct measures have been taken to promote clean cooking solutions, and the status of previously installed stoves remains unknown.

The market is highly fragmented, lacks specialization, and features a strong urban-rural divide. The WFP and other major implementing organizations have often assumed multiple, wide-ranging roles (e.g., stove prototype design, procurement, construction, and quality management; user training; and community awareness raising). Rural markets, where most school feeding programs are located, are underserved. Rural dissemination of stoves procured in urban areas, where the majority of stove suppliers are located, presents major challenges: Stoves are not adapted to local cooking needs, and repair and maintenance services are usually unavailable. Fuel suppliers, mainly located in rural areas, also target urban markets, reporting that low population densities in rural areas make it uneconomical to supply rural schools.

The sector has not established standards and guidelines for testing the quality of cookstoves, without which suppliers and consumers cannot gauge the quality of their products. Since contracts for centrally procured stoves rarely include a maintenance requirement, suppliers are not incentivized to engage in initiatives after dissemination—training for cooks is usually a one-off activity—or offer high-quality products, which, in turn, deter private investment.

Centralized and decentralized delivery models face the challenge of improving materials supply to build high-performance stoves, and will likely differ in their approaches to address it. Stove programs often prescribe that materials be locally available, which can be quite limiting in terms of stove durability and thus performance (e.g., thermal performance, which usually involves higher temperatures). As stove performance improves, the stress on components increases, and traditional materials fail. Contractors are forced to import the needed materials or order them from local merchants at an excessive price; and local producers, who are at a supply disadvantage, cannot compete. Addressing the issue may require the development of new private-sector supply chains.

Affordability is a major hurdle to acquiring cookstoves despite their demonstrated financial savings and short payback periods. It was reported that some schools fail to honor their financial commitment to stove suppliers. Schools are reluctant to borrow from commercial banks for various reasons; however, when suppliers attach a credit line to their products and services, schools readily utilize this type of financing. Having specific budget lines for schools to acquire cooking solutions and the government's guarantee of payment to suppliers through the relevant agency would incentivize schools to utilize existing credit facilities and assure suppliers that the schools will honor their payment obligations. Institutional stoves also require substantial working capital. Efforts that target market development (e.g., revolving loan funds through a facility) would make donor funds go further in supporting sector development. Having commercial enterprises as anchor customers could also generate cash flow for suppliers.

Local communities' minimal participation in school feeding programs calls for better policies and approaches to engage them. To date, it has been difficult to estimate parents' financial contributions to school meals since most countries do not cost in-kind contributions, and schools seldom cost their fuel expenditures. This situation is expected to improve as more countries develop national school-feeding guidelines; however, parents' time and opportunity cost from fuelwood collection for school-meal preparation remains unknown. Programs—particularly those with free stove distribution—have rarely engaged local communities in the planning process. Also, school cooks have seldom been consulted on stove designs or received more than cursory user training. Even with appropriate training, the high staff turnover contributes to skill loss, helping to explain the eventual discontinued use of stoves. Improving the retention of skills requires long-term access to in-service training and/or certification of stove operators.

During the procurement process, school cooks are seldom consulted on the design of stove products, which often do not fit the local cooking context. Several reports indicate that the stoves are not suited to local cooking needs. One consistently reported

problem is the small size of the stove inlet and firebox; since they cannot accommodate large pieces of wood, cooks are required to break the wood down into smaller pieces, adding to their time burden. In addition, fixed-installation technology designs are inappropriate for school kitchens that are often temporary and need to be expanded to accommodate growing student populations.

Opportunities to tackle the challenge

Raising stakeholder awareness

It was widely reported that schools are unaware of the innovative cooking solutions available on the market. In Uganda, for example, the main communication channels for stove manufacturers and distributors are word-of-mouth and self-marketing, explaining the low demand for clean cooking solutions among both public and private school-feeding programs. In Kenya, Food4Education had to conduct its own market research to discover which cooking solution would best fit its needs. In most schools, cooks are not educated on the long-term health risks associated with inhaling smoke emitted by open fires or the benefits that would result from making changes in their cooking behavior. Many school owners or administrators lack knowledge about the fuel savings that would result from adopting clean cooking solutions. Beyond schools, stakeholders across many diverse sectors (e.g., energy, education, nutrition, agriculture, environment, and conservation) need to acknowledge the problem.

Generating reliable sector statistics

Major data gaps have made it difficult to estimate the scale of the problem so that appropriate interventions can be developed. Official statistics on the rate of clean cooking access in schools are lacking in most countries. Those that are available often fail to differentiate sector segments (e.g., schools and other institutions or households and institutions). Most school-feeding initiatives do not use key metrics to collect fuel-consumption data. Without a baseline for comparison, they cannot estimate how much savings would result from switching to cleaner fuels or reliably assess the impact of clean cooking interventions, curtailing future investments in the sector.

Promoting cross-sector collaboration

Creating an enabling environment for the sector requires cross-sector coordination and learning. Kenya and Malawi are unique in having created national committees on institutional clean cooking, which are poised to promote collaboration between energy and

education stakeholders, bridge institutional capacity gaps, and create space for greater private-sector participation. Multiple education-related actors and resources can be tapped to make clean cooking in schools a part of the quality-education agenda. Major players in the household cooking space increasingly recognize the need to expand their focus to institutional settings to avoid missed opportunities for cross-sector learning (e.g., in technology development, stove-testing protocols and standards, stove maintenance, data collection, advocacy and awareness raising, and financing). The World Bank's energy-access projects have started to embed institutional cooking sub-activities within household clean-cooking components, and e-Cooking studies and pilot programs in schools are under way.

Recommended actions

Key actions for overcoming the region's lagging progress in scaling up clean cooking access in schools are summarized as follows:

- ***Step up governments' role in addressing the challenge.*** Governments can take key actions to advance sector policies and legal frameworks. These include regulating processed biomass fuels, developing a training curriculum for stove technicians, coordinating sector stakeholders to advocate for policy change, ensuring transparent procurement systems and procedures, providing up-front financing for stoves, and creating space for private-sector providers. Governments also have a key role to play in generating reliable sector statistics, which are needed to strengthen the business case for investment and action. To create a more enabling environment, they can offer tax rebates on institutional stoves, ensure a level playing field for suppliers, set standards, and regulate the price of fuels and informal firewood markets. National policies should include guidelines for school feeding programs that account for cooking energy needs and incorporate clean cooking requirements. As technical advisor to governments, the WFP is well positioned to spearhead this action.
- ***Leverage lessons from the household cooking sector's decades of experience.*** Stoves should be designed to fit the local cooking context and respond to users' needs and preferences. Mandatory performance and user testing would ensure that cooking initiatives in schools are achieving their goals. Performance testing can reveal design flaws that lead to improvements and avoid having stoves fall into disrepair and disuse. Testing also allows for user feedback, which can be incorporated into the stove designs to increase uptake. Given that institutional stoves are a major investment, a maintenance-and-repair component should be integrated into all programs. In-service training for stove operators is critical, without which results will vary according to the operator's skill. In addition, ready access to technicians and parts can ensure well-functioning stoves, resulting in significant fuel and time savings.

  Clean cooking interventions also require a sustainable financing model. The sector is capital intensive, meaning that the financial burden cannot be borne by the private sector alone. Financing is needed across the entire value chain—from design innovation

and awareness raising to marketing and after-sales support. Risk financing, which allows stove manufacturers and distributors to accept installment payments, is urgently needed. Efforts that target market development (e.g., revolving loan funds through a facility) would make donor funds go further in supporting sector development.

- ***Address schools' unique challenges and harness their institutional advantages.*** Accurate costing of fuels is needed to provide evidence of the true cost of inefficient cooking, based on which governments and other stakeholders can better estimate the returns from investing in this market segment; reliable data, in turn, can incentivize the promotion and uptake of cleaner cooking solutions. Schools should consider integrating stoves into their infrastructure projects to (1) avoid having to make a separate case for purchasing stoves, (2) cover stoves in school inspection reports, and (3) avoid shortening the useful life of stoves in cases where makeshift kitchens are later demolished. Parents and teachers associations are well poised to champion clean cooking solutions, including fund-raising and expenditure accountability, while the schools' highly organized administrative and governance system can provide a unified voice for policy reform.

Moving forward

Raising sector visibility and filling basic data gaps are urgently needed to leverage promising trends, tools, and opportunities for moving forward. Increasing access to grid and off-grid electricity could pave the way for e-Cooking in schools; uptake of emerging technologies (e.g., solar-powered steam cookers) could be accelerated; and new business models (e.g., pay-as-you-go [PAYG]) could enhance the affordability of clean cooking solutions. Multi-Tier Framework [MTF] surveys could better inform practitioners, and results-based financing [RBF]) tools could be used to de-risk the sector for private investment. National governments' growing commitment to school feeding programs has opened an opportunity to raise the sector's visibility by prioritizing clean cooking across sectors. Getting on course for long-term progress also requires basic data and statistics to unlock climate finance and other investment streams to spur market growth and innovations in technologies and delivery models; create jobs along the value chain; and produce societal co-benefits.

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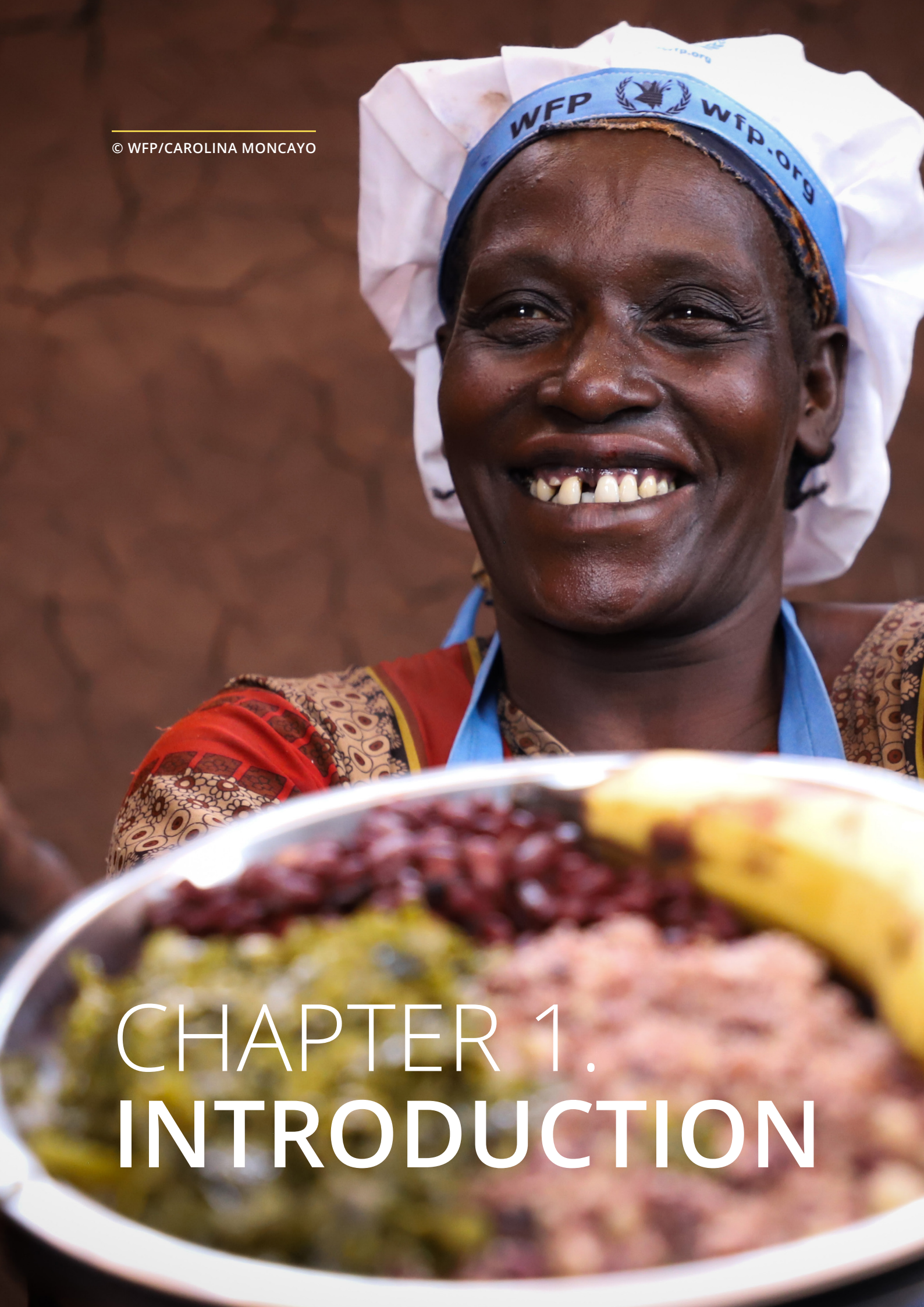

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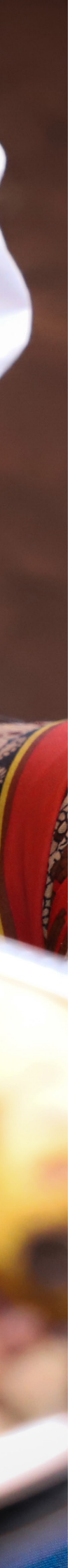
CHAPTER 1. INTRODUCTION



Overview

Schools in most developing countries provide students one or more meals each day. Currently, one in every two schoolchildren—some 418 million children worldwide—receives a school meal (WFP 2022). In Africa, at least 65.4 million children are covered by school feeding programs (AU 2021). Many government programs that prioritize school feeding at the national level are poised to expand in the coming years. For example, the World Food Programme (WFP)—the largest humanitarian agency providing food assistance in emergencies or through school feeding programs—has a target of reaching 73 million vulnerable children in 60 priority countries over the next decade.[1] In countries where large household populations rely on biomass cooking using rudimentary stoves, the cooking needs of schools, like those of other institutions that cook large quantities of food (e.g., restaurants, hospitals, and correctional facilities), are met primarily using biomass fuels and traditional cookstoves, which have adverse health, educational, and financial consequences. To date, however, most documentation on the costs of not having access to clean cooking solutions has been limited to the household sector. Limited data on the scale of the problem at the institutional level has meant that few interventions have been designed to meet the clean cooking needs of schools—the second largest consumer of biomass energy after households—and other large public facilities.

What are the costs of inaction?

Years of research in the household cooking sector have underscored the significant development challenge of not having access to clean cooking. Globally, 2.3 billion people do not have access to clean cooking fuels and technologies (IEA et al. 2023). The estimated cost of inaction in terms of public health, climate and environment, and gender is staggering, at US$2.4 trillion annually (ESMAP 2020). Women and girls, who shoulder most of the household responsibility for fuelwood collection and cooking in developing countries, bear a disproportionate share of the associated health and economic burden. Young children, who stay close to their mothers and older sisters in the cooking environment, are the group most affected by smoke exposure. The high burden of disease among women from household air pollution (HAP) results from long hours of smoke exposure. Fuelwood collection and cooking tasks contribute to women's time poverty, diverting them from more productive economic, educational, and social activities that would contribute to their empowerment.

It remains unknown whether women in schools and other occupational settings also suffer disproportionately from the adverse impacts of cooking with inefficient biomass fuels and stove technologies. Clearly, the additional smoke exposure in institutional settings would

[1] Through its Energising School Feeding initiative, the WFP will address sustainable energy use, providing schools access to clean and improved, market-based stove technologies and fuels.

likely exacerbate the health impacts. A recent study by the CLEAN-Air (Africa) Global Health Research Group (2022) found that pollution levels in schools exceeded World Health Organization (WHO) guidelines for air quality. Catering staff (mainly women) experienced health issues, suggesting that female school cooks have a double burden of household and occupational exposure to cooking smoke.[2] Also, during cooking periods, smoke-filled classrooms disrupted teaching environments.

Fuelwood sourcing for schools is mainly from purchases and contributions from parents and students. The time burden and associated physical and safety risks of fuelwood collection for parents and students are unexplored topics. That school feeding programs often prioritize vulnerable communities, sometimes in fragile and conflict-affected situations (FCS), should ignite debate about the safety and security impacts of not having access to clean cooking. According to the WFP, 38 percent of the children supported by school feeding programs are located in countries affected by conflict or crises (World Bank 2023). The risk of violence against women when they leave the safety of camps to perform such chores as fuelwood and water collection has been extensively documented by humanitarian agencies.[3] Thus, without access to clean cooking, the gains realized from school feeding programs—the most widespread social safety net globally with significant development outcomes, especially for girls (World Bank 2018)—could be undermined.

Shifting the burden of fuelwood collection from parents and students to contracted suppliers can exacerbate pressure on the local environment. It has been widely reported that wood from outside suppliers, unlike wood harvested for household consumption, consists of a higher fraction of non-renewable biomass (fNRB) (i.e., unsustainably harvested firewood and charcoal). In response to this environmental concern, some governments have tried to restrict biomass cooking in schools, although they have not advanced beyond policy statements. For example, Kenya drafted a regulation in 2013 banning traditional biomass cooking for more than 10 people; to date, however, this policy has remained in draft. In 2023, the Government of Kenya stated that all schools should transition to clean cooking by 2025. In 2019, Rwanda made a similar recommendation based on findings from its institutional cooking survey, which showed that schools were the highest institutional consumers of biomass (CESS 2020).

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[2] In various interviews with practitioners, the study team was informed that many school cooks quit their jobs after a few years due to respiratory illness; this anecdotal evidence was consistent across multiple settings.

[3] According to the Germany Agency for International Cooperation (GIZ) and International Medical Corps, 2–3 out of the 10–11 cases of gender-based violence (GBV) reported each month in Uganda's Karamoja settlement occur during fuelwood and water collection.

Leveraging energy-sector trends and innovation

Today, the institutional cooking sector has an opportunity to leverage promising energy-sector trends and experience. Greater access to grid and off-grid electricity is paving the way for e-Cooking in schools. Pay-as-you-go (PAYG) and other new business models are increasing household affordability of clean cooking solutions. In addition, solar-powered steam cookers and other technologies have emerged as a good fit for institutional cooking. Furthermore, better data collection methods, including Multi-Tier Framework (MTF) surveys, which capture multidimensional information on users' cooking behavior and practices, allow for improved standardization of data across settings to inform practitioners. Increasingly, results-based financing (RBF) instruments are being utilized by high-profile programs (e.g., the World Bank's US$500 million Clean Cooking Fund) to de-risk the clean cooking sector to attract private-sector investment. Finally, national governments' growing commitment to school feeding programs has opened a unique opportunity to integrate clean cooking into the priority-setting objectives of education, gender, health, and social protection sectors.[4] Effectively utilizing these cross-sector opportunities, however, requires a detailed understanding of the current state and patterns of energy use in schools.

