Knowledge Brief: Electricity as a Clean Cooking Alternative for Institutions in Humanitarian Settings

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1. Introduction

Humanitarian and displacement settings, such as refugee settlements and communities hosting internally displaced persons (IDPs) often face significant challenges accessing essential services. One of the most pressing is the lack of access to sustainable cooking solutions for both households and institutions, including schools and health facilities. Most of these institutions rely on firewood and other biomass fuels for cooking. This dependency has wide-ranging socio-economic, environmental and health consequences, contributing to forest degradation, household air pollution, and associated health risks. Household air pollution was responsible for an estimated 3.2 million deaths per year globally in 2020 (World Health Organization, 2024). A 2022 World Bank study in Cox's Bazar, Bangladesh, found that forest cover declined by nearly 20% between 2017 (the year of the largest Rohingya refugee influx) and 2020. This equated to an annual loss of 6.7% across the district (Dampha, Salemi, & Polasky, 2022).

Despite global electricity access reaching 91%, approximately 2.1 billion people (about 26% of the world's population) still depend on polluting fuels such as charcoal, wood, kerosene, waste, and dung for cooking (IEA et al., 2024). The situation is particularly severe in displacement settings where access to clean cooking solutions remains very low, with issues related to accessibility, affordability, and sustainability persisting due to the complexity of these environments (Ndahimana, Hangi and Rosenberg-Jansen, 2023).

A joint study by the Energy Sector Management Assistance Programme (ESMAP) and the World Food Programme (ESMAP, 2024) notes that schools are the second-largest consumers of biomass energy, after households. It further notes that an estimated 418 million children receive at least one meal a day at school; a figure that is expected to rise. In low- and middle-income countries (LMICs), around 80% of school meals are prepared using firewood, exposing both cooks and children to harmful emissions. Children's developing respiratory, nervous, and immune systems make them especially vulnerable to this exposure. Air pollution in school settings has also been shown to negatively affect children's attention and attendance. Additionally, when fuel is scarce, meals are skipped or undercooked, undermining the goals of school feeding programs (Bisaga and Campbell, 2022), (Saligari et al., 2024). Several studies have found that air pollution in African schools often exceeds the World Health Organisation's (WHO) guidelines (Saligari et al., 2025), (Kalisa et al., 2023). Women, who are most often the cooks, face a double exposure burden at both home and work. In some cases, smoke from school kitchens even drifts into classrooms, disrupting learning environments. The scale and impact of these challenges, especially in displacement settings, remains under-documented, resulting in low visibility for clean cooking initiatives in schools (and other institutions) and limited targeted investment.

According to ESMAP (2024), school kitchens in Sub-Saharan Africa, the region with the highest food insecurity and lowest clean cooking access, consume about 8 million tons of firewood annually. This generates 12–14 million tons of CO_2 equivalent emissions, with an estimated economic cost of US$575.7 million per year. Parents and students, especially in rural or conflict-affected areas like displacement settings, are often exposed to risks while collecting firewood, which is commonly required as an in-kind contribution to school feeding programs.

However, the increasing availability of electricity, often through renewable off-grid solar solutions, and energy-efficient electric cooking (e-cooking) appliances such as electric pressure cookers and induction stoves present a potential paradigm shift towards cleaner and more sustainable institutional cooking in these contexts. E-cooking can help reduce fuel costs, shorten cooking times, and minimise health risks, while also combatting environmental challenges such as deforestation. Furthermore, e-cooking may also reduce the reliance on unpaid labour from parents for meal preparation in schools (Khalifa et al., 2025) while also lessening the burden of firewood collection, particularly for women and children (Coulentianos et al., 2024), (Odoi-Yorke, 2024).

