
# Access to Clean Energy for Refugees

## Uganda Case Studies

UNHCR
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# Introduction

Provision of clean and affordable energy is a catalyst for sustainable development in all countries of the world. Access to energy increases safety, improves the provision of health services, enhances access to education and economic opportunities.

Refugees worldwide face great challenges accessing energy. But innovative interventions by the humanitarian sector, together with affected communities, host governments, UN country teams, and a wide range of partners from various sectors, can improve access to energy.

UNHCR's Global Strategy for Sustainable Energy 2019-2025 aims to enable refugees, hosts communities and other persons of concern to meet their energy needs in a safe and sustainable manner, while also addressing health, protection and environmental concerns rising from access to energy. In line with the existing framework, UNHCR has adopted the World Health Organization (WHO) definition of clean energy based on the impact on health. Fuel and technologies are considered clean only if they achieve WHO targets for particle matter (PM) and carbon monoxide (CO) emission. In addition, UNHCR defines the use of biomass in combination with improved technologies while moving as a transitional solution while moving towards more sustainable and cleaner practices.

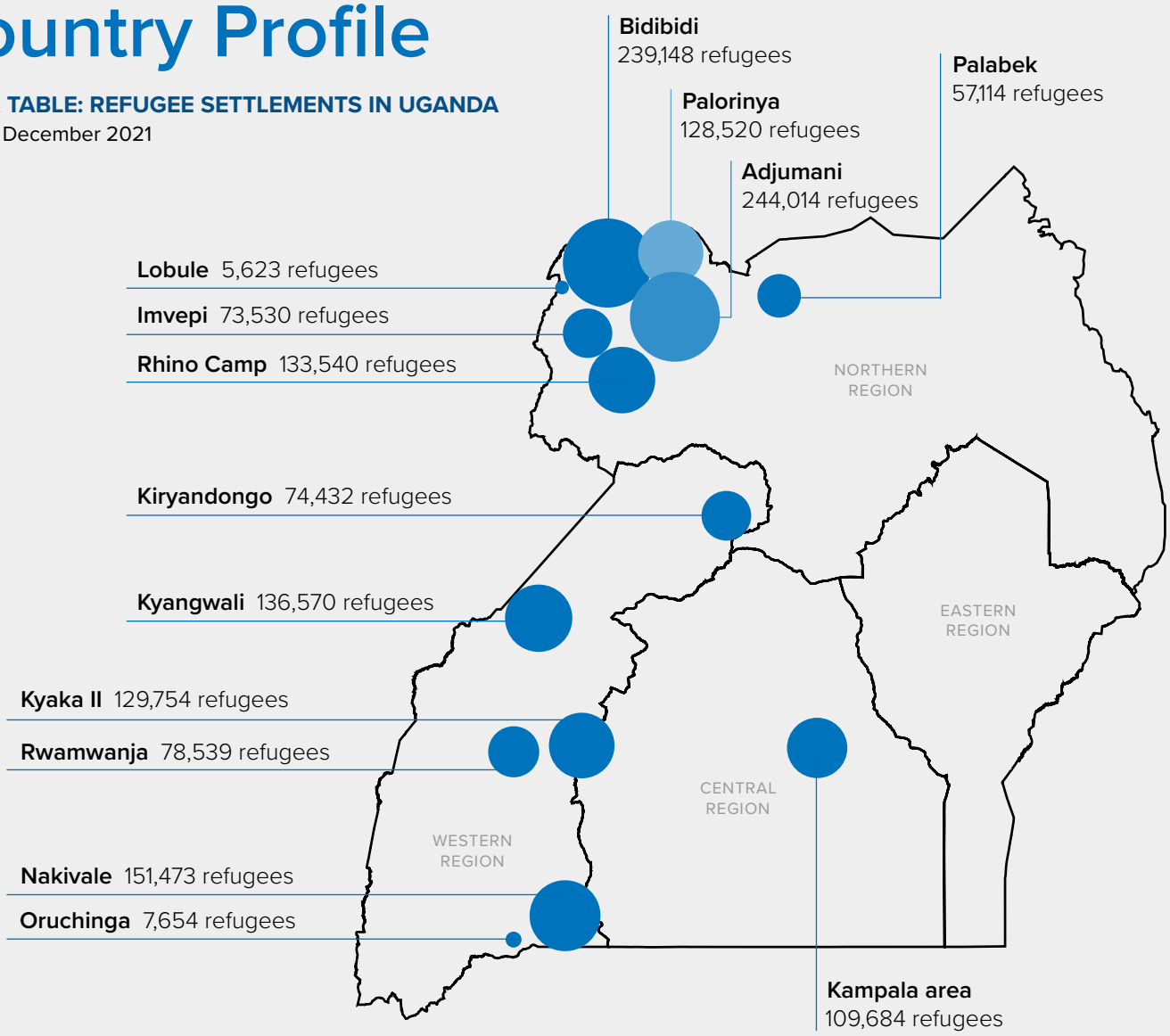
The UNHCR energy strategy is part of the actions and parameters set in the Operational strategy for climate resilience and environmental sustainability 2022-2025, to respond to the growing global climate emergency. Guided by the Strategic Framework for Climate Action (SFCA), UNHCR focuses on mitigating the impact of climate change and environmental degradation on forcibly displaced people and their host communities, supporting sustainability by preserving and rehabilitating the natural environment in displacement settings and minimizing the environmental footprint of humanitarian assistance.