Study objective, methods, and scope

This exploratory study contributes to filling this knowledge gap by synthesizing the available information on energy use in schools with a focus on regions with the highest access deficit,[5] where urgent action is required.[6] The latest SDG 7 tracking report (IEA et al. 2023) finds that 19 of the 20 countries with the lowest share of population with access to clean cooking fuels and technologies are least-developed countries in Africa.[7] Also, Sub-Saharan Africa is the world's most food-insecure region, where school-feeding interventions outperform virtually all others in boosting learning outcomes (Thome et al. 2019; WFP 2022).[8] While the study was designed with a focus on low- and middle-income countries (LMIC), the evidence, by default, is concentrated in Sub-Saharan Africa due to the concentration of interventions in the region in response to the significant access deficit. Experiences from other regions, where available, were also assessed and their findings are synthesized in the

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4 An assessment of World Bank financing for school feeding projects through the education and social protection sectors found that only 3 out of 21 financed projects provided financing for kitchen infrastructure, just 1 of which specifically financed stoves.

5 The top 20 countries with the largest populations lacking access to clean cooking fuels and technologies account for more than 80 percent of the global population without access. Most of these countries are in Sub-Saharan Africa.

6 School feeding programs in developed country contexts are not included as the report focuses on energy access, consistent with the SDG 7 target.

7 The remaining one is located in Haiti.

8 This study does not distinguish between public and private schools as the available data is not disaggregated by these institutional categories.

report. In addition to assessing the stove technologies and fuels used to prepare school meals, the study examines current clean-energy transition initiatives in schools; analyzes key challenges and opportunities to accelerate access to clean cooking; and offers government policy makers, development organizations, and practitioners in the sector—the report's key audiences—global best-case examples and recommendations to better inform their decision-making and guide sector development.

Database development

Through an extensive literature review, internet searches, and interviews with sector practitioners, the study team identified cooking initiatives in schools across developing regions (Latin America and the Caribbean, Sub-Saharan Africa, and South and Southeast Asia). This information was used to develop a database, whereby each initiative was uniquely identified and treated as a unit of analysis. For each initiative, the team collected detailed information, interviewed contact persons representing the responsible organizations, and requested available information and documents from which key data was extracted (e.g., program start-and-end dates, geographical location, target groups, implementation approaches, and fuels and technologies used) (Appendix A). This data was synthesized to generate the insights presented in this report.

Identification of initiatives

The study team identified 45 clean cooking initiatives in schools and conducted interviews with organizations associated with 29 of them.[9] By default, a majority of the initiatives identified were located in Sub-Saharan Africa.[10] Most were implemented by international organizations in the context of school feeding programs. The WFP was often the lead implementing agency in collaboration with education ministries in the respective countries. Other lead implementing agencies identified with more than one program each were the German Agency for International Cooperation (GIZ), International Lifeline Fund (ILF), SNV Netherlands Development Organisation (SNV), and the United Nations Development Program (UNDP). Only 10 initiatives were led by local organizations; these were private sector–led and focused mainly on fuel supply. Five such initiatives identified in Kenya focused on supplying briquettes to a large number of schools and other institutions.

The clean cooking initiatives were generally aligned with the respective missions of the implementing agencies. Energy access was usually recognized as a secondary mission

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[9] Initially, 43 clean cooking initiatives were identified through internet searches. Snowballing from these led to the identification of 16 additional ones, bringing the total to 59. However, only 45 of these could be verified through contact with the organizations responsible for their design or implementation. Of the 45 initiatives identified, 16 did not respond to interview requests. The study team conducted interviews with organizations associated with the remaining 29 initiatives (Appendix B, table B.1).

[10] Due to limited publicly available data, ESMAP and WFP databases were used to support the identification of initiatives; that most of their operations are concentrated in Africa helps to explain underrepresentation of initiatives outside of Sub-Saharan Africa.

important to achieving the primary one. For example, the WFP's Energising School Feeding initiative recognizes that achieving zero hunger means that "every person should be able to cook and consume their food safely and without creating further risks to their food security and nutrition." The initiatives of wildlife conservation agencies had the primary goal of preventing habitat destruction from fuelwood harvesting. Such initiatives were generally ad hoc and small in scale (e.g., one stove donation to a school), with funding provided by philanthropic organizations as opposed to having earmarked program budgets. In contrast, such organizations as the GIZ, which had a defined energy-access mission, featured a more sustainable approach with a long-term perspective.

Many of the identified initiatives, including those led by the private sector, adopted sustainability branding; for example, Acacia Innovations' briquettes solution won the 2020 Sustainable Energy for All (SEforALL) Energy Access Booster Award. In several cases, projects were designed with a carbon component. Since none had progressed to the funding stage, they were not included in this study. Even so, it is worth noting that their designs were robust with detailed preparatory activities, including stove testing to authenticate performance of the proposed solutions and extensive plans for results monitoring and verification. They also tended to target a large number of schools (up to 2,000).

A majority of the initiatives were concentrated in two countries of East Africa: Kenya (21) and Uganda (11). Thus, the study findings on institutional cooking solutions could most easily be extrapolated for these two country settings. Ghana and Malawi had two initiatives each, with the remainder in Chad, Ethiopia, Madagascar, Nigeria, Rwanda, Senegal, Sudan, Tanzania, and Zambia.[11] Schools where the initiatives were implemented were located in both rural and urban areas. The study limitations, discussed in chapter 6, help to explain country representation in the database.

Structure of this report

This report is organized into six chapters. Chapter 2 characterizes the current state of cooking energy access in schools, with a focus on Sub-Saharan Africa. Chapter 3 identifies global best-practice interventions and their reported benefits, while chapter 4 compares the delivery approaches of various school feeding initiatives. Chapter 5 identifies challenges and opportunities that emerged from a synthesis of the study's findings.[12] Finally, chapter 6 recommends actions for moving the sector forward.

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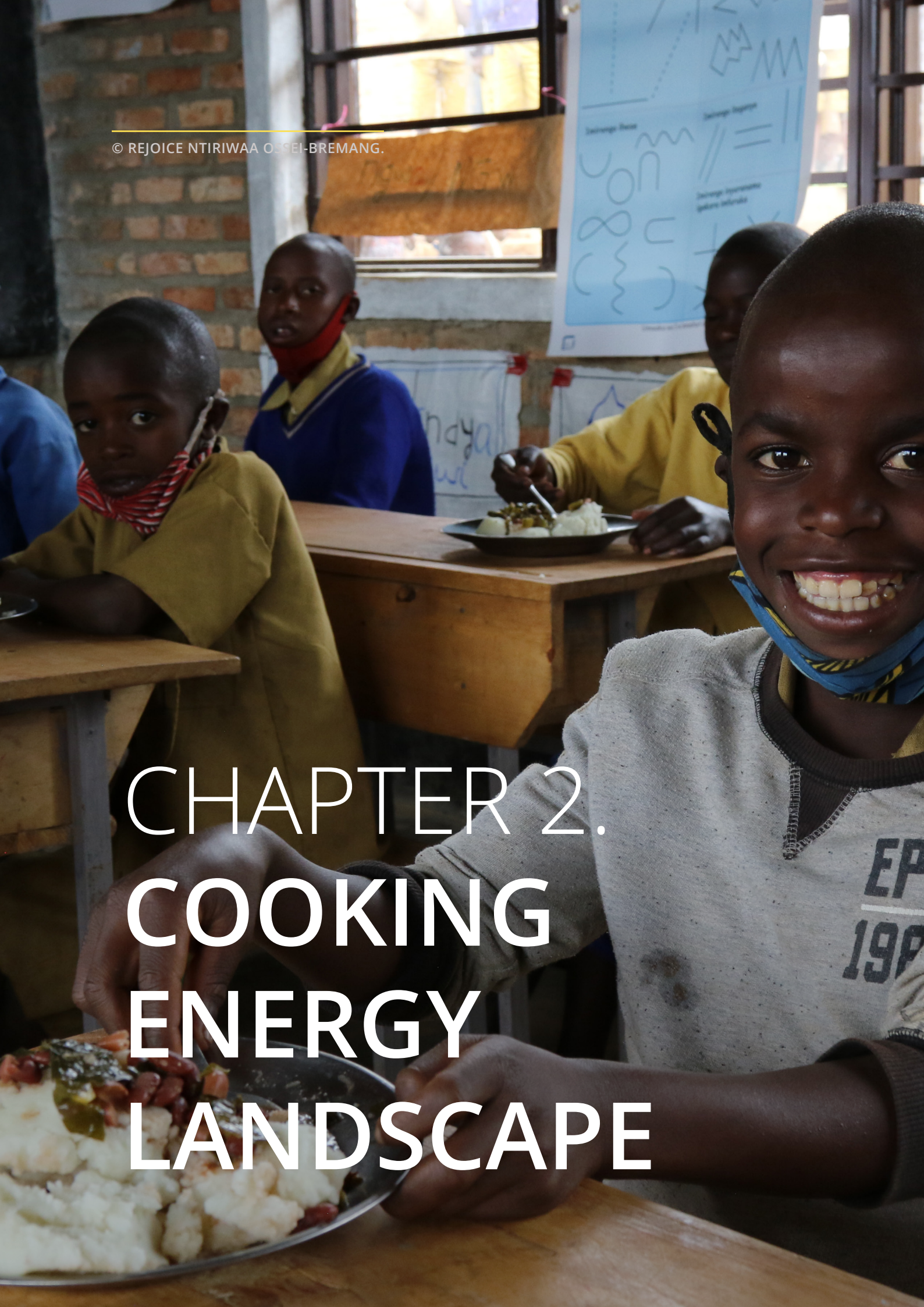
[11] The study identified additional WFP-supported efforts focused on increasing the efficiency of institutional cooking in Guinea, Lesotho, Mauritania, and São Tomé and Príncipe. Since these initiatives were still in the early planning and exploration stages, they were not analyzed further.

[12] Generalizability of the findings may be limited to Sub-Saharan Africa since most of the initiatives analyzed were drawn from that region.



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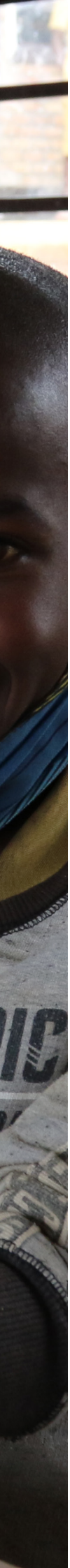
CHAPTER 2. COOKING ENERGY LANDSCAPE



Introduction

Cooking solutions in schools across Sub-Saharan Africa are of various types, ranging from rudimentary three-stone fires to those defined as "clean," according to voluntary performance targets of the International Organization for Standardization (ISO 19867-1:2018). This chapter begins by exploring the demand-side features of institutional cooking in the region's schools, based mainly on large-scale national surveys. It then turns to estimating the scale of impact from schools' lack of access to clean cooking solutions.

Stove technologies and fuels

More than half of the institutions surveyed reported using improved cookstoves (ICS) (Appendix C, table C.1).[13] Institutions had a higher rate of ICS penetration when compared to households (IEA et al. 2022).[14] The first nationwide institutional survey in Kenya reported a 50 percent penetration rate for ICS (GIZ 2006). This figure increased substantially over the next decade, with a follow-up survey showing ICS usage among more than 80 percent of secondary schools and colleges (CCAK and SNV 2018). The penetration rate in primary schools was more modest, at 60 percent, but still exceeded the rates reported for households. Similarly, Rwanda's first National Survey on Cooking Fuel Energy and Technologies found that a majority of schools used some form of ICS. The most common models were the Muvero for firewood (used by more than 50 percent of schools) and the Rondereza for charcoal (used by 33.8 percent of schools). Just 5.2 percent used traditional three-stone fires (CESS 2020). In a World Bank–supported survey in Uganda, more than 60 percent of surveyed institutions reported using improved firewood stoves, while 23.3 percent said they used improved charcoal stoves (PSFU 2020).[15]

For most schools, biomass is the dominant source of cooking energy, with negligible use of alternative fuels. The institutional surveys in Kenya, Rwanda, and Uganda identified firewood as the most commonly used source of cooking energy (Appendix D, table D.1). The two surveys in Kenya found that, among all of the institutions covered, firewood was the dominant cooking fuel. A small number of institutions said they relied on charcoal as their primary (3.4 percent) or secondary (11.0 percent) cooking fuel; while none reported the use of electricity, kerosene, or liquefied petroleum gas (LPG) (CCAK and SNV 2018; GIZ 2006). Rwanda's survey, which covered both households and institutions, also revealed that firewood was the dominant cooking energy consumed among all institutions. Use of alternative fuels (e.g., briquettes, pellets, LPG, and electricity) was negligible (CESS 2020) (Appendix C, table C.2). Similarly, the institutional cooking study in Uganda reported

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13 In countries with available data.

14 This finding is not surprising since households' access rate, reported as 17 percent, comprises both ICS and clean cooking solutions (e.g., LPG and electricity).

15 Despite these gains, use of traditional and open-fire stoves is still rampant in schools; in Kenya, for example, up to 40 percent of primary schools still rely on this rudimentary cooking technology.

firewood as the main fuel source (66.7 percent), followed by charcoal (45.5 percent), electricity (22.7 percent), and LPG (21.2 percent). Compared to other institutions, schools had a higher prevalence of firewood use, with 90 percent reporting it as their primary fuel (PSFU 2020). In Mauritania, a WFP energy-needs assessment covering 13 schools that benefit from the WFP's school feeding program in the Assaba, Brakna, and Guidimakha regions found that all of them rely on traditional open-fire cooking using firewood. This was despite spotting improved stoves, charcoal, and cooking gas used in the surrounding households. In Lesotho, 58.8 percent of school kitchens use biomass on inefficient traditional stoves.

Prevalence of stacking

Like households, schools and other large institutions in various countries have been observed to practice fuel and stove stacking. In Kenya, GIZ (2006) found that, in a few cases, firewood was used in combination with charcoal or gas, neither of which was used as the primary cooking fuel. CCAK and SNV (2018) found that no educational institutions in Kenya were using LPG as their primary cooking fuel; rather, it was being used as a complementary fuel, but only among high-end private colleges. For other schools, charcoal, biogas, and briquettes were the main complementary fuels. A fuel mix comprising firewood and charcoal was reported by 14 percent of primary schools and 11 percent of secondary schools. In Niger, which also reported stacking, millet stubble was used for cooking when firewood was not available. Similarly, in Uganda, fuel stacking was a common occurrence, with schools using charcoal, briquettes, or biogas as supplementary fuels.[16] In Mauritania, a survey of 13 schools found that 12 used firewood exclusively, while the remaining one used LPG as a secondary fuel.

Sourcing of cooking fuels

Schools mainly procure cooking fuels through purchases from vendors and contracted suppliers, as well as contributions from parent and students. In public-school programs, fuelwood is counted among parents' in-kind contributions. A country review of school feeding programs by the African Union lists food preparation and provision of wood for cooking as areas of community involvement in school feeding (AU, WFP, and EPRI 2018). In rural areas where fuelwood availability is more abundant, parents and students are often responsible for procuring cooking fuel and bringing it to the school; this was the case for most WFP-supported school feeding programs (e.g., in Burundi). By contrast, in concentrated urban areas of Uganda, surveyed schools reported that firewood was purchased in local markets, with school fees collected each semester for its acquisition (PSFU 2020).[17] In

[16] Secondary fuels were used to prepare meals for teachers, among other purposes.

[17] Not included in available national surveys or this study sample were schools that have developed their own wood plantations to meet their cooking energy needs; such initiatives, which include biogas production for serving secondary cooking needs, have been variously reported (Sanyal and Kahinga 2018).

the schools surveyed in Mauritania, 70 percent directly collected firewood, 30 percent only purchased it, and 20 percent did both. Forty percent of schools reported that fuel was collected by parents; 30 percent reported it was collected by children; and 30 percent by cooks. The study found that fuel collection could take up to six hours per day in locations farther from the source of firewood (WFP 2022).

Fuel consumption

In most schools, the rate of cooking energy consumption is unknown. Past surveys have omitted key metrics (e.g., number of students, number of meals served, and number of days per year that schools operate), which would allow for making comparisons across institutions. Also, standardized methods for estimating fuel consumption are lacking. In Kenya, the GIZ (2006) found that less than half of the institutions surveyed could approximate the weight (in kilograms) of daily firewood consumption. Instead, their estimates were based on proxies (e.g., number of wheelbarrows, lorries, and pickup trucks). As a result, the daily firewood-consumption estimates derived from this data were characterized by high uncertainty (3–2,000 kg with an institutional average of 217 kg), making it difficult to compare fuel consumption across the surveyed institutions. Consumption data was not disaggregated by type of institution, adding further uncertainty to the estimates provided. The subsequent institutional survey conducted by CCAK and SNV (2018), which provided specific data on schools and included number of students in the analysis, estimated annual fuel consumption per capita for primary and secondary schools using traditional stoves (TS) at 193.4 kg and 250.6 kg, respectively; the corresponding figures for institutions using ICS were 130.2 kg and 178.8 kg. This data was extrapolated to derive country-level estimates of per capita fuel consumption by schools, as follows: 1.31 million MT of woodfuel, including 46,200 MT of firewood and 55,000 MT of charcoal. The projections were based on 2,705 primary schools and 2,724 secondary schools operating 270 days per year (Appendix D, table D.1).

The Rwanda study estimated annual consumption of biomass and non-biomass fuels across the institutions surveyed (CESS 2020). For firewood and charcoal, the respective estimates were 65,701 MT and 15,786 MT. Among non-biomass fuels, the estimates were 50,964 m^3 for biogas, 18,996 kg for LPG, and 31,360 kWh for electricity. Boarding schools had an annual consumption of 48,127,736 kg for firewood, 107,630 kg for briquettes, and 8,640 kg for pellets. Charcoal consumption by schools was negligible, at 58 kg per year. A comparison of energy use across all institutions revealed that boarding schools had the highest annual consumption at 45.2 percent, followed by restaurants at 31.9 percent and other institutions (police and military, correctional facilities, and hotels) at 22.6 percent (Appendix D, table D.1).

In Lesotho, an independent evaluation of the WFP school feeding program conservatively estimated that an average demand of one tree per month is needed to cook for 300

children. This is equivalent to more than 10,000 trees felled nationally each year for the purpose of cooking school meals.

In the Uganda study, estimates of fuelwood consumption were based on proxies. Educational institutions were reported to buy wood in trucks (Canter or Elf with rails). One fully loaded truck with rails was estimated to carry 2.5 MT (2,540 kg) of wood. Based on this proxy, annual fuelwood-consumption estimates for institutions with ICS and TS were 22.5 MT and 37.5 MT, respectively (PSFU 2020) (Appendix D, table D.1).