Despite these benefits, displacement settings lack standardised data on e-cooking adoption. This knowledge brief seeks to bridge this gap by drawing on insights from institutional e-cooking initiatives in four countries (see Table 1): in Kakuma, Kenya (Khalifa et al., 2025), Kyangwali, Uganda (Pesitho HEC presentation, 2024 and follow-up interviews in 2025); Burkina Faso (interview with project lead, 2025); and Cox's Bazar, Bangladesh (GPA field visit and follow-up interviews, 2025). These examples aim to inform the feasibility, design, and impact of institutional e-cooking in displacement settings.

Table 1: Overview of case studies

	Kakuma, Kenya	Kyangwali, Uganda	Cox's Bazar, Bangladesh	Burkina Faso
Project summary	Testing large EPCs in 3 primary schools in Kakuma refugee camp	Solar school kitchen in Kyangwali refugee settlement (Pesitho off-grid solar school kitchen)	A 13-bed in-patient health facility, equipped with a 3.3 kWp PV system and battery backup for e-cooking	Solar Cookers in School Canteens project in Centre-Nord and East regions of Burkina Faso, delivering solar e-cooking solutions to 10 schools
System Set-up	Each school is connected to a standalone solar PV system or solar mini grid	A grid-tied, 11 kWp solar PV system (40 x 275 W) with inverters and lead acid batteries (38.4kWh)	A 3.3 kWp (6 x 550 W) solar PV system with inverter and 48 V, 130 Ah (6.24 kWh) battery storage system	Each school is equipped with 3.3 kWp PV panels, a 5 kWh battery back-up, 5 kW inverter and a charge controller
System cost	Not disclosed	~ 45 000 USD, for the system cost (excluding maintenance cost)	~ 6100 USD for purchase, installation and 1 year maintenance of the solar e-cooking system	~ 5000 USD for purchase, installation and 1 year maintenance of the solar e-cooking system.
Project period	Not available	September 2022 – May 2024	2024 – present	2024 – present
Funders	FCDO (through MECS) & SNV	Innovation Norway	Super Star Group and Schneider Electric	WFP
Partners	SNV (Netherlands Development Organisation), EnDev, Modern Energy Cooking Services, UNHCR	CARE, ECOCA East Africa, Pesitho	UNHCR and NGO Forum	WFP and local private company (MAS Distribution)
WFP and local private company (MAS Distribution)	Refugees	Refugees	Refugees	Refugees
Type, and number of institutions	3 Primary Schools	1 Primary School	1 Health clinic	10 Primary Schools
Number of people catered for in each facility	178 at Angelina Jolie Girls Primary Boarding School; 789 at Jebel Mara Primary Day; 3 178 at Morning Primary Day	135 pupils[1]	13-bed in-patient facility	The smallest school has 96 pupils while the largest school has 489 pupils. The average enrollment across the 10 schools is 296 pupils per school.[2]
Number of meals served per school per day with the system	1 lunch & dinner meal at Angelina Jolie Girls Primary Boarding School; 1 lunch meal for staff at Jebel Mara Primary School; 1 lunch meal for staff at Morning Star Primary School	1 Lunch meal per pupil per day in the Kinakyeitaka Primary (day) School	40 meals (1 Breakfast, lunch and dinner per patient)	1 Lunch meal per pupil per school
Baseline cooking fuel prior to e-cooking intervention	Firewood	Firewood (9 Trucks of firewood per year, costing 1200 USD annually)	LPG (Two to three 12kg cylinders per month)	Firewood, paired with low efficient stoves (Each pupil was expected to bring a piece of firewood to school each day)
Type & quantity of e-cooking technology per facility	2 EPCs	2 Tiltable induction stoves	2 Single-burner induction stoves	2 EPCs
Power rating of e-cooking appliances	Not available	Each induction stove is 12000 W max	2000 W and 1500 W respectively	Each EPC is 2300 W

[1]Kinakyeitaka Primary (day) School has a total enrollment of 2,352 students; however, only 135 pupils, primarily candidates, are currently enrolled in the school feeding program.

[2]Names and number of pupils per school are as follows. Ecole de: Nabitenga (374), Waguesse (96), Torodo (290), Tansega (263), Soubdougou (321), Zempasgho (295), Lemnogo (240), Nambeguian (269), Saaba A (489), Sibalou (320).