This report presents case studies of clean and transitional energy interventions in refugee settlements implemented by UNHCR and partners in Uganda. Energy-related approaches from these case studies can be adapted and replicated in other refugee-hosting countries, as a means of meeting basic needs of people in displacement, improving their well-being and, when possible, creating sustainable livelihood opportunities through the provision of energy. The following case studies are based on experiences in refugee situations but can be adapted to internal displacement situations as well.

> Innovative interventions [...] can transform the lives of those who've been forcibly displaced, helping them to build better futures for themselves and their families.

# Country Profile

**MAP & TABLE: REFUGEE SETTLEMENTS IN UGANDA**
as of 31 December 2021




| Refugee settlement | Established | Origin of refugees |
|---|---|---|
| Bidibidi | 2016 | Mainly South Sudanese |
| Imvepi | 2017 | Mainly South Sudanese |
| Kampala area | | Somali (42,269), Congolese (27,058), Eritrean (21,104) and others. |
| Kiryandongo | 1990 | Mainly South Sudanese |
| Kyaka II | 2005 | Mainly Congolese |
| Nakivale | 1958 | Mainly Congolese |
| Palorinya | 2016 | Mainly South Sudanese |
| Rhino Camp | 1980 | Mainly South Sudanese |
| Lobule | 2013 | Mainly Congolese |
| Oruchinga | 1961 | Congolese (3,948), Rwandan (1,952), Burundian (1,716) |
| Palabek | 2017 | Mainly South Sudanese |
| Kyangwali | 1961 | Mainly Congolese |
| Adjumani | 1997 | Mainly South Sudanese |
| Rwamwanja | 2012 | Mainly Congolese |

## COUNTRY CONTEXT

- Landlocked country in East Africa spanning 241,038 km² (Uganda Bureau of Statistics)
- Inhabited by a population of over 44 million, growing at an annual rate of 3.7%
- The official languages are English and Swahili, but Luganda is spoken in the central and south-eastern regions
- Most Ugandans are Christian, while Islam is the second most common religion (13.7% of the population); a small minority follow traditional religions
- Low-income country with a gross domestic product (GDP) of USD 35.3 billion (2019, World Bank), which grew at an average annual rate of about 4.5% in the last years, with a harsh decline to a 2.9% growth due to the COVID-19 crisis (World Bank).

## REFUGEE SITUATION

Uganda is the largest refugee-hosting country in Africa and hosts currently over 1.4 million refugees and asylum seekers (UNHCR, 2022) from South Sudan (852,690), followed by the Democratic Republic of the Congo (456,211), Somalia (55,579), Burundi (48,871) and others (158,175).

Of the 1.4 million refugees almost 50% are located in the biggest settlements BidibBidi, Nakivale, Kyangwali and Rhino Camp, in the northwest region of the country.