Fuel expenditure and maintenance cost

Few surveys have reported on schools' cooking fuel expenditures, possibly because the schools themselves often do not keep track of them. Survey-reported costs are often derived from fuel consumption estimates characterized by high uncertainty, as mentioned above.

The study in Uganda (PSFU 2020) estimated the annual cooking-fuel expenditure at US$1,170.50 (UGX 4.5 million) for institutions with ICS and US$1,950.80 (UGX 7.5 million) for those with traditional stoves. The initial cost of installing a typical institutional cookstove was in a range of US$780–1,171 (UGX 3–4.5 million).

In the most recent Kenya survey (CCAK and SNV 2018), the respective estimates of the annual institutional per capita cost of firewood and charcoal were US$15 and US$34 on average. At the time of the survey, the market price for both firewood and charcoal was below US$0.5 per kg.

In addition to the cost of stove acquisition, stove maintenance is an important cost factor for institutions. CCAK and SNV (2018) reported that US$250 in annual maintenance was required for the Bellerive stove, a common institutional model; however, cost varied significantly by stove quality at manufacture and usage. Good-quality, properly used stoves installed by skilled technicians were observed to function for up to two years without requiring maintenance. The Rocket stove had a maintenance cost of US$209 after expiration of the five-year warranty period. Charcoal stoves had a considerably lower maintenance requirement (US$8–17), consisting mainly of replacing the fire grate.

BOX 2.1 LESSON FROM MAURITANIA ON THE NEED FOR FOLLOW-UP SUPPORT

The school feeding program implemented in Mauritania consists of two daily meals, both of which require boiling the food products involved. Generally, cooking fuel is not provided by the program's implementing entity. Instead, the school and surrounding community must organize themselves to ensure that enough fuel is available to operate the program and cook school meals. All schools rely on firewood as their only cooking fuel, except for one (Baghdade), which uses liquefied petroleum gas (LPG) as a secondary fuel. This is the result of a Counterpart International–led initiative to introduce LPG for cooking in the schools it supports. Under the initiative, one full LPG cylinder and an LPG stove are supplied to each school, which, from then on, is responsible for recharging the fuel using its own means. According to school staff in Baghdade, one 12 kg recharge lasts approximately 5–6 days per month. The school limits its use to the least windy days or when firewood is unavailable. However, the school has not recharged the bottle since the first full one was delivered. No fuel provision or distribution activities have been implemented under the program support provided by the World Food Programme (WPF) and the Government of Mauritania. In two schools (Hsey Tine and Tevaradite), the government provided empty 12 kg cylinders and stoves; however the one provided to Tevaradite was not well adapted, and the school has neither charged the bottle nor used the stove.

Source: WFP.

In Mauritania, it was reported that quantities of purchased fuel in carts had a price range of MRU 250–500 per cart, depending on the collection distance. Data from one school (150 students) that used LPG showed that a 12 kg bottle could last five days, at a price of MRU 350, which is equivalent to MRU 1,400 for four school weeks. This figure is within the range of the firewood expenses for 20 days of cooking in Ehsey Sidi (306 students) and 21 days in Hsey Tine (130 students) schools, which spend an average of MRU 2,400 and MRU 1,350, respectively (box 2.1). The results show that the cost of LPG usage is comparable to that of wood for cooking.

Estimated impacts

Various anecdotal reports suggest the large-scale environmental impacts that can result from supplying large amounts of biomass for preparing school meals. According to Equity Foundation studies, one school was found to cut 300 trees per month for school meals, despite having ICS. The implication of such findings is that interventions designed to increase fuel-use efficiency in schools would offer substantial co-benefits for society.

Using the limited data available, the study team estimated substantial climate and financial impacts from schools' heavy reliance on rudimentary biomass stoves (box 2.2). Increasing the adoption of improved cooking methods—even moving from a cooking poverty baseline (Tier 0 or Tier 1) to a transitional status (Tier 2 or Tier 3)—would offer significant benefits. That said, significant data gaps suggest uncertainties in the estimates, which call for better data that would allow for accurately estimating the scale of the problem and incentivize development of clean cooking solutions that fit the needs of schools.

BOX 2.2 UNDERSTANDING THE SCALE AND IMPACT OF TRADITIONAL BIOMASS COOKING

The study team undertook a back-of-the-envelope calculation to better understand the scale of impact from schools' lack of access to clean cooking solutions. School population estimates are based on country-level data from the 2021 Global Survey of School Meal Programs. That survey covered 38 countries in Sub-Saharan Africa, accounting for meals provided to some 45.2 million children in pre-school and elementary school and about 3.7 million secondary-school students. Assuming half of the schools rely on traditional stoves (TS) and the other half on improved cookstoves (ICS), total fuel consumption for the region is estimated at about 8 million tons of firewood per year. The resulting emissions from inefficient burning of this fuel is estimated at 12–14 million tons of carbon dioxide equivalent (tCO_2e) per year. When the emissions are monetized, the resulting cost of using inefficient cooking practices totals US$575–668 million per year. For schools consuming 360 tons of firewood annually, switching from a traditional, low-performing biomass stove (equivalent to Tier 0 or Tier 1) to a more efficient, improved stove (more than 30 percent efficiency) would result in emission reductions in a range of 135–160 tCO_2e per school per year. For schools that switch to liquefied petroleum gas (LPG) or biogas stoves, the emission reductions are even higher, at 140–180 tCO_2e per school per year.

Source: Authors' calculations.

Fuelwood savings was a consistently reported outcome of interventions that sought to displace the use of fuelwood (by adopting alternative fuels) or improve its efficiency (through improved biomass cooking solutions). However, estimates of fuelwood savings varied widely. An independent evaluation of an institutional Rocket stove promoted by the GIZ in Kenya reported fuel savings of 33 percent (Adkins et al. 2010). In Malawi, promoters of the same stove design reported 80 percent fuel savings.[18] Performance testing of nine institutional stoves, conducted as part of the Green Schools Nationally Appropriate Mitigation Action (NAMA) proposal, found average fuelwood savings of 41.4 percent (24 percent minimum and 61 percent maximum). In the absence of field performance data for most initiatives, it is difficult to ascertain the performance of the technologies relative to TS. The study team's estimate of 50 percent fuel-use reduction takes this uncertainty into account.

[18] Interview with GIZ staff in Malawi.

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CHAPTER 3. CLEAN COOKING INITIATIVES

Introduction

This chapter focuses on the characteristics of clean cooking initiatives in schools, including their design, implementation approach, technologies and fuels, and modes of financing. The study team did not attempt to draw comparisons across programs, given their high heterogeneity. Those featured as case-study examples were selected for their uniqueness (e.g., motivation, technology type, and target group), global best practices, and amount of available information that could be verified.[19]

Entry points for addressing the challenge

Most of clean cooking initiatives reviewed targeted stove replacement as opposed to displacement of the existing biomass fuel. A subset of initiatives aimed at improving the condition of existing stoves instead of replacement, given the high up-front investment cost (case study 1). In a few cases, initiatives without a stove replacement component focused on building public awareness (case study 2) and knowledge generation (case study 3).

CASE STUDY 1. REPAIRS BRING NEW LIFE TO STOVES IN KENYA'S REFUGEE CAMP SCHOOLS

Kenya's Kakuma refugee camp—one of the world's largest—has a growing community of more than 180,000. Thanks to support from various donors, nearly all of its schools have improved cookstoves (ICS); however, many are in a dilapidated state. In 2018, the schools approached SNV Netherlands Development Organisation (SNV) via the Lutheran World Foundation for support. To gain a better understanding of the stoves' condition before intervening, SNV hired a consultant to assess the kitchens and stoves in all of Kakuma's institutions, including those in nearby settlements and host communities. The consultant's report detailed the condition of each stove and offered recommendations on which could be repaired (including types and costs) or needed replacement. Common damages were chimneys clogged with soot, broken grills, and poor inner bodies. Based on results of the consultant's report, SNV repaired 24 stoves in 12 schools. To ascertain the value added, it performed controlled cooking tests in a sample of 6 schools and 1 protection center. The results showed energy and time savings, as well as positive user feedback.

Source: Interview with SNV staff.
Note: The schools were also in need of larger-capacity stoves and expansion of some kitchens to meet the needs of their growing student populations. The plan to perform stove repairs and replacements in all schools has not been possible as funds were diverted to other priorities due to the COVID-19 pandemic.

[19] It should not be construed that the programs highlighted as case studies have more significance than others.

CASE STUDY 2. ADVOCACY FOR CLEAN COOKING SOLUTIONS IN GHANA'S SCHOOLS

When entering a school kitchen in Ghana, one is likely to find caterers—mostly female—cooking over an open fire. They complain of the smoke and believe it has a harmful effect on their life. One caterer was cited as saying "the smoke makes me cry every day because it enters my eyes while fanning the fire. I end up breathing all the smoke—which may kill me one day."

The Ghana Alliance for Clean Cookstoves and Fuels (GHACCO) and the Organisation for Indigenous Initiatives and Sustainability (ORGIIS) sought to improve this situation. Through the Voice for Change Partnership (V4CP), their staff and volunteers developed advocacy capacity, which bolstered their confidence; by generating and strategically using sound evidence, their message reached the district and national levels. Through the V4CP, Ghana's Minister of Local Government and Rural Development, Mrs. Hajia Alima Mahama, learned for the first time about the adverse impacts of not having clean cooking access, and later became a member of the Clean Cooking Alliance's Global Leadership Council.

GHACCO concentrated on advocacy at the national level, while ORGIIS focused at the district level, building the capacity of assembly members to serve as change makers. Female assembly members were specifically targeted as clean cooking champions because of the disproportionate impact that lack of clean cooking access has on women. These efforts resulted in clean cooking issues being taken seriously, with one assembly member observing that "clean cooking issues are now discussed at subcommittee meetings, executive meetings, and general assembly sessions. Also, clean cooking is now part of the Municipal Chief Executive sessional address." These efforts also resulted in developing a pilot project in 10 schools in northern and southern Ghana, implemented by World Education Incorporated and GHACCO, with the support of the Clean Cooking Alliance.

Source: Interviews with V4CP and SNV staff.

CASE STUDY 3. EXPLORING THE POTENTIAL OF FUEL-EFFICIENT SCHOOL FEEDING IN RWANDA

Menus of school feeding programs often consist of maize and beans, both of which require hours of cooking utilizing a large quantity of fuel. Any intervention that can shorten the cooking time can thus lead to considerable fuel savings. In 2021, The World Food Programme (WFP) engaged Loughborough University (LU) to carry out a fuel-efficiency study in selected schools of Rwanda. A joint WFP-LU mission in November of that year included visits to the Farm Fresh Beans Factory. Among other observations, the mission team found no significant cost difference between dried and fresh beans; dried beans only appeared cheaper because the energy cost had not been factored into the price. The team further observed that school feeding programs had not incorporated a budget for firewood, water, and cooks. Currently, the team is developing a fuel-efficient menu that will be piloted in 10 schools across 5 districts in Rwanda. The study's objective is to make schools' feeding programs more fuel efficient using a combination of recipes, cooking behavior, and fuel-and-stove combinations. Associated costs will be considered to show the most cost-effective, fuel-efficient pathways.

Source: Interview with WFP staff.

One rare initiative had financing as a major project component; the impact of this project has extended to other initiatives identified in the study (case study 4). Other initiatives featured multiple interventions offering broad-based solutions. Among others, these included the ADES project in Madagascar, which, in addition to cookstoves, included cooking area improvements and public education (case study 5); the World Food Programme (WFP) initiative in Uganda, which entailed woodlots and fuel-efficient stoves; and the German Agency for International Cooperation (GIZ)–supported stove program in Kenya, which provided skills training and market sensitization.

CASE STUDY 4. FROM EFFICIENT TO CLEAN COOKING: EQUITY BANK INITIATIVE IN KENYA

Field observations during Equity Bank's large tree-planting program in 2019 revealed that schools were the country's largest consumers of fuelwood. This observation was consistent with findings of a nationwide study, which showed schools were consuming 1 million metric tons (MT) of wood per year, translating to the cutting of millions of trees and deforestation. This situation inspired Equity Bank to develop a clean cooking intervention for schools through its Foundation. As a first step, it assessed the schools' cooking technologies, fuel supply chain, infrastructure, and costs. Next, it selected the Alliance Secondary School to test its intervention. To meet its fuelwood demand, Alliance Secondary School had been cutting 300 trees each month, despite having infrastructure in place for efficient fuelwood use. Equity Bank worked with the school to retrofit previously installed fireplaces to accommodate the use of liquefied petroleum gas (LPG). Although 24 percent of Kenya's households use LPG for cooking, the fuel has rarely, if ever, been used as a source of institutional cooking energy.

Data monitoring over a six-month period revealed that, by switching from fuelwood to LPG, the school reduced its fuel expenditure by 50 percent. Replication of the intervention in other schools yielded similar results. However, for many schools, the up-front cost of converting to more efficient stove technologies and fuels (as much as US$3,000) is a drawback. For those that want to switch to more efficient cooking solutions, Equity Bank provides loans, which are repayable over a three-to-five-year period. The bank also provides the schools loans for procuring or repairing cookstoves and renovating kitchens, and links them with partners who can do the work. Tracking of the program's social and environmental benefits for the bank's sustainability reporting is ongoing.

Source: Interview with Equity Group Foundation staff.

CASE STUDY 5. ADES' INTEGRATED COOKING SOLUTIONS FOR MADAGASCAR'S SCHOOLS

Madagascar is home to unique fauna and flora and has a high proportion of endemic species. Yet many are endangered as a result of habitat overexploitation. Less than 10 percent of the island's original forests have been preserved as a result of commercial timber extraction and land-clearing for crop cultivation. Eighty percent of wood felling is utilized for cooking. In response, ADES (Association pour le Développement de l'Energie Solaire Suisse-Madagascar), a climate protection project of myclimate, (a Swiss foundation), works to promote integrated cooking solutions in Madagascar's schools, including the use of renewable fuels. Since 2001, the project has been engaged in cookstove design and manufacture, building of school kitchens, and education and awareness-raising activities.

With the support of Energising Development (EnDev), ADES has developed and tested an energy-saving institutional cooking model in 8 schools run by project partner Bel Avenir. The project operates 8 stationary production, sales, and information centers where 138 local employees produce, sell, and repair stoves and cooking utensils, advise interested parties, train users, and offer environmental education modules for primary and secondary schools. It also operates a mobile promotion center. ADES has also helped to build a local school canteen and kitchen with installed sun ovens and fuel-efficient biomass stoves, serving 245 children per day.

Source: Interview with ADES staff.

A cluster of initiatives focused on tree planting and development of woodlots. These resulted from the schools' own efforts or through the support of various organizations. In Uganda's northern districts, the WFP, in partnership with Straight Talk Foundation, supported a school tree-planting project known as Tree Talk Plus. The project aimed to create 1-acre woodlots for fuelwood and provide amenity trees in areas where pressure on biomass resources had reached an alarming scale; concurrently, it focused on capacity building of students and school personnel in natural resource management and conservation. As part of Malawi's Nutrition and Access to Primary Education (NAPE) program, the GIZ worked with other program partners promoting afforestation and training in how to grow pigeon peas and other fuel crops.[20]

[20] The study did not include private-school initiatives as it was not possible to interview school staff to corroborate the information obtained from online sources.

Promoted technologies and fuels

Given the prevalence of fuelwood as schools' baseline cooking fuel, the initiatives mainly promoted biomass cookstoves, while those targeting fuel replacement focused primarily on briquettes. Cleaner forms of biomass cooking solutions (e.g., pellets burned on gasifier stoves) were rare. Cooking solutions considered "clean" consist of gas stoves, electric stoves, liquid fuel stoves, pellet-using mini-gasifiers, and solar-thermal; however, only a handful of initiatives were based on some of these solutions (table 3.1).

TABLE 3.1
Institutional cooking solutions

Type	Number of initiatives
Improved firewood stoves	27
Briquettes	7
Liquefied petroleum gas (LPG)	6
Biogas	2
Electricity	1
Pellets	1
Solar-thermal stoves	1
Total	**45**

Source: Authors.

With the exception of electricity and piped gas (commonly used in richer countries), biogas and LPG (established solutions in household-sector implementation settings), and briquettes (with good penetration in Kenya and Uganda), alternatives to firewood and charcoal were in the innovation, research, and development phases. Pioneering technologies included LPG-powered steam cooking, briquettes burning with heat-retaining volcanic rocks, and the use of electric pressure cookers (EPCs). In Kenya, a Food4Education program utilized steam cooking technology that relied on imported equipment not available in the local market (case study 6); while Renetech piloted a solar thermal cooking system and EPCs in schools.[21] In Uganda, Masrcorp's Eco Stove solution relied on briquettes to heat insulating volcanic rocks.

[21] The study identified a promoter of the steam cooking solution in Kenya that manufactures some of the system's minor components while importing the main ones.

CASE STUDY 6. FOOD4EDUCATION'S AFFORDABLE COOKING QUEST: GAS-DRIVEN STEAMERS

Food4Education, a Kenya-based non-governmental organization (NGO) that feeds 33,000 children daily in 30 primary schools, utilizes a centralized model, whereby meals are prepared in central kitchens and distributed to the schools. The program's three kitchens (with plans for expansion in the works) are located in public primary schools and staffed by parents of children attending those schools. Parents contribute half the cost of the meals, with the other half funded by the program. To make school meals more affordable, Food4Education has been actively engaged in identifying more energy-efficient fuels and other ways to reduce costs. In the past, it utilized purchased fuelwood, but later transitioned to briquettes, which resulted in significant cost savings.

Through its 2021 assessment of feeding programs in other countries, Food4Education discovered that generating cooking energy through gas-driven steamers was more efficient than using briquettes. A key challenge was the lack of local experience to inform the NGO's decision to acquire the technology; since no institution with a large-capacity system corresponded to its feeding requirement, the decision to purchase the system was based on its own internal research on estimated fuel savings from the investment. A second hurdle was unavailability of the technology in the local market. The entire system had to be imported from India, which added to the costs. The cooking system was financed through the program budget, as part of infrastructure investments, and the energy cost was not passed on to parents. To date, the steam-based cooking system has been installed in two kitchens.

Source: Interview with Food4Education staff.

Scale and phase of initiatives

Few initiatives had data on the number of stoves disseminated or the number of schools targeted. It was also difficult to establish implementation periods owing to low institutional memory in the organizations. Therefore, the information presented in this section is based on a subset of initiatives for which information was available to the study team.

The scale of initiatives has been wide-ranging (table 3.2). In the early 2000s, the UNDP-DANIDA-WFP project in Kenya—among the earliest initiatives with which the team could establish contact—procured more than 1,000 energy-saving stoves, which it delivered as donations to schools. Most carbon-finance initiatives were also initiated in the early 2000s.[22] More initiatives have been implemented in the past decade. They include SNV Netherlands Development Organisation (SNV) and Equity Foundation stove-repair programs in Kenya, a Modern Energy Cooking Services (MECS) research program on institutional EPCs, a WFP and

[22] The authors could not find reliable information on programs that pre-date this period.