2. Advantages of Electric Cooking

The adoption of e-cooking in displacement settings offers numerous benefits, addressing critical health, environmental, economic, and social challenges associated with traditional biomass-based cooking. As demonstrated in pilot projects across Kenya, Uganda, Burkina Faso, and Bangladesh, e-cooking can improve indoor air quality, reduce cooking time, lower costs, improve comfort, enhance safety, and thus makes cooking more enjoyable overall. This section explores the key advantages of transitioning to e-cooking in institutional settings within humanitarian contexts.

Health and environmental improvements

E-Cooking in primary schools in Burkina Faso © WFP Burkina Faso

A significant advantage of e-cooking is the elimination of indoor air pollution and associated physical, respiratory and cardiovascular health risks, particularly for the cooks, usually women, who are often responsible for cooking, as well as the school pupils or patients within the facilities. In Kakuma, school cooks reported a cleaner cooking environment with the use of the EPCs, noting less smoke and soot, leading to reduced eye irritation. In Kyangwali, the cook reported no longer experiencing headaches, eye irritation, or fatigue from smoke; issues that were common when using firewood. Similarly, in Burkina Faso, the cooks reported improved working conditions and feeling less fatigued, as they no longer spent extended hours near open fires, sweating and inhaling smoke that previously caused eye irritation, coughing, and persistent headaches.

Transitioning to e-cooking significantly reduces reliance on firewood (and other fossil fuel-based fuels), thereby addressing climate related issues of CO_2(e) emission, deforestation, habitat loss, soil erosion, and degradation prevalent in many humanitarian settings where biomass is the primary fuel source. The Pesitho solar school kitchen in Kyangwali demonstrated a significant reduction in firewood consumption, shifting from nine (9) trucks of firewood per year to approximately two trucks per year after the adoption of e-cooking, representing an 80% decrease in firewood usage. Similarly, in Cox's Bazar, e-cooking replaced the use of two to three 12kg LPG cylinders per month to just one cylinder in two to three months, an estimated 83% reduction in LPG consumption after the transition. In Burkina Faso, firewood consumption in schools decreased by about 80%, with each pupil previously providing one piece of firewood per (school) day, now providing only one piece per week. The Burkina Faso school administration appreciated this benefit, adding that due to the e-cooking intervention, parents are relieved because they no longer have to search for firewood every evening for their children to take to school the next day.

Time and cost savings

E-cooking offers significant time savings in food preparation. In school settings, it eliminates the burden of collecting or procuring firewood for school cooking, which often falls on parents or students themselves. Meanwhile for cooks, e-cooking aids in resolving the time-consuming and often strenuous task of preparing firewood. In Kyangwali, the cook reported saving 2 - 3 hours of cooking time daily, reducing time pressure. Similarly, cooks in Kakuma noted that EPCs enabled faster cooking and multitasking, as the EPCs require minimal supervision, as opposed to cooking on firewood. The shift from firewood or improved institutional firewood stoves to EPCs in Kakuma reduced daily cooking time by nearly half. In Burkina Faso, the transition to e-cooking also significantly reduced average cooking time. Though not yet quantified, the cooks and schoolteachers in Burkina Faso reported that meals were now served on time, and the cooks no longer needed to leave their homes at 3 am just to start meal preparation well in advance. Additionally, with the automated nature of the EPC, the cooks in Burkina Faso reported being able to do other things while the food cooked, such as preparing for the next meal, cleaning the kitchen or even resting, instead of constantly stirring the food and tending the fire which they were often occupied with previously.