**44 million**
inhabitants

**USD 35.3 billion**
GDP in 2019

Persons of Concern
Uganda

**1.4 million**
displaced people

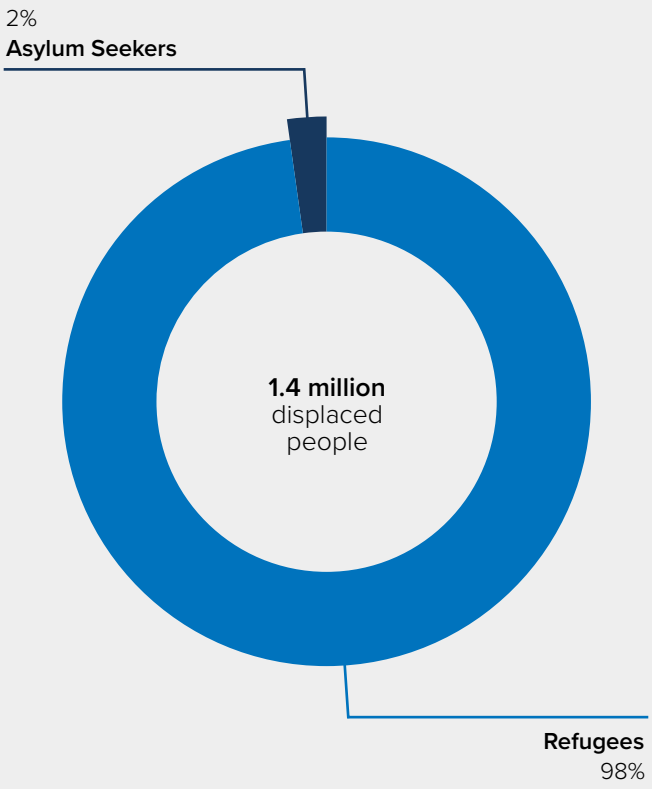
**852,690**
from South Sudan

**456,211**
from DRC

**55,579**
from Somalia

**48,871**
from Burundi

**158,175**
from other countries



## RELATIONSHIP BETWEEN REFUGEES AND HOST COMMUNITY

Uganda has an approach that focuses on peaceful coexistence and local settlement of refugees in host communities. Refugees and host communities share the same health centres and children go to the same schools. In all settlements, the refugees are provided with a piece of land for housing and cultivation. The application of the Comprehensive Refugee Response Framework (CRRF) of Uganda focuses on refugee self-reliance and strengthening local service delivery for both groups — displaced persons and local communities. The National Action Plan for the Implementation of the Global Compact on Refugees (GCR) and its CRRF is the guiding document for the direction and milestones of implementation.

## COUNTRY POLICY FRAMEWORK

### REFUGEE SITUATION POLICIES

- Uganda has a progressive refugee policy, enshrined in the 2006 Refugee Act and the 2010 Refugee Regulations, serving as a model for other countries in terms of innovative policies for refugee inclusion.
- Uganda's legal framework grants IDPs the right to work, start a business, own property, access government services including primary and secondary education, and receive health care.
- In 1979, Uganda ratified the 1951 Refugee Convention and its 1967 Protocol with some reservations. In practice however, these were not really implemented. South Sudanese and Congolese asylum seekers are granted refugee status by default, while refugees of other nationalities must prove their refugee status determination (RSD) before the Refugee Eligibility Committee.

### ENERGY REGULATION POLICIES

- Uganda submitted its Nationally-Determined Contributions to the United Nations Framework Convention on Climate Change (UNFCCC) in 2016 to implement the National climate change policies in 2015.
- Uganda incorporated the Sustainable Development Goals early in its development plan and developed the Uganda Green Growth Development Strategy to operationalise green growth planning. Focus is particularly on protecting its economy and the livelihoods of its people, who are highly dependent on natural resources.
- Increased adaptation in the key sectors of water, energy, health and agriculture, especially on increasing sustainable agricultural and livestock production, improving forestry, improving infrastructure, and further strengthening disaster risk management is an important goal for the country.
- A significant Renewable Energy Policy for Uganda was approved by Cabinet and adopted since September 2002 as the government's commitment to the development and use of renewable energy resources and technologies. The overall objective was to diversify the energy supply sources and technologies in the country, increasing the use of modern renewable energy.
- The total energy sourced in Uganda in 2018 consisted of 92% renewables and 8% oil.