Loughborough University (LU) study on energy-efficient school menus, and the WFP's Burundi program. Initiatives in the pipeline include Ghana's National LPG program and the Government of Rwanda's European Union–funded program; both are in the design and preparation phases with World Bank support. Pipeline initiatives in the research and development phase include Renetech's solar cooking system, the GIZ-supported design of institutional stove models by BURN Manufacturing in Kenya, and institutional stove design by Emerging Cooking Solutions in Zambia.

TABLE 3.2
Summary of initiatives by scale

Initiative	Stoves supplied (number)	Beneficiary schools (number)
Masrcorp, Uganda	50	19
World Food Programme (WFP), Uganda	n.a.	4,000
ADES, Madagascar	13	n.a.
United Nations Development Program (UNDP)-Danish International Development Agency (DANIDA)-WFP; Kenya	more than 1,000	1,500
WFP Kenya, with Federal Ministry for Economic Cooperation and Development (Germany) (BMZ)	240	n.a.
Equity Bank, Kenya	n.a.	20
WFP and International Lifeline Fund (ILF), Burundi	3-4 stoves per school	700
Powershot, Kenya	1	1
SNV Netherlands Development Organisation (SNV), Kenya	24 (stoves repaired)	6
German Agency for International Cooperation (GIZ), Malawi	487	150
Renetech, Kenya	1	1
World Wildlife Fund (WWF) and Tanzania Traditional Energy Development and Environment Organization (TaTEDO), Tanzania	1	1
Counterpart International, Senegal	n.a.	270
Counterpart International, Mauritania	Not specified	3
Government of Nigeria	n.a	29
Acacia Innovations, Kenya	n.a.	350
GIZ and Monitoring and Verification Platform (MVP), Kenya	2	2
East African Wildlife Society and Karen Country Club, Kenya	1	1
Nature Kenya and BirdLife Denmark (DOF)	3	3
IT Power Eastern Africa, Kenya	3	3
UNDP, Kenya	1	1
WFP, Ethiopia	n.a.	2,000
WFP and ILF, Uganda	20	4
Food4Education, Kenya	2	2
FESE Works, Kenya	n.a.	6
Vuma Biofuels, Kenya	n.a.	1
Panorama Solutions, Uganda	n.a.	11
WFP and Straight Talk Foundation, Uganda	Not applicable; aimed to create 1-acre woodlots for fuelwood	230

Source: Authors.
Note: n.a. = not available.

Large-scale initiatives include WFP projects and those supported by the World Bank. Information from project preparation documents suggests that the Government of Ghana's National LPG program will provide stoves to 261 secondary schools, and Burundi will support installation and maintenance of improved institutional stoves for 400 schools. The Kenya Off-grid Solar Access Project (KOSAP) has earmarked US$1 million for institutional cooking, suggesting the large scale of the initiative.

Results-based carbon finance linking financial payment to achieved emission reductions can deliver results-based revenue, as well as unlock upfront financing for capital investments; thus, it is a potentially attractive source of financing for clean cooking programs in schools. Under both the Clean Development Mechanism (CDM) and the voluntary Gold Standard mechanism, various programs have sought carbon finance with mixed results. Lessons learned and experience sharing can be captured from projects that have successfully received carbon finance payment (e.g., Institutional Improved Cook Stoves for Schools and Institutions in Uganda under the United Nations Framework Convention on Climate Change [UNFCCC] CDM). At the same time, stakeholders must carefully manage the challenges and downside risks (e.g., streamlining the mitigation-value [MV] procedure, trade-offs in carbon revenue sharing, and over-crediting).

The length of the initiatives' operation, though difficult to gauge, can generally be inferred as short, often ending after stove distribution. For example, the GIZ-supported Malawi initiative, which can be considered moderate in scale, was implemented over an 18-month period. After achieving their distribution milestone, most initiatives provided no program follow-up information. In fact, many organizations declined to interview for lack of institutional recall of the initiatives the study team had identified through its internet search. In certain cases, websites were removed following the team's contact with organizations inquiring about the programs.

Reported benefits of interventions

The reported benefits of cleaner cooking solutions in schools were similar to those reported in the household cooking sector.[23] The most commonly cited one was fuel savings, which translated into reduced fuel expenditure for schools. The time-saving benefits of faster cooking were also widely appreciated. For example, most primary schools in the WFP's Burundi program divide learners into morning and afternoon groups. Delayed cooking of meals can delay the start of afternoon classes, directly affecting students' learning and triggering unrest. Contained fireplaces were reported to have improved the safety of cooks by reducing the risk of burns. Two initiatives (one in Kenya and the other in Burundi) reported improved personal safety of children, who had previously risked wild animal attack when collecting fuelwood for school meals. Various initiatives reported that improved

[23] A few initiatives (e.g., United States Department of Agriculture [USDA] McGovern-Dole and Equity Foundation) cited outcomes of reduced deforestation and reduced greenhouse gas (GHG) emissions.

kitchen solutions had reduced labor and physical strain on kitchen staff. For example, Equity Foundation's LPG intervention was reported to have reduced staff workload because the stove was easy to light and clean. ADES's "Box Miracle" intervention, which entailed building of kitchens and stove installation, is reported to have enabled cooking while standing, which was less strenuous; provided access to storage space, which reduced working distances; and reduced the need to carry water since hot water pipes were connected directly to cooking vessels.

Financial benefits resulting from more efficient fuel use and the cleanliness and durability of modern cooking technologies were widely reported. For example, Equity Group Foundation reported lower maintenance costs in school kitchens where LPG had replaced fuelwood. The regulated pricing of LPG compared to biomass improved financial planning by the schools. The Waste to Energy Youth Project in Uganda reported that its briquettes solution had not only provided cleaner energy for preparing students' meals; it also provided energy for baking bread sold in the school canteen to generate income for the school. A WISIONS school biogas project reported financial savings, which was channelled into constructing better classrooms and acquiring more animals.

Initiatives in other regions

The previous chapter sections have focused on initiatives identified through a global literature search, which mostly identified initiatives implemented in Sub-Saharan Africa. To make the study representative, a purposive search was conducted to identify initiatives outside Sub-Saharan Africa. These additional initiatives were generated from the WFP database and thus may not be fully representative of the entire sector, which, as discussed above, comprises a variety of actors (including the private sector) and efforts outside the school feeding program. Owing to these restrictions, this subset of initiatives is not fully analyzed against the five criteria presented in chapter 4. Instead, it is presented as case studies that can be compared and contrasted with initiatives in Sub-Saharan Africa (Annex 3).

The following key differences were observed between these additional initiatives and those within Sub-Saharan Africa:

- Type of cooking technology: Unlike initiatives in Sub-Saharan Africa, where biomass is the predominant cooking fuel and the use of clean cooking solutions is negligible, this subset of initiatives demonstrates high use of LPG. This is not surprising as the current study shows a strong correlation between cooking energy use in households and schools. Fuels like LPG depend on the same supply infrastructure regardless of the subsector targeted.
- Cooking energy as part of school infrastructure: The initiatives show an advancement in terms of considering cooking energy access alongside other basic school infrastructure like water supply and electrification. Cookstoves and fuels fall under kitchens; and the considerations go beyond technology to include such aspects as lighting, ventilation, and hygiene.

- Public-sector funding: The initiatives recognize that the role of providing clean cooking energy is not for the parents or children. Rather, governments have a primary role to play in financing clean cooking solutions, with parental contributions (where needed) as complementary.
- Policies and guidelines: Clean cooking is anchored under school feeding policies and guidelines. In contrast to Sub-Saharan Africa, where some countries are yet to develop and adopt school feeding guidelines, the countries assessed by this study outside Sub-Saharan Africa have those policies in place.

Despite these advancements, these initiatives still show some gaps and major areas for improvement. Most of these case studies appear to focus on gas; however, some programs in Sub-Saharan Africa that have attempted to switch schools directly from open fire to gas have reported limited uptake. Thus, these cases should not be taken as best practices by themselves without fully considering the unique challenges faced in Sub-Saharan Africa.

Annex 3.
Initiatives outside Sub-Saharan Africa

The WFP's database was used to identify additional initiatives outside the Sub-Saharan Africa region, including ones that operate in multiple countries (e.g., El Salvador, Lao PDR, and the World Central Kitchen). The examples presented in this annex illustrate some of their key features, including both innovations and areas in need of improvement (case studies A3.1–A3.5).

CASE STUDY A3.1 LESSONS FROM A FAILED COOKSTOVE PROGRAM IN TIMOR-LESTE

In Timor-Leste, the Sustainable Bioenergy Production from Biomass (SBEPB) Project—a four-year initiative supported by the Global Environment Facility (GEF), Government of Timor-Leste, United Nations Development Programme (UNDP), and other funding partners—aimed to have 400 industrial stoves installed and operational by project close. However, market conditions changed dramatically between project's design phase and its implementation. At project formulation, the country's overall electrification rate was just 42 percent (78 percent urban and 27 percent rural), but had reached 80 percent by the time the project was implemented. As economic conditions improved and an emerging middle class expanded, the use of liquefied petroleum gas (LPG) also increased dramatically, especially in urban areas. These factors led to changing the industrial stoves' target group to catering companies. However, a survey of catering companies concluded that, in urban areas, fuelwood had little use in industrial applications, given its high cost and ready availability of alternative fuels (i.e., LPG and subsidized electricity). Out of 169 restaurants and bakeries surveyed, only 3 percent were using fuelwood; while 18 percent were using open fires for secondary functions (e.g., preparing specific dishes that required a "smoky" taste). Thus, the program decided to abandon industrial stoves, concentrating only on stoves for households and institutions. Even with this change in target groups, rural schools had no incentive to switch to cleaner cooking solutions, given the abundance of "free" biomass supply in most parts of the country and school management's failure to appreciate the value of improved stoves.

Source: UNDP Project Evaluation Report.

CASE STUDY A3.2 INDIA'S POLICY AND INCENTIVE FOR CLEAN COOKING IN SCHOOLS

India's midday meals program in schools has a long history, dating back to 1925. The National Programme of Nutritional Support to Primary Education (NP-NSPE)—the world's largest school feeding program—was launched as a centrally sponsored scheme in 1995; by 2002, its coverage had extended to all blocks of the country (i.e., all children in government-supported primary and upper-primary schools, including special training centers). In addition to food grains, the midday meal involves the cost of cooking, including fuels, and provision of essential infrastructure, including cookstoves. Unable to provide adequate funding to meet the cost of cooking, many state governments/UT administrations resorted to distributing food grains only rather than providing cooked midday meals. To ameliorate the problem, the central government took on an expanded role in 2006 that included, among other responsibilities, (1) assisting states with cooking cost at variable rates, depending on school location and contributions of state governments/UT administrations (the higher their contribution, the greater the central government's support) and (2) replacement of kitchen devices, including ones for cooking (e.g., chulhas) at an average cost of Rs. 5,000 per school. Guidelines for the midday meals program are complemented by those on food safety and hygiene. These provide for properly constructed chimneys in school kitchens; safe installation and storage of fuels and stoves (e.g., kerosene, fuelwood, charcoal, and LPG); safe use of smokeless chulhas; training of cooks in the safe handling of kerosene and gas stoves; and raised cooking platforms with adequate lighting and ventilation.

Source: WFP literature.

CASE STUDY A3.3 NEPAL'S NATIONAL GUIDELINES PROVIDE FOR CLEAN COOKING/ASSIGN COST

In Nepal, midday meals for schoolchildren are given due importance in many of the country's education and health-related policy documents,[a] and are incorporated into the national budget. The Government of Nepal has developed a local guidebook to facilitate implementation of the school meal program by setting norms, criteria, standards, and procedures. Under the guidebook's rules for kitchen safety and hygiene (section 2.5.2), provisions are made for safe storage of gas cylinders to avoid any fire-related accidents in kitchens that use liquefied petroleum gas (LPG). The guidelines also state that cooks should be well trained in the handling and use of the gas and gas-fuelled stoves. In addition, the guidelines assign the local government responsibility for coverage of fuel cost. Section 3.4 states that, in cases where the midday meal is prepared in the school kitchen, "food commodities, labor, and fuel cost must be managed from grants received through the local government;" at the same time, local governments are allowed to mobilize these resources from other additional sources (e.g., parents), but only in cases where "the available grant is inadequate for this purpose." Finally, each school is required to complete a progress report at the beginning of the academic year and immediately after students' enrollment. The progress report requests responses to such questions as kitchen availability and cooking location, cooking fuel and stove type, and fuel source and expenditures. This information allows the government to continuously monitor and improve the state of school feeding.

Source: WFP literature.
a. Examples include the Free and Compulsory Basic Education Act, School Sector Development Plan, Approach Paper of Fifteenth National Plan, Integrated Health Strategy, and latest report of the High-Level Education Commission.

CASE STUDY A3.4 ASSESSING INFRASTRUCTURE NEEDS IN VENEZUELA'S SCHOOL KITCHENS

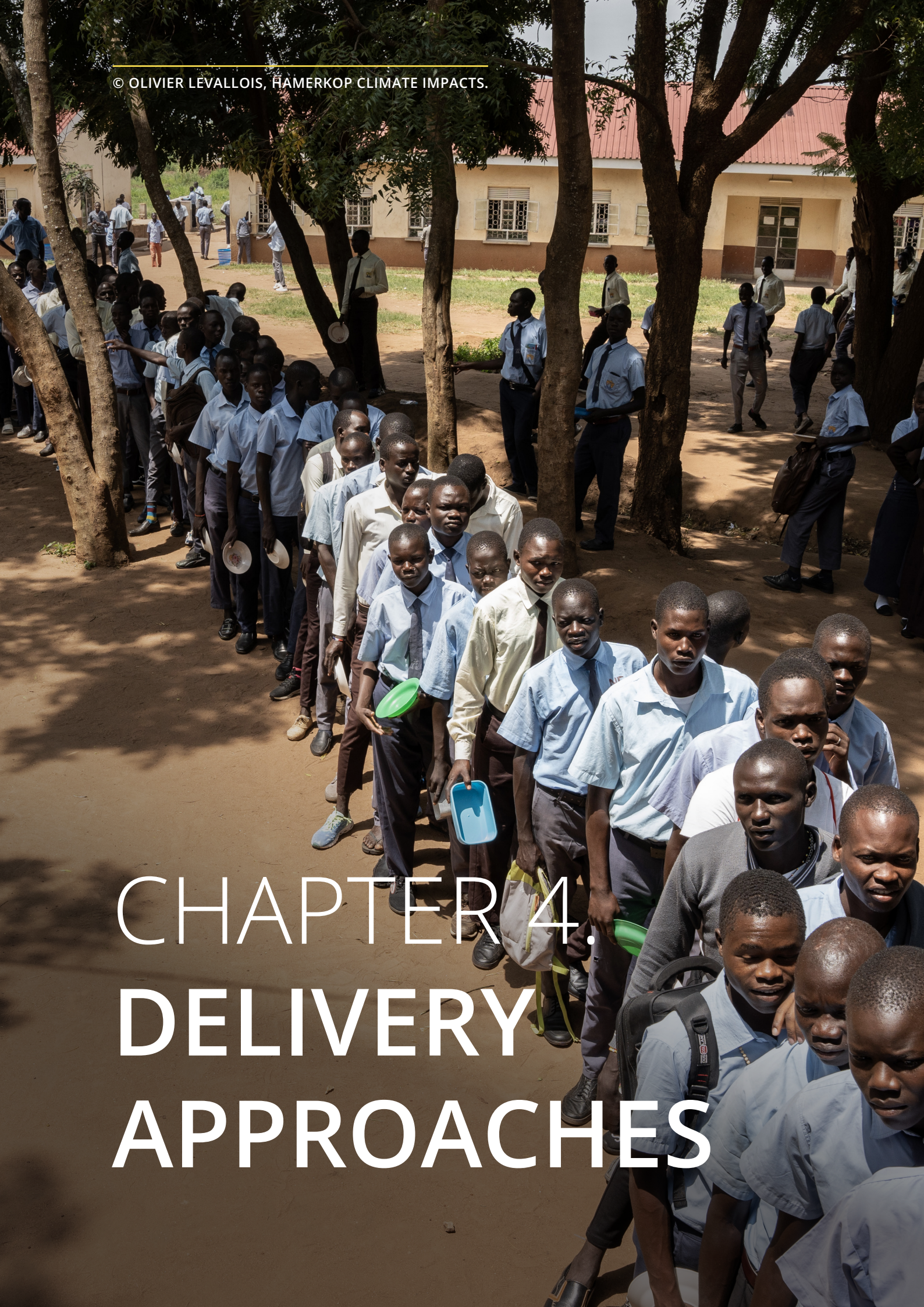
Since 2021, the World Food Programme (WFP) has been distributing take-home rations to vulnerable groups in Venezuela, including 520,000 children in 2,000 educational centers. This approach was necessitated by the COVID-19 pandemic. The goal is now to transition to on-site school meals targeting 2,500 pre-primary, primary, and special education schools. Program activities include provision of school kitchen infrastructure and equipment maintenance, as well as provision of minimal equipment for preparation, storage, and serving on-site meals. The first activity entailed an assessment of kitchen conditions in some 1,700 pre-primary schools where the program is being implemented. Assessment results showed that all kitchens required some type of investment in equipment, supplies, repairs, and/or infrastructure refurbishment (water, storage, and cooking areas). Most schools cooked with gas supplied by the public utility. The key challenge is thus repair/replacement of gas tanks and pipes (for 47 percent of schools). However, it was reported that one-third of the schools require heavy investment, including stove replacement.

Source: WFP literature.

CASE STUDY A3.5 EL SALVADOR'S KITCHEN-IN-A BOX

El Salvador's Ministry of Education, Science, and Technology has recognized the need to improve the condition of the country's school kitchens and storage facilities as a national priority. With the help of World Food Programme (WFP) engineers, Kitchen-in-a-Box—a "smart" kitchen project—has been launched in one of San Salvador's schools. This innovative, clean cooking solution, made from used shipping containers, is affordable and can easily be adapted, transported, and installed. It comes equipped with solar panels, induction stoves, and electric pressure cookers (EPCs), which replace traditional biomass cooking with firewood. The project includes rainwater and drip irrigation systems in the school garden, resulting in significant savings on water use. Because the solar panels power pumps for efficient rainwater distribution, electricity use is also reduced. The school garden, in turn, produces food for school meals and educates students on local food production; while digital kitchen screens promote healthy nutrition and environmental education for students and the community. The project plans to reach more than 700 schools, benefiting more than half a million children each year.

Source: WFP.