Despite the initial investment costs, e-cooking offers significant long-term savings by reducing or eliminating fuel expenses. The Kakuma study demonstrated substantial cost reductions when switching from improved firewood stoves to EPCs, with savings varying by EPC size. Transitioning to a 40L EPC resulted in a 21.7% cost reduction per kilogram of food, increasing to 58.5% when Ugali (maize meal) is excluded. The 21L EPC achieved even greater savings, 31% per kilogram of food and 56% when Ugali was excluded. It was noted that due to the relatively small size of EPCs, fuel costs for cooking Ugali remained higher compared to improved firewood stoves, as the Ugali would have to be cooked in two rounds using the EPCs. The health facility in Cox's Bazar reduced LPG consumption by about 83%, an estimated monthly savings of 25 USD. Similarly, the Pesitho project in Kyangwali realised a $960 reduction in annual firewood costs, further demonstrating the economic advantages of switching to e-cooking.

Kyangwali Primary School Kitchen, Uganda, using tiltable 110L induction stoves © Pesitho

Safety and other benefits

E-cooking eliminates the open flames associated with some biomass and gas stoves, reducing the risk of burns. This is a crucial consideration within the often limited cooking spaces noted in humanitarian settings. The cook at the health facility in Cox's Bazar noted that using an electric induction stove felt significantly safer compared to cooking over an open LPG flame. In Burkina Faso, cooks shared that the use of EPCs eliminated the risk of burns from fire sparks, which were common with traditional firewood stoves.

A range of other benefits have been observed as well. In Burkina Faso, the cooks reported that the food cooked more evenly, without burning, and tasted better. In Kakuma, the cooks reported that the pots (EPCs) were easier to clean. Similarly, the health facility in Cox's Bazar noted that induction cookers tend to keep pots cleaner compared to LPG, which leaves behind soot and food residue. They also help reduce food waste as food does not burn easily and stick to the pots, requires less water to wash as a result. The cook also mentioned being able to use a fan during summer, which was not possible with LPG. The introduction of e-cooking in the Burkina Faso schools is beginning to generate a spillover effect, with growing interest among teachers and parents who are now considering adopting e-cooking solutions in their own homes too.

The benefits of adopting e-cooking solutions in these facilities have been summarised in Table 2.

Table 2: Impacts of transition to e-cooking

	Kakuma, Kenya	Kyangwali, Uganda	Cox's Bazar, Bangladesh	Burkina Faso
Average cooking time savings	Daily cooking time reduced to almost a half	About 2 – 3 hours	The cook acknowledged that e-cooking requires slightly less time, though she couldn't specify the exact amount	The cooks did not quantify the time, but both cooks and school administration admitted that food is now being served on time.
Fuel savings	Not available	~ 80% reduction in firewood usage (2 trucks of firewood per year, compared to 9 trucks prior), with exceptions during maintenance, breakdowns, or prolonged rainy days.	~83% LPG savings (from 2 -3 12kg cylinders a month to 1 cylinder in 2-3 months)	80% savings on firewood used per week (From one piece of firewood per pupil per day to 1 piece per pupil per week.)
Average cooking fuel cost savings	Preparing staple meals like beans and githeri was at least 50% cheaper compared to using improved institutional firewood stoves	~ 960 USD saved on firewood per year	~ 25 USD saved per month	*Firewood was originally provided free of charge by school pupils
Additional feedback from cooks	School cooks reported a cleaner cooking environment with EPCs, noting less smoke and soot, leading to easier pot cleaning and reduced eye irritation. - Switching from firewood to EPCs reduced water usage by an average of 24.6% per kilogram of food cooked	In Kyangwali, the cook reported not getting tired from smoke anymore, a problem experienced with firewood.	The induction cookers keep pots cleaner than LPG, which leaves residue. - The cook added that she can use a fan during summer which was not possible with LPG. Additionally, she requires less water for pot washing, as there is no residue under the pots.	"Cooking used to be very difficult. We spent hours near the fire, sweating and inhaling smoke that stung our eyes, made us cough, and gave us headaches. Sometimes, sparks would 'fly', and we would get burned..."[3]

[3] "Cooking used to be very difficult. We spent hours near the fire, sweating and inhaling smoke that stung our eyes, made us cough, and gave us headaches. Sometimes, sparks would fly, and we would get burned. But now, with these new solar electric pressure cookers, everything has changed. There's no more smoke, no open flames, and fewer burn risks. The food cooks evenly without burning, and it tastes better. …

Before, we constantly had to stir and monitor the fire, but now, once we set the cooker, we can do other tasks: clean the kitchen, prepare the next meal, or even rest a little. The device shuts off automatically when the food is ready. At the end of the day, we are much less tired. Cooking is no longer a burden - it's a pleasure."

3. Barriers and Considerations for Implementation

Despite its benefits, e-cooking in institutional humanitarian settings faces a range of challenges, including high upfront costs, lack of or unreliable electricity supply, and the need for training and regular technical support. Security risks, such as theft and vandalism further threaten infrastructure sustainability. Additionally, government policies, restrictions and regulations can limit access to electricity and increase costs, or place barriers to entry for providers of off-grid energy solutions. Addressing these challenges is crucial, requiring strategic and context-appropriate considerations, investment, awareness creation and sensitization. The need for capacity building, and policy advocacy is also imperative in enabling the successful and sustainable adoption of e-cooking solutions in humanitarian settings.

Cost

The upfront costs associated with transitioning to e-cooking including the installation of off-grid solar PV systems (which is usually the case), purchase of appliances, infrastructure upgrades, and potential acquisition of new cookware or utensils. These can be significant barriers, especially in resource-constrained displacement settings. The Cox's Bazar case mentioned challenges with the cost and space for a panel-holding structure initially. In Burkina Faso, the purchase, installation and a 1-year quarterly maintenance of the 3.3kWp solar e-cooking system in each school costs about 3 million FCFA (~ USD 5000). In Cox's Bazar, the purchase, installation and maintenance cost for the 3.3kWp solar e-cooking system was ~ USD 6100. The upfront purchase and system installation cost in Kyangwali was USD 45 000; there was equally a need for a new kitchen structure in this school, which also delayed the project.

Electricity access and reliability

Consistent and reliable access to electricity is crucial for e-cooking, especially in institutions where timely meal preparation is a critical requirement. Off-grid solar systems, while promising, can be affected by weather conditions, leading to brown-outs, power outages and the need for battery storage (which is often expensive), as well as other alternative backup cooking energy solutions. Due to constant brownouts noted in the Cox's Bazar case, the health facility upgraded its solar system by adding more PV panels and doubling battery storage capacity from 24V to 48V. This enhancement ensured a consistent power supply and sufficient energy to support a full day of cooking, even without sunlight. Despite these upgrades, the facility continues to experience around three to four days without power during the monsoon season, requiring a partial shift back to LPG. This underscores the importance of accounting for periods of minimal solar radiation when designing solar PV e-cooking systems, particularly when aiming for a full transition to e-cooking. The Kakuma study noted that the use of EPCs was constrained by the battery storage capacity installed at the schools. In Kyangwali, the need for a backup solution when operating off-grid was highlighted as a key consideration for future e-cooking system designs. Additionally, the cooks in the Burkina Faso were unable to prepare breakfast using the EPCs due to small capacity of the solar systems and the need to start lunch preparation early, as it must be prepared in two batches before midday.

Appliance size

It is essential that e-cooking appliances are appropriately sized and suited to the types and quantities of food being prepared for large groups of people. In Burkina Faso, cooks had to prepare meals in two rounds using the 25L EPCs to ensure that the appropriate quantity of lunch was served on time. The health facility in Cox's Bazar reported a need for more induction hobs to prepare multiple meals simultaneously. Similarly, in Kakuma, cooks were unable to prepare large-quantity dishes like Ugali and porridge with EPCs, as the appliance size was insufficient to meet the needs of the student population.