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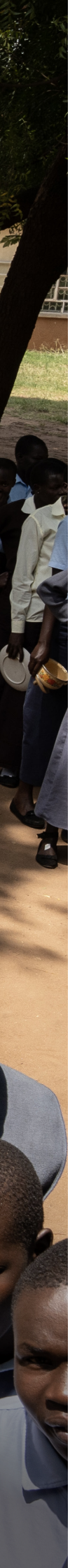
CHAPTER 4. DELIVERY APPROACHES



Introduction

To examine the delivery approaches of interventions, the study team adopted an analytical framework comprising five standards for rethinking school feeding programs. These are (1) design and implementation, (2) institutional arrangements, (3) policy and legal frameworks, (4) financing, and (5) community participation (Bundy et al. 2009; Drake et al. 2016). Using this framework, it was possible to compare the design and implementation of programs across multiple contexts so that good practices could be drawn from them. This chapter delves into the various approaches that the initiatives covered used to deliver their clean cooking solutions to schools. Contextual factors that enable or impede last-mile delivery efforts and their effect on program quality and effectiveness are also considered.

Design and implementation

No literature is currently available on delivery models for institutional cookstoves. The study's review of household-sector models (e.g., village-level piggybacking of entrepreneurs and proprietary sales network) was found to have limited applicability in the cooking setups of educational institutions. Some well-established institutional supply-chain models might apply; these are characterized in terms of level of decentralization in program management, procurement and distribution, monitoring, and use of third-party implementation (Gelli et al. 2012). In the context of school feeding programs, six models have been proposed. Owing to the scarcity of available information on the implementation approaches adopted by most of the initiatives covered in this study and the substantial overlap between them, the team decided to focus on the extent to which the initiatives' supply-chain functions were either centralized or decentralized.

Centralized model

The motivations for adopting a centralized approach were found to vary. Centralized school-feeding systems can benefit from economies of scale, and their budgets are easier to manage. For programs that target poor marginalized areas, local systems might lack the capacity to handle the entire procurement process. The study found that larger-scale programs tend to favor top-down decision-making models, with procurement handled at the national level and delivery of the stoves either directly to schools or to school districts for redistribution (box 4.1). This pattern is similar to the one that national procurement-services departments use for delivery of dry food and non-perishable commodities to schools.

The study found numerous variations in application of the centralized model. Under Malawi's Nutrition and Access to Primary Education (NAPE) program, the German Agency for International Cooperation (GIZ) was in charge of procurement. However, it also developed

the stove design; provided technical expertise on manufacture of the stoves; and invited bids from manufacturers, two of which were selected and assigned to supply cookstoves to 150 schools in several regions. In Senegal, Counterpart International utilized the same centralized approach but relied mostly on local systems for stove design, testing, and roll-out to 270 schools.

BOX 4.1 CENTRALIZED STOVE DISSEMINATION: THE WORLD FOOD PROGRAMME IN BURUNDI

The World Food Programme (WFP) is the central agency involved in the procurement and delivery of stoves under Burundi's school feeding program. As the first step in the procurement process, the WFP submits proposals to donors requesting support for the program's clean cooking component. Once funds are secured, the WFP decides on the types of solutions to provide specific schools. In some locations with depleted fuelwood, the WFP has sent schools a fuel supply (briquettes) in addition to the stoves. Once the cooking solution is determined, an internal decision is made on the stove's design features, and a prototype is developed. Next, the WFP issues a call for proposals from companies who could supply the stoves and fuels, followed by selection and contracting of the winning bidder. Subsequently, the stoves and/or fuels are delivered to the schools, complemented by user training in stove operation and maintenance.

Sources: Interview with staff of the WFP's Burundi program; review of project design documents.

Decentralized model

Initiatives that operate independent of government, as well as schools that are positioned to acquire cooking solutions without reliance on national budget and procurement systems, tend to favor a decentralized model. Decision-making is concentrated at the local level, usually with the schools themselves, who contract with service providers directly. This approach, which allows the schools to customize cooking solutions to their needs, is utilized by nearly all of the initiatives reviewed that supply schools with cooking fuels. Like the centralized approach, the decentralized model has been variously applied. Food4Education, whose core business is supplying school meals (chapter 3, case study 6), benefits from economies of scale, which allow it to make up-front investments in more energy-efficient solutions that bring further benefits.[24]

[24] One should note that Food4Education's urban location makes this delivery approach possible; the high up-front investment cost and technological features of its steam cooking solution would not be appropriate for school feeding programs located in rural areas.

Institutional arrangements

A key design feature of national school-feeding programs is shared responsibility among international organizations, government ministries (box 4.2), schools, and the local community. The role of the World Food Programme (WFP) in early-phase, school feeding programs has entailed coordination; financial contributions; and technical support, including development of school feeding guidelines, procurement, supervision, and quality assurance. For mature programs (i.e., those that have been in operation for a decade or longer), primary responsibility for implementation is transferred to the government, while the WFP provides technical assistance support.[25] The roles of the GIZ and SNV Netherlands Development Organisation (SNV) in school feeding programs—both stand-alone initiatives and those complementary to government and WFP efforts—have spanned the entire value chain (box 4.3), while the private sector's role has been limited to service provision (e.g., fuel supply within a decentralized model) and the design and piloting of technologies (e.g., solar thermal and LPG-powered steam generators).

BOX 4.2 COORDINATING CROSS-SECTOR COLLABORATION IN KENYA AND MALAWI

Kenya and Malawi are unique in having created an opportunity for cross-sector collaboration between their governments' ministries of energy and education. Members of Kenya's inter-ministerial committee on clean cooking include stakeholders from the energy and education sectors, as well as key organizations involved in institutional cooking initiatives (Equity Bank, the German Agency for International Cooperation [GIZ], SNV International Development Organisation [SNV], and the World Food Programme [WFP]). Similarly, Malawi has developed a national cookstove steering committee. These committees and other coordinating bodies (e.g., Clean Cooking Association of Kenya [CCAK]) have the potential to bridge capacity gaps in institutional cooking and create space for the private sector to play a more prominent role in the sector. To have an impact, however, such efforts require supportive policies that prioritize interventions in institutional cooking.

Source: Interviews with SNV and GIZ staff.

[25] It was unclear whether responsibility for cookstove procurement and distribution in mature programs remains with the WFP or transitions to government.

BOX 4.3 THE GIZ'S KEY ROLE IN INSTITUTIONAL COOKING: KENYA AND MALAWI INITIATIVES

The German Agency for International Cooperation (GIZ) has played a major role in institutional cooking initiatives, particularly in Kenya and Malawi. It is a founding member of the Clean Cooking Association of Kenya (CCAK), an organization representing the interests of clean cooking stakeholders in the private sector, as well as those in research, government, and other related sectors. The GIZ has actively engaged Kenya's education sector through sensitization of head teachers and showcasing of cookstove designs at annual agricultural society events where educators participate.

In Malawi, the GIZ serves as the government's technical lead on biomass cooking. In addition to market development activities (e.g., designing institutional stoves, improving stove builders' capacity, and generating sector knowledge), the agency advises the National Cookstove Taskforce on implementation of initiatives. As an implementing partner of the Nutrition and Access to Primary Energy (NAPE) program's cooking-energy component, it has contributed knowledge from its long experience in the sector. While other actors designed and implemented the program's school feeding component, the GIZ was responsible for the stove component, which was not part of the program's initial design.

Source: Interview with GIZ staff.

Policy and legal frameworks

Several interviewees reported absence of the government as a challenge, and identified various avenues through which it could support the institutional cookstove sector. The following list summarizes their recommended actions for effecting positive change:

- *Regulate the sector.* Regulations on briquettes and other processed biomass fuels are lacking, with most fuels supplied through informal networks.
- *Develop a training curriculum for cookstove technicians.*
- *Coordinate sector stakeholders.* Coordination and cooperation between associations of primary and secondary school heads, which are currently lacking, would create a unified voice to advocate for policy change.
- *Be transparent in procurement systems and procedures;* this includes honoring payments to private-sector suppliers for stove and fuel services delivered.
- *Support schools with up-front financing needed to procure clean cooking technologies.*
- *Develop school feeding policies;* this can create room for private-sector providers, as large demand cannot be met by government alone.
- *Generate data on institutions' access to clean cooking and other key sector statistics.*

- *Set standards for institutional cookstoves.*
- *Mandate the use of efficient stoves in schools.*

Kenya and Rwanda stand out as countries that have made some progress in advancing sector policies and regulations. Kenya's 2018–22 National Climate Change Action Plan (NCCAP) has specified a target of 600 biogas systems for schools and public facilities. A draft regulation on improved biomass cookstoves stipulated that all institutions should switch to improved or energy-saving cookstoves by 2030.[26] In Rwanda, school feeding is an integral part of the government's strategy to address students' hunger during the school day, support the country's human capital creation, and expand access to education for children from low-income families. A comprehensive national policy, approved in 2019, includes guidelines for school feeding. The guidelines account for fuelwood in costing school meals (box 4.4a), and specify the use of fuel-efficient stoves as minimum kitchen requirements (box 4.4b). The government has scaled up program coverage (now pre-primary through secondary schools), equipped schools with kitchens and cookstoves, and provided a subsidy for each student's meal to complement parents' contributions.

BOX 4.4a RWANDA'S SCHOOL FEEDING GUIDELINES: FUELWOOD PROVISIONS

With World Food Programme (WFP) support, Rwanda's Ministry of Education (MINEDUC) has developed guidelines to support implementation of its high-quality, national school-feeding program. Based on menu modeling conducted by the MINEDUC and the WFP in 2020, the national policy on school feeding values a nutritious meal at RWF150 (US$0.15). Under the program, the government provides each student a subsidy of RWF56 (US$ 0.05) per meal, while parents are required to contribute the remaining RWF94 (US$0.09) per student per meal via cash and/or in-kind contributions (fuelwood, labor, and food items). A firewood bundle is costed at RWF1,000 (US$0.97). To meet the monthly contribution requirement of 1,974RWF (US$1.92), parents can contribute 2 bundles of firewood, 2 days of labor, or 3 kg of beans. They can also contribute a combination of these options (e.g., 1 bundle of fire-wood and 1 day of labor) if it leads to the total equivalent monthly (RWF3,150 [US$3.06]), quarterly (RWF9,450 [US$9.18]), or annual (RWF28,500 [US$27.67]) contribution.

District school-feeding committees, in consultation with those at the school level, have leeway to revise the amount to be contributed by parents based on their ability to pay and food commodity costs in the local area. The guidelines are flexible, and can be adjusted to fit individual situations and needs, while advising on standards and best practices for program utilization.

Source: Rwanda National Guidelines on School Feeding, Republic of Rwanda, 2021.

[26] While the draft provided the professional qualifications required for installing the institutional cookstoves, it failed to include an implementation framework for the proposed biogas systems. Not surprisingly, the initiative on regulating biomass stoves fizzled out at the drafting stage.

BOX 4.4b RWANDA'S GUIDELINES ON SCHOOL FEEDING: FUEL-EFFICIENT STOVE PROVISIONS

Cookstoves are part of the kitchen requirements under Rwanda's national guidelines on school feeding. The guidelines stipulate that school inspectors should utilize a kitchen management and food preparation checklist, extracts of which are provided below:

Direct observation: Walk around the kitchen and inside the store to verify food-safety measures in the kitchen.

E01. Kitchen Infrastructure and Safety (yes/no)

E01.1 Is there a kitchen or cooking area inside the school compound?

E01.2 Is the kitchen located at an ideal distance (at least 30 m from the latrine, playground, classrooms, and animal grazing)?

E01.3 Is the kitchen wall closed from prevailing winds and safe from accidents?

Questions from the Kitchen Module

E01.4 Does the kitchen have sufficient space for the cook to move about freely for mixing and preparing foods?

E01.5 Is the kitchen well ventilated and non-smoky?

E01.6 Is the kitchen located in a well-drained area?

E01.7 Is the stove well protected to avoid smoke?

E01.8 Are flammable materials (e.g., straw) inside the kitchen?

E01.9 Are the stoves safe for the cook's health to allow for safe food preparation?

E01.10 Is the kitchen area cleaned regularly and free from vegetation and bushes?

Source: Rwanda National Guidelines on School Feeding, Republic of Rwanda, 2021.

Financing

Collectively, donors have played a key role in financing institutional cookstove programs, but the study found no consistent funding approach. For example, donor funds for a WFP school-feeding program initiative in Kenya were not earmarked for cookstoves. Rather, the WFP made the decision to direct a portion of the funds received for the stoves, suggesting it had leeway for making such allocations. In other cases, its school-feeding programs had to raise additional funds for clean cooking solutions; its Burundi program is one such example, whereby World Bank funds were used to support the inclusion of a stove component. Earmarked funding for cookstoves and associated technical support, including user training and a clearly defined operations and maintenance (O&M) component, contributes to well-designed projects.

Initiatives that were not part of national school-feeding programs, usually in private-school contexts, acquired their stoves privately or through philanthropic donations (e.g., from embassies and the country offices of international organizations); these were often one-off donations (table 3.2). The stoves were either (1) procured by donors, brought to the schools, and unveiled at public events or (2) procured through funds given to the implementers. Table 4.1 lists donors that contributed to various stove initiatives included in the database. The list is limited to initiatives for which information was publicly available or volunteered by interviewees; information on funding sources for the stoves could not be captured systematically—a limitation that future studies can address.

TABLE 4.1
Funding sources for clean cooking in schools

Donor	Initiative	Part of national school-feeding program (Yes/No)	Scale of activity
Danish International Development Agency (DANIDA)	United Nations Development Program (UNDP)-World Food Programme (WFP), Kenya	Yes	More than 1,000 stoves to over 1,000 schools
LG Korea	UNDP-WFP program, Kenya	Yes	No information
Government of Japan	UNDP-WFP program, Kenya	Yes	No information
Drew Barrymore	UNDP-WFP program, Kenya	Yes	No information
Nordic Climate Facility	WFP, Ethiopia	Yes; but financing of cookstoves focused on their climate benefits.	2,000 schools
McGovern Foundation	WFP, Ethiopia	Yes	No information
WFP Regional Bureau Nairobi (RBN) and Rwanda Country Office (RWCO)	Modern Energy Cooking Services (MECS)-WFP, Rwanda (study on fuel-efficient diet)	Yes	Pilot study in 10 schools
GET.invest	Powershot	No	Pilot phase; no stove dissemination yet
SNV Netherlands Development Organisation (SNV)	Clean Cooking Association of Kenya (CCAK), Kenya	No	Not applicable (research)
SNV	Usafi Green Energy, Kenya	No	No information
United Nations High Commissioner for Refugees (UNHCR)	None; UNHCR pays for fuelwood used by schools in refugee camps.	No	No information
Clean Cooking Alliance	Ghana Alliance for Clean Cookstoves and Fuels (GHACCO) and Voice for Change Partnership (V4CP) (in collaboration with the United States Department of Agriculture [USDA] McGovern-Dole Food for Education Program)	Yes	Pilot in 10 schools; advocacy at national and district levels
Embassy of the Netherlands	WFP, Burundi	Yes	No information on cookstoves' allocation
European Union	WFP, Burundi	Yes	No information on cookstoves' allocation
Equity Foundation	Equity Foundation, Kenya	No	20 schools directly; others indirectly through financing
German Agency for International Cooperation (GIZ)	ADES, Madagascar	No	13
World Bank	National stoves programs; Burundi, Ghana, Kenya, Rwanda and Uganda	Only in Burundi	Aimed to deliver about 60,000 eligible stoves, with incentives (no separate targets for schools)

Source: Authors.
Note: Ten initiatives that made one-off stove donations to a small number of schools (fewer than five) are excluded since it would be challenging to draw implementation lessons from such efforts.

The World Bank has contributed to financing institutional cooking initiatives through lending and non-lending support to national stove programs, including those in Burundi, Ghana, Kenya (e.g., Kenya Off-grid Solar Access Project [KOSAP]), Rwanda, and Uganda. As a donor, the GIZ has supported ADES in developing an efficient biomass cooking solution for schools in Madagascar (chapter 3, case study 5); in Kenya, it supported BURN Manufacturing in developing an institutional stove model and financed sector studies. SNV has financed a

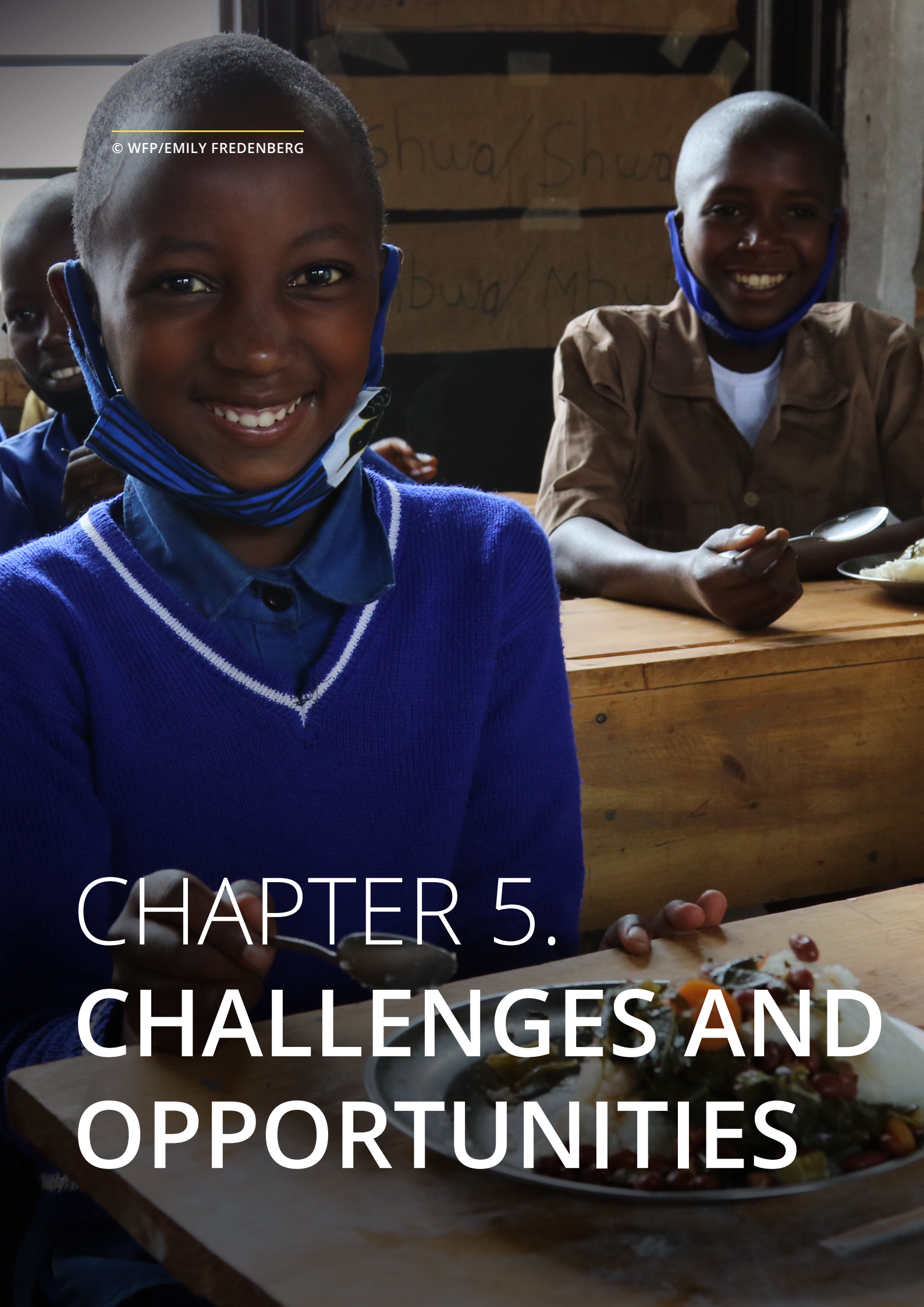
landmark national study in Kenya on institutional use of biomass cookstoves and fuels (CCAK and SNV 2018), as well as localized studies to inform the design of institutional cooking initiatives implemented in Kenyan refugee camps.

Community participation

It is difficult to estimate parents' financial contributions to government school-feeding programs since in-kind contributions are not costed in most countries, and schools do not cost their fuel expenditures. This situation is expected to improve as more countries develop national school-feeding guidelines with support from the WFP. Recent examples in Sub-Saharan Africa include Rwanda and Tanzania, which have started to cost parents' fuelwood and other in-kind contributions. However, parents' time and opportunity cost from fuelwood collection for meal preparation in schools remains unknown. Outside of national feeding programs, it is safe to assume that parents have been paying indirectly for the cooking fuel and appliance costs through school fees.

In the school feeding programs reviewed in this study, the stoves were procured by the WFP through a tender process and given to the schools for free. While cost would bar the local community from participating in the purchase of stoves, it should not preclude their involvement in the planning process. Several interviewees in the study revealed that cooks were not even involved in choosing the stove designs, which was cited as a reason for discontinued use of the stoves. Cooks present at the time of the stoves' distribution were provided only very basic user training.[27] Given the high turnover rate of cooks in these schools—often volunteers with low incentive to continue in these jobs—community-wide training would offer a more sustainable approach.

[27] One exception was the Burundi program, which took a more sustainable approach by extending user training (including an O&M component) to the local community.



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CHAPTER 5. CHALLENGES AND OPPORTUNITIES

Introduction

This chapter synthesizes the findings and implications of the clean cooking initiatives covered by the study. The challenges that emerged help to explain why the sector has remained nascent, with few players and solutions in place.[28] However, the study also identified opportunities for tackling these challenges, utilizing broad-based interventions that prioritize near- and longer-term solutions.

Challenges

Major data gaps

In most of the countries covered, the lack of official statistics on the rate of clean cooking access in schools has made it difficult to make any estimates on the scale of the problem, based on which appropriate interventions could be developed. Of the published surveys on cooking-energy access in institutions, only those in Kenya and Rwanda are nationally representative.[29] Some available statistics do not separate schools and other public institutions (e.g., correctional facilities and hospitals), adding further to the challenge of estimating the nature and scale of the problem. Given the disparity in setup, each type of institution is likely to require its own set of interventions informed by disaggregated data. The study found that some actors in the institutional cooking space that also work on household energy do not disaggregate their data and reporting; for example, the Germany Agency for International Cooperation (GIZ), which has extensive data on impacts, does not separate those of institutional and household cookstoves.

The World Food Programme (WFP) and Food4Education's school feeding program in Kenya were the only initiatives identified that routinely collect key metrics (e.g., number of schools, meals prepared, and students served). This gap suggests the need for initiatives to take a bottom-up approach enabling schools to routinely collect such data, which would necessitate close collaboration between the energy and education sectors. In addition to quantitative school-feeding data, documented experience in implementation and follow-up evaluations would be needed to assess the initiatives' impacts.

As previously mentioned, the study found that most initiatives could not accurately estimate their fuel consumption. This gap deters the adoption of clean cooking solutions since no baseline is available for estimating the potential savings from switching to cleaner fuels. It also means that the impact of such initiatives cannot be reliably assessed, curtailing future

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[28] For ease of presentation, the challenges are clustered into 10 categories; in practice, however, they overlap significantly.

[29] Uganda's survey covered a smaller population that was not nationally representative; Ghana has also conducted a national survey, but the findings are not yet available.

investments in the sector. Apparently, the Ecobora initiative is tackling this challenge by providing cooking energy audits for schools to support investment planning. One interviewee reported developing a low-cost digital scale capable of measuring the weight of large firewood bundles used in school settings. Such initiatives can work well if coupled with the development of standardized methods for capturing and reporting schools' fuel-use data and offering schools incentives to undertake such reporting.[30]

Need for an enabling environment

The lack of policies to guide school cooking initiatives can be linked to various challenges identified in this study. When comparing the adoption of clean cooking, government-aided institutions fared worse than private schools owing to a lack of incentives and supporting measures. The study found that governments controlled public-school budgets, placing tight restrictions on expenditures and raising of funds through loans and other sources. Though infrastructure investments included kitchens, they excluded clean stove installations. School inspections and annual licensing were missed opportunities for assessing the state of school kitchens and enforcing requirements for institutional stoves. Even in mature feeding programs that had transitioned to national governments, no direct measures were undertaken to promote clean cooking solutions; furthermore, the status of previously installed stoves remained unknown.

Lack of quality standards

One consistently reported finding was poor-quality stoves, coupled with lack of maintenance services. This is not surprising, given that the sector has not established standard procedures and guidelines for testing the quality of cookstoves, and no incentives for testing are in place; also, stove maintenance is not a component of most initiatives. The testing procedures and guidelines developed for household cookstoves would not directly apply to the much larger, non-portable institutional stoves. Without standards and guidelines in place, suppliers (and consumers) cannot gauge the quality of their stove products. Since contracts for centrally procured stoves rarely include a maintenance requirement, suppliers are not incentivized to offer high-quality products. Briquettes and other fuels, which similarly lack quality standards and guidelines, are also of poor quality.

In this aspect, the institutional cooking sector lags far behind the household cooking sector, where the key concern is not adhering to existing standards due to weak enforcement mechanisms. For the institutional cooking sector, developing standards and guidelines should be a priority. That few institutional stoves have been tested should be a key concern for the sector. Lack of reliable data on stove efficiency limits the sector's ability to tap into

[30] It was suspected that one program that lacked transparency in fuel-use reporting was a conduit for performing an audit on school expenses.

relevant funding opportunities (e.g., climate finance and impact capital), and poor-quality products deter future private investment.

Need for appropriate stove-and-fuel design

As discussed in chapter 4, the study found that stove users were little engaged in the procurement process. Several reports indicated that the stoves were not suitable for local cooking needs. Some revealed improper stove use, which led to inefficiency and shortening of the stoves' lifespan. One consistently reported problem was that the stove inlet and firebox were too small to accommodate large pieces of wood used in institutional cooking. Cooks were thus required to break the wood down into smaller pieces, which added to their time burden. Use of inappropriately sized firewood led to the commonly reported problem of damaged fireboxes, which were of low-quality construction—a clear example of how stove and fuel supply need to be designed in coordination.[31]

In many cases, technology designs did not fit the school context. Most of the solutions offered were fixed installations, whereas most schools had non-permanent kitchens. If such a school were required to build a new kitchen (e.g., to accommodate a growing student population or improve its infrastructure), its stoves would have to be abandoned. The Rocket stove (a common design in all of the countries reviewed) is designed with a fixed pot size. If a school were required to increase its size of cooking pots over time, those stoves would become obsolete or would be used with incorrectly-sized pots, which would compromise efficiency. Clearly, schools and other institutions need to advance beyond the fixed Rocket stove to a range of designs that account for variations in user needs by context and over time.

Fuels and financial products also need customization. One pellet supplier reported being in the process of designing and testing a pellet-burning stove since schools prefer buying the stove and fuel as a bundle. Emerging Cooking Solutions is reported to have witnessed a 20 percent sales increase as a result of bundling cookstoves with pellets. With regard to financial products, several initiatives reported institutions' preference for products offered directly by the service provider instead of ones requiring them to enter into relationship with multiple entities.

Lack of after-sales support

As previously mentioned, suppliers were little engaged in the initiatives after stove dissemination, and user training was often a one-off activity for cooks who had no prior knowledge of institutional cooking technologies. As mentioned in chapter 4, school cooks were usually volunteers or low-paid staff with a high turnover rate. Design of the initiatives rarely

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[31] In the household cooking sector, this problem has been frequently cited; that is, some stove design features that were intended to increase efficiency created practical challenges for cooks (ESMAP 2021).

considered the need for training to reinforce users' skills and retain institutional knowledge about the stoves. In cases where schools were provided warranties, particularly for stoves acquired directly from suppliers, warranty claims were rarely made or honored (PSFU 2020).

Urgent need for consumer and supplier finance

Affordability was a major hurdle to acquiring institutional cookstoves despite their demonstrated financial savings and short payback periods. An 80-liter stove, at an average cost of US$3,000, was beyond reach for most schools with small budgets. Some suppliers entered into credit arrangements with the schools; however, this was a risky engagement without payment guarantees; it was reported that some schools failed to honor their financial commitments to suppliers, which is likely to have resulted from not having a payment-enforcement mechanism. Schools did not take advantage of the credit lines extended to them by commercial banks for a variety of reasons, including government restrictions on public-school borrowing. The Uganda study found that only two institutions had ever acquired financing for clean cooking technologies from commercial banks (PSFU 2020). However, when suppliers attached a credit line to their products and services, schools readily utilized this type of financing. These findings support those from household-sector studies that show consumers are highly reluctant to borrow from commercial banks, preferring to acquire stoves through installment payments to a financial intermediary linked to the service provider.

Financing the high up-front cost of clean cooking technologies is a major burden that cannot be left up to suppliers and schools to resolve on their own. Two initiatives—International Lifeline (ILF) in Uganda and Equity Foundation in Kenya—successfully tackled the issue by linking with financial institutions to offer solutions. Governments also have a major role to play in resolving the issue. Public-school administrators have no incentive to go into debt on behalf of the school to acquire non-mandatory services. Having specific budget lines for schools to acquire cooking solutions and the government's guarantee of payment to suppliers through the relevant agency would incentivize schools to utilize existing credit facilities and assure suppliers that the schools will honor their payment obligations. The program in Lesotho (box 5.1), which fully shifts the role of fuel provision to the private sector, was described as fairing worse than other school feeding programs in Southern Africa that featured a combination of community engagement and decentralized budgets. In Namibia, for example, the school board recruits volunteer cooks and is also required to ensure the provision of fuel, water, eating and cooking utensils, cleaning agents, shelter, and storage.

BOX 5.1 INCENTIVIZING CATERERS' SWITCH TO CLEAN COOKING IN LESOTHO

Lesotho offers a unique example of a school feeding program that combines public- and private-sector financing. In advance of each school year, an annual tender to feed up to 150 children per day in a target school is launched by the district-level School Self-Reliance and Feeding Unit (SSRFU) of the Ministry of Education and Training (MOET). Once a name is put forward, the subsequent selection of cooks and caterers is made by the school on a lottery basis from a short list that enters a public draw. Newly selected cooks and caterers undergo health and financial checks before being awarded an annual contract by the SSFRU; caterers receive a monthly payment from the MOET-SSRFU, which is directly deposited into their bank account at a fixed rate of M3.50 per child per day.

While anyone is eligible to apply, caterers must have the up-front resources to buy, transport, and store foodstuffs, water, and fuel; as well as oversee the provision and cooking of five lunchtime meals per week according to the government menu. These up-front costs have made it challenging for those without resources to participate in the program.

Evaluation of the program finds that 58.8 percent of school kitchens use inefficient traditional stoves. However, with the increasing number of urban caterers, the shift to gas cooking is on the rise. Unlike their rural counterparts who have struggled with up-front finance, caterer businesses in urban areas that have cooked for children in one or more schools over a period of years view energy-efficient gas and wood stoves as an investment that introduces economies of scale, financial collateral, and business efficiencies. Stakeholders consulted on the cooking energy situation suggested that a gradual shift over to gas and fuel-efficient stoves should be supported, while others felt the issue should be incorporated as part of environmental campaigns (e.g., reintroduction of tree-planting day in schools).

Source: Interview with WFP staff.

Most private-sector initiatives were financed by owners' equity; however, it was observed that access to finance for projects, including those in the design phase, was a major challenge. The study in Uganda found that most financial institutions were unwilling to finance the sector, holding the view that most producers are informal, disorganized, and lack sufficient accounting records critical to the banking sector's ability to evaluate them for the purpose of financing (PSFU 2020). In cases where financing was available, the collateral requirements and interest rates were excessively high and did not make business sense.

The substantial working capital required by institutional stoves compounds the up-front affordability issue. In Uganda, the Green Schools Nationally Appropriate Mitigation Action (NAMA) proposal attempted to resolve this problem using two approaches: (1) provision of capital through the NAMA facility to the revolving loan fund, which would offer loans to schools at no or low interest and (2) creation of funding lines with local and national banks, whereby the facility would cover the interest charged by the banks. Such efforts, which target market development rather than simply stove procurement for schools, would make donor funds go further in supporting the sector's development. Having commercial enterprises (e.g., hotels and hospitals) as anchor customers could also generate cash flow for companies, allowing them to serve schools as secondary customers. Suppliers of commercial enterprises that view schools as a potential market should be a target group for awareness raising as they have "deeper pockets" for supporting investment in research and development (R&D) to identify suitable technologies for schools.

Underdeveloped markets

Review of the initiatives covered shows that the cookstoves market has not developed beyond a few urban centers, helping to explain the dominance of a procure-and-disseminate approach to implementation (chapter 4). The underdeveloped market status also explains why so few market players have engaged in any part of the supply chain (i.e., design, manufacturing, marketing, distribution, and sales). The market has been hampered by a high level of fragmentation and lack of specialization. International implementing organizations have similarly lacked specialization; for example, the WFP has played multiple roles (e.g., designing stove prototypes, procuring stove-supplier services, supervising stove construction, managing quality of the supplied stoves, training stove users, and sensitizing the local community).

Despite the high concentration of school feeding programs in rural areas (including boarding schools, which are large biomass consumers), the urban-rural divide is particularly strong, with rural markets largely unserved. The Uganda study found that 90 percent of stove producers are located in the central region (Kampala and Wakiso) (PSFU 2020). Similarly, the Kenya study found that suppliers are concentrated in urban centers (CCAK and SNV 2018). Disseminating stoves procured in urban areas to rural schools presents multiple challenges. First and foremost, the stoves are not adapted to local cooking needs. Second, repair and maintenance services are usually unavailable. In such nascent markets, identifying and equipping rural artisans with stove maintenance skills could create more knowledge about stove services and contribute to stove uptake. However, in less fragmented, mature markets dominated by mass-produced stoves, warranty and other after-sales services should be considered.

Initiatives that supplied fuels to schools, unlike those that supplied stoves, were located in rural areas. However, their target market was in urban locations, with rural schools left underserved. For example, two initiatives in Kenya, Powerspot and Vuma, supplied pellets and briquettes produced in the countryside to institutions in Nairobi. They reported that

low population density in rural areas made it uneconomical to supply the fuels to rural schools. Targeting urban markets meant they could supply the same fuels to larger institutions (e.g., hotels and restaurants) that had no financing challenges.

Having few market players also explains the inundation of markets with poor-quality products. Without market competition, consumers cannot penalize suppliers by switching to other ones that offer better-quality products and services.

Lack of awareness

It was widely reported that schools understand the challenges posed by heavy dependence on traditional biomass cooking but lack awareness of the solutions that could resolve them. The Uganda study found that formal marketing strategies for institutional stoves are entirely lacking (PSFU 2020), which this study's findings confirm. The main communication channels for stove manufacturers and distributors are word-of-mouth and self-marketing, which explain the low demand for institutional cooking solutions across both public and private school-feeding programs. Food4Education's initiative in Kenya had to conduct its own market research to learn about solutions that would suit its program needs (chapter 3, case study 6). As previously discussed, its research identified only one school in the entire country that was using steam cooking, which had a much smaller feeding capacity (800 students served per day) than that of Food4Education (3,000 students served per day). Food4Education staff reported having no knowledge of how much savings it could expect from adopting the steam system because of differences in food preparation techniques between the source country (India) and Kenya.

Lack of awareness was found to extend beyond institutional-level management to users of the stove technologies and fuels themselves. School cooks were reported to suffer adverse health effects resulting from exposure to cooking smoke emitted from open fires, as well as drudgery (e.g., cleaning sooty pots and cooking areas). Reports of clean cooking solutions falling into disuse can be attributed, in part, to the cooks' lack of stake in the fuel-savings benefit (i.e., they were not responsible for fuel collection and purchase). However, reports also suggest that the cooks lack knowledge about the long-term health benefits of using cleaner-burning stoves. Improved comfort from smoke reduction can be easily recognized, while reduced risk of chronic respiratory infections may not be apparent. Explaining such benefits as part of a training curriculum for cooks could promote positive changes in cooking behavior (e.g., using dry wood); pressure school administrators to invest in clean cooking solutions; and incentivize regular use of clean cooking products. With greater knowledge and awareness, schools would be less likely to adopt solutions that add to the burden of their cooks.[32]

[32] It was observed that awareness-raising activities that targeted school owners, as opposed to school administrators, had the greatest impact since owners had a vested interest in fuel savings.

Awareness raising in schools is a requisite step in making sector progress and thus should be viewed from a broader perspective than simply owners, administrators, and cooks. The need to recognize the problem extends to stakeholders in many diverse sectors, ranging from energy and education, to nutrition, environment, agriculture, and conservation, among others. Using this study's methods, it was surprising to discover that no key players in the household cooking sector could be identified as having awareness-raising initiatives in the institutional cooking space. While the study's limitations may have resulted in certain ones being overlooked (chapter 6), its methods were rigorous enough to identify the major players and their initiatives.

Need for innovation and long-term sector vision

Although interventions in the household and institutional cooking sectors both started in the 1970s and 1980s, progress in the institutional sector has lagged far behind. The sector has not adapted lessons from the household sector's long experience, and has not achieved any major innovations in technology, implementation approach, financing, or impact monitoring. The sector's absence of innovation and progress are reflected in stove users not being consulted in design decisions, lack of after-sales support, ad-hoc donor support without a long-term perspective, concentration of initiatives in peripheral markets, excessive subsidies, low-quality artisanal technologies without any testing, and word-of-mouth marketing.