School Kitchen in Kyangwali refugee settlement © Pesitho

Training and maintenance

Implementing and sustaining e-cooking systems requires technical expertise for installation, operation, maintenance and repair, as well as user training. Training local personnel, including refugees on system maintenance and operation along with addressing any initial user concerns or preferences, are crucial for long-term sustainability. The Kyangwali project emphasised continued on-site training and long-term service agreements. In Cox's Bazar, UNHCR and NGO Forum took initial responsibility for maintenance while training refugee volunteers, which also provided potential income-generation opportunities; the PV panels are now cleaned on a weekly basis by the volunteers. In Burkina Faso, as well as Kakuma, provision of comprehensive training to cooks and other school staff was an integral part of the project. In the case of Cox's Bazar, initial safety concerns were addressed through training and sensitisation, leading to confident use by the cooks. In Burkina Faso, it was noted during monitoring visits in some schools that the EPCs were used to prepare just the foodstuff provided by WFP through its school feeding programme. This highlights the need for continuous monitoring and sensitisation even after installing the systems, to optimise system usage.

Security and other constraints

Security concerns pose significant barriers to the adoption of e-cooking in displacement settings, where instability, theft, and vandalism can damage critical energy infrastructure, including solar panels, batteries, and wiring, disrupting electricity access and forcing institutions to revert to traditional biomass fuels. Additionally, restricted movement due to security threats can delay necessary maintenance and repairs, further undermining system reliability. In Burkina Faso, security issues in the project area caused delays in the transportation and installation of solar e-cooking systems in several schools.

Other challenges faced in these facilities include insufficient water supply and a lack of proper cleaning kits (such as sponges and soap), as reported in Burkina Faso. These issues can hinder proper maintenance and reduce the lifespan of e-cooking appliances. Many of the schools in Burkina Faso lacked sturdy surfaces for placing the EPCs, often resorting to placing them on the floor, which increased the risk of burns and food spills. Similarly, in Cox's Bazar, the cook requested a higher cooking station to improve convenience. These factors highlight the importance of considering infrastructure and support systems when transitioning to e-cooking in facilities to ensure a safer, more efficient, comfortable, and **sustainable cooking experience.**

Use of induction cookers at a health facility in Rohingya refugee camps, Cox's Bazar. Field visit to Rohingya Refugee camps, Feb 2025. © UNITAR/GPA,

4. Conclusion

The four case studies presented in this brief demonstrate the promising potential of institutional e-cooking in humanitarian settings. Reported benefits include significant reductions in biomass and LPG consumption and costs, improved health and working conditions for cooks, time savings, and a more conducive learning environment for students. Additionally, e-cooking has helped ease the burden on parents, reduced food and water waste, and enhanced overall kitchen efficiency.

Despite these benefits, several challenges must be addressed to scale e-cooking sustainably. High upfront costs ranging from USD 5,000 - 6,000 for 3.3kWp systems (Burkina Faso and Cox's Bazar) to around USD 45,000 for an 11kWp system with kitchen upgrade (Uganda), continue to pose a barrier. Reliability is also affected by seasonal solar variability, underscoring the need for larger batteries or backup fuels. Practical issues such as mismatched cookware sizes, lack of appropriate surfaces, and the need for user training and sensitisation, further highlight the importance of careful system design and support.

E-cooking can deliver substantial health, environmental, and economic gains over time. However, its successful implementation depends on addressing power reliability, ensuring appliance suitability, and providing adequate user training and maintenance. Fuel and appliance stacking remains a critical strategy to ensure resilience and adaptability. While comprehensive cost-benefit analyses are still limited, the observed reductions in fuel use and costs point to a strong case for long-term sustainability, especially when paired with carbon finance opportunities. Continued investment, data collection, and experience-sharing will be key to mainstreaming institutional e-cooking and advancing clean energy access in humanitarian settings.

For more details on the featured case studies and other institutional clean cooking efforts in displacement contexts, please refer to the *Clean Cooking Access in Displacement Settings Dashboard,* which consolidates findings from the 2024 Clean Cooking Mapping exercise conducted by the GPA Coordination Unit.

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