Opportunities

Cross-sector coordination and synergies

As discussed in chapter 4, some government initiatives have opened up space for coordination across sectors affected by the biomass cooking issue. In Kenya, for example, members of the inter-ministerial committee include major actors in the institutional cooking space: Clean Cooking Association of Kenya (CCAK), Equity Foundation, the GIZ, SNV, and the WFP, among others. Malawi's government appointed the GIZ as its technical lead on biomass for both households and institutions. With WFP support, the Government of Rwanda has developed school feeding guidelines with specific requirements on efficient cookstoves, as earlier mentioned. In Burundi, a World Bank–financed program on solar-energy access includes a detailed component on the dissemination and long-term maintenance of institutional stoves. Similar efforts by other national governments—especially those focused on private-sector participation—would go a long way in promoting an enabling sector environment.

Adapting lessons from decades of experience in the household cooking sector can be harnessed to accelerate the institutional cooking sector's development. To date, key

organizations in the household cooking space have missed opportunities for synergies in multiple areas, ranging from technology development, stove-testing protocols and standards, and stove maintenance to data collection, advocacy and awareness raising, and financing. The World Bank has started to finance institutional clean-cooking initiatives as sub-activities within the household cooking components of energy access projects; even so, such initiatives require a higher level of prioritization.

To ensure cross-sector learning occurs, it is important that actors promoting modern energy cooking solutions for households also engage in the institutional cooking sector. Carbon finance initiatives have well-utilized opportunities for cross-sector synergies in their proposed program of activities (POA).

Electricity access for institutional cooking in Sub-Saharan Africa has lagged, in large part, owing to slow expansion of national grids. In 2020, the World Bank estimated that 1.75 million of the region's schools and health centers still lacked access to a reliable supply of electricity (Elahi, Srinivasan, and Mukurazhizha 2020). Today, advocacy on the electrification of rural schools, health centers, and other public institutions is growing. Thanks to recent technological advancements in stand-alone solar systems and other off-grid solutions, the rate of electrification in schools is increasing, paving the way for electric cooking solutions. Ongoing studies and pilot programs are assessing this feasibility; pioneering efforts include the Modern Energy Cooking Services (MECS) research program, which works in partnership with SNV and the WFP.

Synergies between schools and the humanitarian sector also offer opportunities for cross-sector learning. For example, the World Central Kitchen's resilience program has trained hundreds of chefs and school cooks in addition to building and renovating school and community kitchens. Cross-sector collaboration with refugee camp schools in Sub-Saharan Africa could extend such solutions to host communities and beyond. In return, the humanitarian sector would learn about market-based approaches that could be integrated into the value chain to enhance the sustainability of its programs.

Multiple actors and entry points for intervention

The education sector has access to a wide range of actors whose goals are aligned with achieving Sustainable Development Goal 4 (SDG 4) on quality education. Earlier on, education was among the Millennium Development Goals (MDGs) that achieved the most progress. Thanks to a commitment to the global agenda, the number of out-of-school children of primary-school age dropped by 42 percent between 2000 and 2012. Today, feeding programs are a key component of an inclusive and equitable, quality education worldwide. Annual global investment in school feeding is estimated at US$41–43 billion, most of which is from national government budgets. Making clean cooking in schools a part of the quality-education agenda can be advanced by tapping into the multiple actors and resources directed toward education. Opportunities abound along the value chain, including policy development, fund-raising, procurement processes, quality assurance (e.g., school inspections), data management systems, and program monitoring and evaluation.

Increasing schools' access to clean cooking solutions is not limited to stove procurement and dissemination. To the contrary, the entry points for intervention are wide-ranging (chapter 3). Innovative cooking solutions have involved briquettes, electric pressure cookers (EPCs), liquefied petroleum gas (LPG), pellets, solar thermal energy, gas-steam systems, and heat-retaining volcanic rocks. Most such initiatives have been at the research and pilot phases; even so, they represent an encouraging trend that could witness major advancements if supported through investments (box 5.2). The promotion of non-biomass cooking solutions—even if not the school's primary cooking fuel—can allow for clean stacking within institutions and support such functions as water heating, which is linked to schools' high level of energy consumption.

Initiatives in improved energy efficiency have included energy audits, energy-efficient diets, fuel weighing and drying solutions, afforestation, improved kitchens, and finance, among others. Various organizations outside the energy and education sectors can also contribute to designing and implementing such interventions; in Rwanda, for example, the MECS program on fuel-efficient diets received support from food processing companies. Various conservation organizations— BirdLife International, East African Wildlife Society, Nature Kenya, UNITE for the Environment, and World Wildlife Fund, among others—are also helping to grow the sector; these stakeholders' contributions to the school cooking agenda are viewed as a way to conserve wildlife habitats while doing social good.

BOX 5.2 HIGH-PERFORMANCE BIOMASS STOVE DEVELOPED IN RWANDA

Preliminary testing data from the Kabuga 2.0 advanced biomass stove, developed by the German Agency for International Cooperation (GIZ) and the Energy Sector Management Assistance Program (ESMAP) in Kigali, Rwanda, shows that the stove has achieved ISO Tier 5 performance (i.e., less than 3 g of carbon monoxide [CO] per MJd, less than 5 mg of $PM_{2.5}$ per MJd, and a thermal efficiency above 50 percent). It underscores the importance of classifying clean cooking solutions by the combination of the stove technology and fuel used; not by either in isolation. It also shows that investment in the research and development of stove technologies can make a difference in performance.

In use since June 2023, the Kabuga 2.0 has a 465-liter capacity and addresses several key complaints from users of today's institutional biomass stoves: excessive smoke, too much fuel used, and emission of CO and other noxious gases. Its name has been shortened to KB2-465 since it will be available in other sizes. For version KB3.0-465, pot modifications were made, providing additional heat gain. In October 2023, it was further improved to facilitate faster and easier construction, and the KB4-465 will be built in November 2023. The design is now being discussed among practitioners and is potentially a game changer for implementing cost-effective institutional clean cooking solutions at scale.

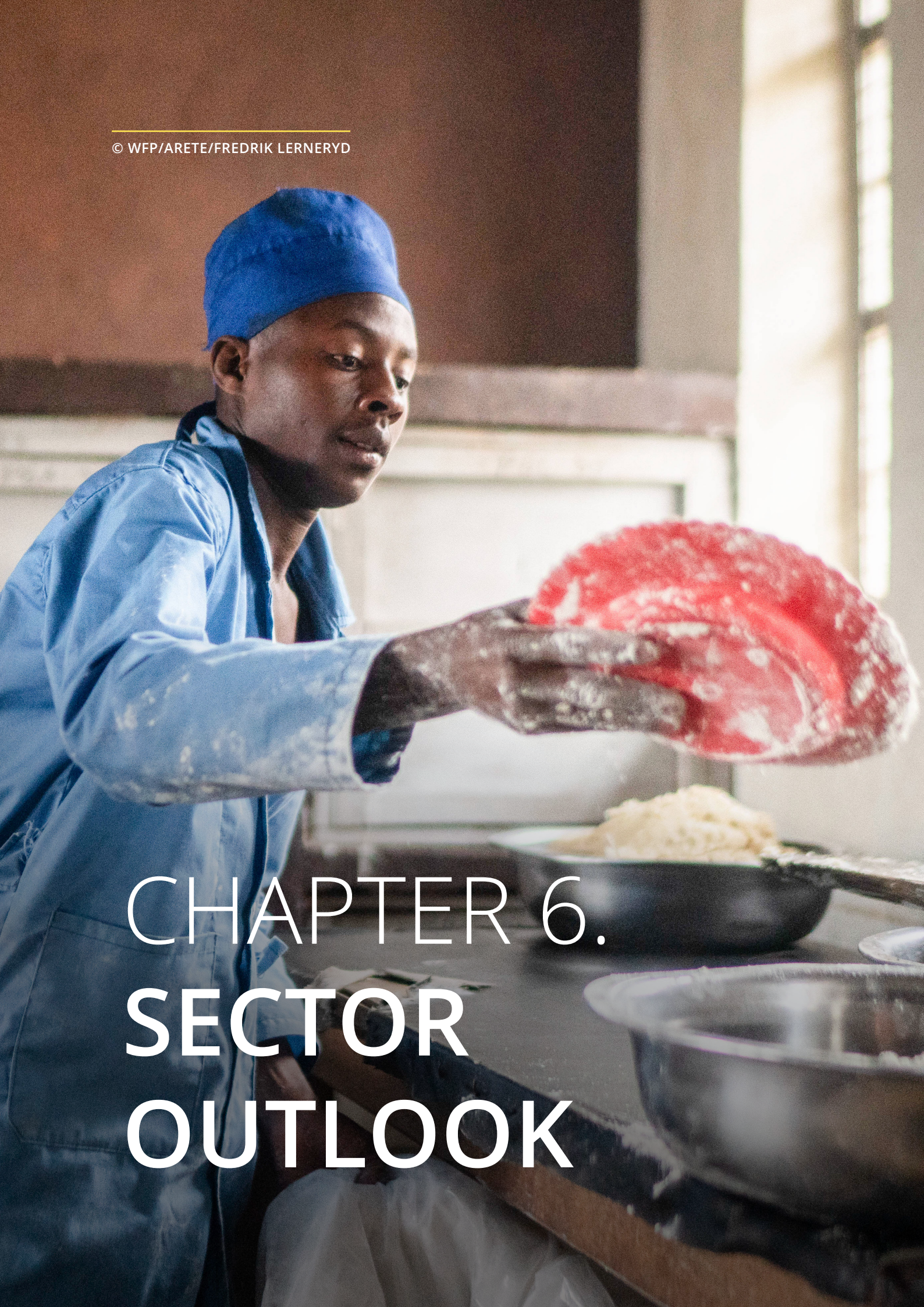
Source: Authors.

Pitching schools as potential secondary clients of companies that supply other energy-intensive public institutions and commercial enterprises (e.g., hospitals, correctional facilities, and industrial biomass users) could unlock myriad resources, including knowledge and technological solutions. Clustering schools with these sectors would also allow for developing a program of activities that could be used to tap into climate finance.

Advantages of the institutional context

Schools have several major advantages that can accelerate their transition to clean cooking solutions. The study found that more than half of schools in Kenya, Rwanda, and Uganda are already using some form of improved wood stoves, while a majority of their respective household populations still rely on three-stone fires.[33] A major concern for schools is the low quality of the solutions available, which has led to poor performance and discontinued use—a problem that developing and enforcing quality standards would help to resolve. Also, schools enjoy the advantage of having systems in place for kitchen and stove inspection, as well as enforcement processes; auditing of expenditures; and licensing requirements for operation. In addition, parents and teachers associations, as part of a school's governance system, can be a strong force for championing clean cooking solutions, including fund-raising and expenditure accountability. The highly organized administrative and governance system at all levels (from local to regional and national) can provide a unified voice for policy reforms. Because schools are centers of learning with firsthand experience of the fuelwood access problem, gaining knowledge about clean cooking solutions can empower them to tackle many of the challenges identified in the study.

[33] The study found that nearly all of Kenya's Kakuma camp schools cook on improved wood stoves, compared to an average of just 50 percent for the nation overall (including urban centers). In Chad, it was found that more than half of all refugee camp schools use LPG for cooking.



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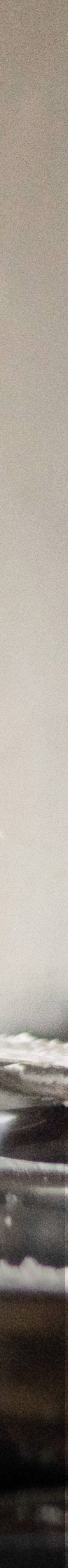
CHAPTER 6. SECTOR OUTLOOK



Summary

This study finds that, to date, limited support has been directed toward achieving clean cooking access in Sub-Saharan Africa's schools. Progress has been especially hindered by a lack of data on the scale of the problem, which is critical for making the business case for investing in the sector. Even so, a significant number of initiatives are found to have varied cooking solutions, which is promising. Also encouraging are the global best-practice cases identified by the study team in a variety of areas—refurbishment strategies, advocacy, financing, after-sales service, and technology innovations—which future initiatives can replicate and build on.

Recommended actions

Step up government's role in addressing the challenge

Governments have a major role to play in creating the enabling environment for sector investment. Most schools with feeding programs are publicly owned. Without the government's acknowledgment of the cooking challenge in schools and the role that clean cooking solutions can play in addressing it, the market for these products will not develop. Apart from direct budget provision of stoves for schools, governments have a major role to play in creating an enabling environment for investors, using such various instruments as tax rebates on institutional stoves, creating a level playing field for suppliers, setting product standards and regulating the price of fuels (e.g., liquefied petroleum gas [LPG]) and informal firewood markets. Governments also need to generate reliable sector statistics to strengthen the business case for investment and action. With better statistics on the scale of the problem and market potential, suppliers that are already serving commercial enterprises as anchor customers could consider serving schools as well.

The ambition for clean cooking in schools requires scaling up. Governments' low prioritization of clean cooking in schools and other large institutions is characterized by small-scale, fragmented efforts that are "invisible" and thus fail to attract the attention needed for growth. More ambitious programs can generate multiple benefits. These include unlocking new investment streams (e.g., climate finance), spurring innovations in technologies and delivery models, creating jobs along the value chain, and having positive impacts for society (e.g., public health and environment).

National guidelines for school feeding programs should take account of cooking energy needs. In its role as technical advisor to governments on school feeding programs, the World Food Programme (WFP) is well positioned to spearhead this action. Assessing the programs' energy needs (currently being undertaken in some WFP country initiatives) and incorporating clean cooking requirements into national school-feeding guidelines are promising efforts that should be scaled across countries.

Leverage lessons from the household cooking sector

The solutions offered should fit the cooking context of schools and respond to stove users' needs and preferences. When schools received centrally procured and disseminated stoves, major criticisms were the cooks' unfamiliarity with the stove technology and its unsuitability for local cooking practices. The inclusion of needs and wants assessments, enabling users to choose among various technologies, and training for cooks should be mandatory features of any cooking intervention.[34]

After-sales service for maintenance and repair should be integrated into all programs. Institutional stoves are a major investment, costing an average of US$3,000 per unit. The stoves often come as a package that includes cooking pots, fuel shelves, and other accessories, all of which are costly investments for schools. Ready access to skilled technicians and the availability of parts and repair services can ensure well-functioning stoves, which, in turn, can improve fuel efficiency and reduce cooking time. A long-term vision needs to consider stoves' life span and plan for their substitution.

Stove testing should be mandatory. Performance and user testing are necessary to ensure that institutional cooking initiatives are achieving their goals. Performance testing can reveal design flaws that lead to improvements. Even simple design changes can improve performance, thereby preventing stoves from falling into disrepair and eventual disuse. Testing also allows for user feedback, which can be incorporated into the stove designs to increase uptake.

To succeed, programs require a sustainable financing model. Decades of experience in the household cooking sector have demonstrated that stove giveaways are a disincentive to regular stove use and maintenance. However, it is challenging for schools to impose stove payment requirements on parents, particularly since feeding programs often target communities in poor, marginalized areas. Thus, a sustainable financing model for efficient cooking solutions is needed.[35]

Consumer and supplier finance are vital. Because the institutional cooking sector is capital intensive, the financial burden cannot be borne by the private sector alone. Lack of capital has limited the operations of multiple actors to a few urban areas, located far from their rural-based clients. Financing is needed across the entire value chain—from design innovation and awareness raising to marketing and after-sales support. Risk financing, which allows stove manufacturers and distributors to accept installment payments, is critical.

Awareness raising is required for all stakeholder groups. School cooks, administrators, and owners require knowledge and training on the long-term health impacts from dependence on polluting traditional stoves and fuels and the savings that would result from adopting

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[34] This study found that many implementing organizations had no prior experience in the household cooking sector, suggesting that household-sector lessons were not being transferred to school settings. It also found that the most successful product developers for schools started off working with household cookstoves.

[35] Carbon finance emerged as a promising approach for financing institutional stove projects; a deeper evaluation of those projects' failure to take off is needed so that lessons can be drawn to inform the design of future programs.

clean cooking solutions. In addition, cross-sector collaboration between closely related sectors, particularly energy and education, is needed to bridge potential capacity gaps in institutional cooking and create space for private-sector participation.

Address schools' unique challenges

School feeding programs need to accurately reflect the cost of fuels in school meals. Most of the programs reviewed in this study failed to include or correctly estimate their fuel costs, resulting in underestimating parents' contributions to school meals. This practice creates potential inequality since poor parents are more likely to make in-kind contributions compared to better-off ones, who can afford to make cash payments. Accurate costing of fuels would also provide evidence of the true cost of inefficient cooking. Based on this data, governments and other stakeholders could better estimate the returns from investing in this market segment; this, in turn, would incentivize the promotion and uptake of cleaner cooking solutions.

Before implementation, program designers need to gain an understanding of how the school system works. To succeed, programs need a good grasp of the school's budget structure. Also, prior to stove dissemination, they need to seek complete buy-in from school administrators and cooks.

The benefits of integrating cookstoves into schools' infrastructure projects should be considered. Since most institutional stoves are thought of as part of the kitchen's infrastructure, an argument could easily be made for considering stoves as part of school infrastructure projects from the outset. This approach would have multiple benefits. Instead of having to make a separate case for purchasing stoves, they would already be incorporated into schools' infrastructure budgets. Also, projects would avoid shortening the useful life of the stoves, which oftentimes occurs when stoves are disseminated to schools without permanent kitchens (i.e., when makeshift kitchens have to be demolished, the stoves are also lost). In addition, it would be easier to estimate program costs and location of the stoves. Furthermore, the stoves would be covered in school inspection reports.[36]

The design of clean cooking solutions need to account for expected growth in student populations. Many initiatives have selected stove capacities based entirely on the school's current number of students. In Kenya, for example, exponential growth in the Kakuma camp school's student population over time rendered some previously installed cookstoves unusable.

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[36] Stoves could be bundled with other interventions (e.g., kitchen gardens and home-grown feeding programs); regardless of the approach adopted, the needs and preferences of end users should be at the center to ensure that the technology choice is appropriate and thus more likely to have sustained use.

Study limitations

When interpreting the study's findings, several key limitations should be kept in mind. First, it was not within the study scope to sample and interview school administrators, who are among the key stakeholders. Because the perspective of this participant category was based on third-party accounts (i.e., those of companies and organizations that supplied cooking solutions to the schools), the potential for bias cannot be ruled out. Thus, it is strongly recommended that future studies interview school administrators directly. Second, the study design was qualitative and took an interpretive approach. Questions posed to participants were, for the most part, unstructured and open-ended, allowing interviewees to choose the types of information they wanted to present or emphasize during one-hour interview sessions. Since information was gathered only from those participants who volunteered it, the study has important data gaps (e.g., sources of program financing and their impacts, cost of cooking solutions, and scale of operations). It is recommended that future non-exploratory studies adopt a more systematic approach to data gathering.

Third, the limited time and resources allocated for the study suggest that some initiatives may have been missed. That said, there is no reason to believe that any selection bias occurred during the study's identification of initiatives and interview of participants. The likelihood that any initiatives overlooked would have changed the conclusions reached is extremely low.

Looking ahead

The problems that have prevented most cookstove initiatives in schools from reaching scale and driving co-benefits for society are solvable. In many respects, they resemble those of the household cooking sector in its early phases. Like most of the institutional initiatives covered in this study, household cookstove programs in the 1980s measured success by the number of stoves disseminated without any attempt to ensure their long-term adoption. The market was similarly characterized by fragmentation, lack of detailed data, and an inundation of low-quality products. Impact measurements were lacking, and stove users were rarely consulted on their needs and preferences. Although the household sector is far from achieving universal access to clean cooking solutions, it has made considerable progress in recent decades. The nascent institutional cooking sector can draw from this rich knowledge base (e.g., impact financing, innovative business models, and impact measurements) to address some of its own problems. Leveraging these lessons, along with tackling institutional cooking issues that are unique to the region's schools, can set a course for long-term progress.

References

Adkins, E., J. Chen, J. Winiecki, P. Koinei, and V. Modi. 2010. "Testing Institutional Biomass Cookstoves in Rural Kenyan Schools for the Millennium Villages Project." *Energy for Sustainable Development* 14 (3): 186–93.

AU (African Union). 2021. *African Union Biennial Report on Home-Grown School Feeding* (2019–2020). Addis Ababa: African Union.

AU, WFP, and EPRI (African Union, World Food Programme, and Economic Policy Research Institute). 2018. *Sustainable School Feeding across the African Union*. Addis Ababa.

Bundy, D. A. P., C. Burbano, M. Grosh, A. Gelli, M. C. H. Jukes, and L. J. Drake. 2009. *Rethinking School Feeding: Social Safety Nets, Child Development and the Education Sector.* Directions in Development Series. Human Development. Washington, DC: World Bank.

CCAK and SNV (Clean Cooking Association of Kenya and SNV Netherlands Development Organisation). 2018. *Study on Use of Biomass Cookstoves and Fuels in Institutions in Kenya.* Nairobi: Clean Cooking Association of Kenya and SNV Netherlands Development Organisation.

CESS (Centre for Economic and Social Studies). 2020. *National Survey on Cooking Fuel Energy and Technologies in Households, Commercial and Public Institutions in Rwanda.* Kigali: Ministry of Infrastructure and Ministry of Finance, Government of Rwanda.

CLEAN-Air (Africa) Global Health Research Group. 2022. "Pollution in Place: Place-based Perspectives Inform Air Pollution Priorities for Clean Energy Transitions in Nairobi Schools." Liverpool, U.K.: University of Liverpool.

Drake, Lesley, Alice Woolnough, Carmen Burbano, and Donald Bundy. 2016. *Global School Feeding Sourcebook: Lessons from 14 Countries*. London: Imperial College Press. http://hdl.handle.net/10986/24418.

Elahi, R., R. Srinivasan, and T. Mukurazhizha. 2020. "Increasing Human Capital by Electrifying Health Centers and Schools through Off-grid Solar Solutions." *Live Wire* 2020/104. Washington, DC: World Bank Group.

ESMAP (Energy Sector Management Assistance Program). 2020. *The State of Access to Modern Energy Cooking Services.* Washington, DC: World Bank.

ESMAP (Energy Sector Management Assistance Program). 2021. *What Drives the Transition to Modern Energy Cooking Services? A Systematic Review of the Evidence.* Technical Report 015/21. Washington, DC: World Bank Group.

Gelli, A., A. Kretschmer, L. Molinas, and M. Regnault de la Mothe. 2012. "A Comparison of Supply Chains for School Food: Exploring Operational Trade-offs across Implementation Models." Home-Grown School Feeding (HGSF) Working Paper. London: Partnership for Child Development (PCD).

GIZ (German Agency for International Cooperation). 2006. *PSDA Institutional Stoves Baseline Report.* Nairobi: German Agency for International Cooperation.

IEA, IRENA, UNSD, WB, WHO (International Energy Agency, International Renewable Energy Agency, United Nations Statistics Division, World Bank, and World Health Organization). 2023. *Tracking SDG 7: The Energy Progress Report.* Washington, DC: World Bank.

PSFU (Private Sector Foundation Uganda). 2020. *Market Survey on Institutional Cooking in Uganda.* Kampala: Private Sector Foundation Uganda.

Sanyal, Sanjoy, and Esther Kahinga. 2018. "Cleaner-Burning Fuels at Kenyan Schools Feed Students and Protect Forests." *Insights* (blog), November 5, 2018. https://www.wri.org/insights/cleaner-burning-fuels-kenyan-schools-feed-students-and-protect-forests.

Thome, K., D. M. Smith, K. Daugherty, N. Rada, C. Christensen, and B. Meade. 2019. *International Food Security Assessment 2019–2029.* GFA-30. Washington, DC: United States Department of Agriculture, Economic Research Service.

WFP (World Food Programme). 2022. *State of School Feeding Worldwide 2022.* Rome: World Food Programme.

World Bank. 2018. *The State of Social Safety Nets 2018.* Washington, DC: World Bank. https://openknowledge.worldbank.org/entities/publication/8fef01f3-fb9f-5e6d-b3f3-a9d5d846f5aa.

World Bank. 2023. "Classification of Fragile and Conflict-Affected Situations." *Brief,* July 10. https://www.worldbank.org/en/topic/fragilityconflictviolence/brief/harmonized-list-of-fragile-situations.

APPENDIX A.

Variables Explored in the Study

Most of the variables in the study methodology yielded no information, highlighting the need for primary data collection. The initial set is listed below.

Background on the National Setting

- Country
- Location: Rural, urban, or peri-urban
- National access rates to clean cooking solutions
- Penetration of clean cooking solutions
- Types of technologies on the market (household and institutional)
- Policies on clean cooking and its impact areas
- Stakeholders

Features of the School's District (i.e., Catchment Area)

- Access rates to clean cooking solutions
- Key development indicators
- Key actors and stakeholders
- Setting-specific policies and strategies
- Primary household fuel and stove
- Secondary household fuels and stoves
- Sources of household fuels and stoves
- Clean fuels penetration
- Access to electricity (e.g., availability, affordability, and reliability)
- Fuel-and-stove combinations of other institutions

Institutional Features: Internal Structure and Governance

- Category of educational institution (e.g., public primary or private secondary)
- Access to basic infrastructure (i.e., electricity and water)
- Governance structure
- Budget structure
- Sources of funding
- Gender composition in management
- Number of staff
- Feeding program (yes/no)

If There Is a Feeding Program

- Sponsoring organization (if any)
- Free or paid
- Number of meals
- Number of students participating in the program (by age group or class)
- Background information on program participants (e.g., socioeconomic or gender)
- Number of staff
- Number of cooks (by gender)
- Cooking location
- Primary fuel and stove
- Secondary fuels and stoves
- Source of primary fuel (fuel 1)
- Sources of secondary fuels (fuels 2, 3, 4, and 5)
- Source of primary stove (stove 1)
- Sources of secondary stoves (stoves 2, 3, 4, and 5)
- Responsibility for sourcing fuel
- Cost of acquiring fuel
- Share of fuel cost in school budget

Impacts

- Qualitative information

Information Sources

- Publication date, type, author, year, URL/library link, and quality rating

Owing to data limitations, the initial set of variables was reduced to the subset shown below.

- Project code
- Main organization
- Mission
- Role
- Funding source (if not main organization)
- Implementer (if not main organization)
- Activity country
- Type of activity
- Details on activity
- Link to organization/information source
- Link to program/literature
- Contact persons

The following cooking technology variables were further explored, but failed to yield the full set of information sought.

- Project implementer
- Fuel used by the technology (multiple entries if more than one solution)
- Key design features of non-biomass stove (description of key stove parts, whether fixed or portable, construction material used, and combustion principles)
- Stove size (actual dimensions or pot size that can be accommodated)
- Stove burners (number)
- Stove cost
- Number of people that a meal prepared on the stove can serve
- Specific fuel consumption (grams of firewood per kilogram of food prepared; specified food type)
- Performance relative to traditional stove (e.g., percent fuel savings and health benefits)
- User feedback (positive and negative) on stove (e.g., speed of cooking, ease of lighting, and wood preparation)
- Stove durability (number of years it can last without repair)
- Is the stove available in the local market? (yes/no)
- Are stove parts locally available? (yes/no)
- Is technical capacity for stove repair locally available? (yes/no)
- Is fuel for the stove locally available? (yes/no)
- Is stove performance independently evaluated? (yes/no)
- Other relevant information on the stove technology and fuel
- Pictures of the stove technology and fuel

APPENDIX B.
Identified Cooking Initiatives in Schools

TABLE B.1
Data collection status of initiatives by country and main organization

Organization, activity	Status
Kenya	
AERA Group	I/R
Clean Cooking Association of Kenya (CCAK)	I/R
Equity Bank	I/R
Food4Education	I/R
German Agency for International Cooperation (GIZ), Millenium Village Project	I/R
FESE Works	I/R
Powerspot	I/R
Renetech	I/R
SNV	I/R
Vuma Biofuels	I/R
World Bank and Ministry of Energy	I/R
World Food Programme (WFP)	I/R
WFP, Support to Government of Kenya	I/R
Uganda	
International Lifeline Fund (ILF)	I/R
Masrcorp	I/R
UNITE for the Environment-North Carolina Zoo	I/R
WFP	I/R
Burundi	
ILF	I/R
WFP	I/R
Chad	
Hamerkop	I/R
Ethiopia	
WFP	I/R
Haiti	
WFP and ILF	I/R
Lao PDR	
World Bank and WFP	I/R
Madagascar	
ADES (Association pour le Développement de l'Energie Solaire Suisse-Madagascar)	I/R
Malawi	
GIZ	I/R
Rwanda	
WFP	I/R
Sudan (Darfur)	
WFP	I/R

Organization, activity	Status
Zambia	
Emerging Cooking Solutions	I/R
Multiple locations	
Climate Solutions	I/R
World Central Kitchen	I/R
Kenya	
Acacia Innovations (financed by SEforALL)	NR
East African Wildlife Society and Karen Country Club	NR
Ecobora (financed by The Futures Project)	NR
EcoZoom	NR
Uganda	
Expertise France	NR
Kakira Outgrowers Rural Development Fund (KORD)	NR
Maximpact	NR
Panorama Solutions for a Healthy Planet	NR
Paying.Green	NR
United Nations Development Program (UNDP) and Government of Uganda	NR
Waste to Energy Youth Project	NR
Ghana	
Global Alliance for Clean Cookstoves through World Education	NR
Haiti	
United States Agency for International Development (USAID)	NR
India	
Stove Team International	NR
Multiple locations	
United Nations Children's Fund (UNICEF)	NR
Eco Ltd	NR
Kenya	
IT Power Eastern Africa	NC
Nature Kenya in partnership with BirdLife Denmark (DOF)	NC
Olkaria Bio	NC
UNDP and GEF	NC
Ghana	
Voice for Change (SNV-supported partnership)	NC
India	
Government of India	NC
Malawi	
CO_2OL Effect (Cool Effect)	NC
Nigeria	
Government of Nigeria	NC
Senegal	
United States Department of Agriculture (USDA) McGovern-Dole Food for Education Program	NC
Sudan (Darfur)	
Various UN agencies	NC
Tanzania	
World Wildlife Fund (WWF) and Tanzania Traditional Energy Development and Environment Organization (TaTEDO)	NC

Organization, activity	Status
Timor Leste	
UNDP and Global Environment Facility (GEF)	NC
Zambia	
Alternative to Charcoal	NC
Global	
Modern Energy Cooking Services (MECS) Program	NC

Source: Authors.
Note: I/R = interviewed/researched, NR = no response, and NC = not contacted.

APPENDIX C.
Institutional Cooking Technologies Identified

TABLE C.1
Features of the stove technologies

Stove technology	Energy source	Design features	Cost	Stove durability and maintenance	Efficiency (%)	Initiatives utilizing the technology	Reference
Rocket stove (Bellerive and various other brands)	Firewood	Modular with a mostly fixed brick body, in a capacity range of 50–600 liters; small-capacity (15–20 liters), portable ones also available	Varies by stove size: US$494 for (30-liter model), US$1,827 (400-liter model), and US$2,450 (600-liter model); US$2,000–3,500 for Bellerive brand, depending on size	Life cycle of 5 years or longer with proper maintenance (one study reported US$300 in annual maintenance cost)	33–65	Most initiatives reporting efficient biomass cookstoves (e.g., EnDev in Malawi, SNV in Kenya, and GIZ in Kenya)	CCAK and SNV 2018; Interviews
Oli B-60 stove	Firewood	Stoves anchored in slab, with brick furnace to insulate the pot; up to 12 units per school, depending on size of student population	n.a.	n.a.	n.a.	ADES in Madagascar	ADES
Institutional Kenya Ceramic Jiko (KCJ)	Charcoal	The most common improved charcoal stove; portable, featuring a metal exterior and internal clay liner	n.a.	Replacement of fire grates, at annual cost of US$8.3–16.6 per stove	50	Reported as being used in Kenyan schools	CCAK and SNV 2018 (based on survey of Kenyan institutions)
Biomass stove (unspecified)	Biomass	n.a.	US$628 (100-liter double pot), US$785 (150-liter double pot), and US$916 (200-liter double pot); varied prices, depending on location of institution	Life cycle of about 8–10 years; maintenance usually late in the third year after installation	n.a.	n.a.	PSFU 2020 (based on survey of Ugandan institutions)
Muvero	Firewood	n.a.	n.a.	n.a.	n.a.	n.a.	CESS 2020 (based on survey of Rwandan schools)
Darfur stove	Firewood	n.a.	n.a.	n.a.	n.a.	n.a.	CESS 2020
Rondereza Plus	Charcoal	n.a.	n.a.	n.a.	n.a.	n.a.	CESS 2020
Double place metal	Charcoal	n.a.	n.a.	n.a.	n.a.	n.a.	CESS 2020
Ruhuka IP	Briquettes	n.a.	n.a.	n.a.	n.a.	n.a.	CESS 2020

Stove technology	Energy source	Design features	Cost	Stove durability and maintenance	Efficiency (%)	Initiatives utilizing the technology	Reference
ILF institutional stove	Fuelwood (can also burn briquettes)	Elevated fixed stove, with various models and sizes available (e.g., WFP in Burundi used a 100-liter capacity model)	Varies by customer budget and needs; US$2,000 for 3-pot stoves, inclusive of stainless steel pots and stove-use and maintenance training	n.a.	42–45	WFP in Burundi	Interview
Large electric pressure cooker (EPC)	Electricity	n.a.	US$393 for 60-liter EPC and US$655 for 80-liter EPC (in Uganda)	10-year lifespan	n.a.	n.a.	PSFU 2020
Renetech Solar Cooker	Solar	Features 2–6 solar collectors (depending on application type, location, and need for input heat), with a heat storage component and multiple cooking units; heat transference between components via gravity, using thermosiphons (tubes filled with water at a slight sub-pressure); cooking before sunrise possible due to heating of energy storage unit by thermal solar collectors; available pot-size capacity of 200–400 liters	n.a.	n.a.	n.a.	n.a.	n.a.
Masrcorp cooking system	Solar, firewood, and volcanic rock	System with 3–8 burners that uses firewood to heat rocks, which generate cooking energy and are reusable; high temperatures maintained by solar-driven fan	US$2,000	20-year lifespan	80 (fuel savings)	Masrcorp in Uganda	Interview and website
Steam cooker	Steam generated by other energy source	LPG used to heat water in cooking vessels to 150 degrees (typically 10 600-liter capacity vessels per kitchen)	US$30,000 per unit, depending on size; Food4Education systems (US$130,000 total cost): (1) 8 cooking vessels (300-liter capacity) and (2) 12 cooking vessels (600-liter capacity)	n.a.	n.a.	Food4Education	Interview
Pellet stove (unspecified brand)	Pellets	Fan-assisted stove; can use electricity generated to power a radio or phone	US$100 with 50% subsidy for a 50-liter stove; cost range of US$900–2,000, depending on size	n.a.	n.a.	Powerspot in Kenya	Interview

Source: Authors.
Note: n.a. = not available.

TABLE C.2

Reported costs of alternative fuels

Fuel type	Cost	Reference
Non-carbonized briquettes	Fuel: US$0.13–0.21 per kg Production machine: $21,000 per unit	PSFU 2020
Liquefied petroleum gas (LPG)	First charge: US$81.3 (12.5 kg), US161.2 (38 kg), and US$163.0 (45 kg) Refill cost: US$23.8 (12.5 kg), US$59 (38 kg), and US$89 (45 kg)	PSFU 2020
Pellets	Reported as 50% lower than charcoal	Interview

Source: Authors.
Note: Firewood and charcoal baseline fuels were excluded owing to the wide cost variability by location and time.

APPENDIX D.

Fuel Consumption by Schools Reported in Large-Scale Surveys

TABLE D.1

Survey results on fuel consumption for schools in Kenya, Rwanda, and Uganda

Country	Schools surveyed (number)	Students/ school (number)	Meals served/ day (number)	Length of school year	Fuel consumption/school		Total annual fuel consumption (all schools)	Reference
					Metric	Consumption		
Kenya	746	n.a.	n.a.	n.a.	Not disaggregated for schools		n.a.	GIZ 2006
Kenya	204 primary schools; 239 secondary schools	n.a.	n.a.	270 days	Consumption per person per year	Biomass: primary schools (TS 193.4 kg; ICS 132.2); secondary schools (250.6 kg; ICS 178.8) LPG: primary schools (1.7 kg); secondary schools (0.8 kg)	Biomass: 1.31 million tonnes; Firewood: 0.47 million tonnes; charcoal 0.55 million tonnes	CCAK AND SNV 2018
Rwanda	82 boarding schools	n.a.	n.a.	n.a.	Quantity consumed per year	Biomass: firewood (48,127,736 kg); charcoal (58 kg); pellets (8,640 kg); briquettes (107,630 kg) Clean fuels/energy: biogas (50,964 m3); LPG (18,996 kg); electricity	44,292,817 MJ	CESS 2020
Uganda	n.a.	500–900 (median of 700)	Varies by school; up to 3 for boarding schools	9 months	Consumption per school per year	Biomass: TS (37.5 tonnes); ICS (22.5 tonnes)	Firewood: 1.1 million tonnes	PSFU 2020

Source: Authors.
Note: n.a. = not available.

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