## ENERGY SITUATION

### COUNTRY ENERGY SITUATION

Uganda has one of the lowest per capita electricity consumption rates in the world, with 215 kWh per capita per year. The average in Sub-Saharan Africa is 552 kWh per capita and the world average is 2,975 kWh per capita (Energypedia). Hydropower generation dominates, supported by heavy oil and biomass-fired combined heat and power plants. In 2018, 92% of the energy supply comes from renewable sources and 8% from oil (IRENA). Only one-third of the population has access to electricity, with urban areas much better connected (58%) than rural areas (18%). Only 1% of the population has access to clean cooking.

Uganda currently has an installed capacity of 850 megawatts (MW) of which about 645 MW is hydropower and 101.5 MW is through combustion of a fuel. A recent study has identified hydropower and biomass as having the greatest potential for increasing electricity generation (Netherlands Enterprise Agency). With its large hydropower resources, Uganda has an estimated total electrical energy potential of over 5,300 MW (2,200 MW from hydropower). These resources remain largely untapped so far, mainly due to technical and financial constraints. Nevertheless, the government is investing in the construction of additional large hydropower plants, such as the Karuma hydropower plant and the Isimba waterfall project. However, the country's energy infrastructure (e.g., dams, generation facilities) are highly vulnerable to climate variability and impacts. There are already adverse impacts in Uganda due to degraded watersheds, reduced river flows,

increased siltation, blown transmission and distribution systems (World Bank).

### REFUGEE ENERGY SITUATION

Numerous energy access interventions were successfully implemented, however further programmes are required to improve the current state for refugees having to walk 4-10 km to access firewood (UNHCR). Biomass is used in all sectors in Uganda, and almost 100% of rural households and 98% of urban households use biomass energy for cooking (Sustainable Energy Response Plan for Refugees and Host Communities 2022-2025). The lack of access to clean and sustainable energy for displaced people is recognized by the Uganda Country Refugee Response Plan (UCRRP). The collection of firewood by refugees from central forest reserves is increasingly limited by government laws and potential competition over this resource between refugee and host population needs to be avoided. 50% of South Sudanese and 69% of Congolese and Burundian households lack access to clean renewable energy. About 30% of health centres do not have a source of electricity, while another 30% still use diesel generators. Against this backdrop, UNHCR Ugandas Strategy 2016-2020 aimed at enhancing the protection, well-being and quality of life of refugees and other affected persons. Refugees' access to income-generating activities is supported through skills training and involvement in activities such as building energy-efficient cookstoves and heat-retaining cooking baskets, as well as briquette manufacturing. All UNHCR reception centres now have access to energy-efficient cookstoves, reducing the need for firewood to prepare hot meals for the thousands of new arrivals each year. Improved cookstoves are gradually being introduced in schools (UNHCR).

## DEVELOPMENT ACTORS AND FUNDING OF ENERGY PROGRAMMES

A mapping of development actors in the country shows that the African Development Bank (AfDB), the French Agency for Development (AFD), the German Corporation for International Cooperation (GIZ), the International Finance Cooperation (IFC), the Credit Institute for Reconstruction (KfW), the United States Agency for International Development (USAID) and the World Bank (WB) are active in Uganda energy programming and involve significant energy programme

The Nyakabande transit centre in Kisoro, Uganda, offers assistance to some of the thousands of people who fled across the border from the Democratic Republic of the Congo.

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budgets. The budgets are directed into energy activities ranging from large scale energy sector market and infrastructure improvement activities to on-the-ground electricity access in remote locations and improved cooking solution activities. Large scale and infrastructure activities in the country will support the energy situation in refugee settings in the long-term and provide for a general framework to improve the energy situation. On-the-ground and bottom-up electricity access and improved cooking solutions have an immediate and timely beneficial impact on the refugee population. The following graphs show energy activities ranked according to their relevance for refugee contexts.

Figure 1 shows the programme and project activities with a high relevance thematic to refugee contexts in Uganda: electricity provision in remote locations with a budget of USD 830.8 million and general energy access improvement in remote locations with a budget of USD 103.9 million. The category of general energy access improvement was used whenever it was not possible to differentiate from the programme description into electricity access or cooking solutions. The main funding actors are the WB, AfDB, GIZ, KfW, USAID and GIZ. The budgets for activities with high and medium relevance are detailed by funding agency and by financing mechanisms in Figure 3.

Figure 1

**Active and proposed project activities**

budget in million USD

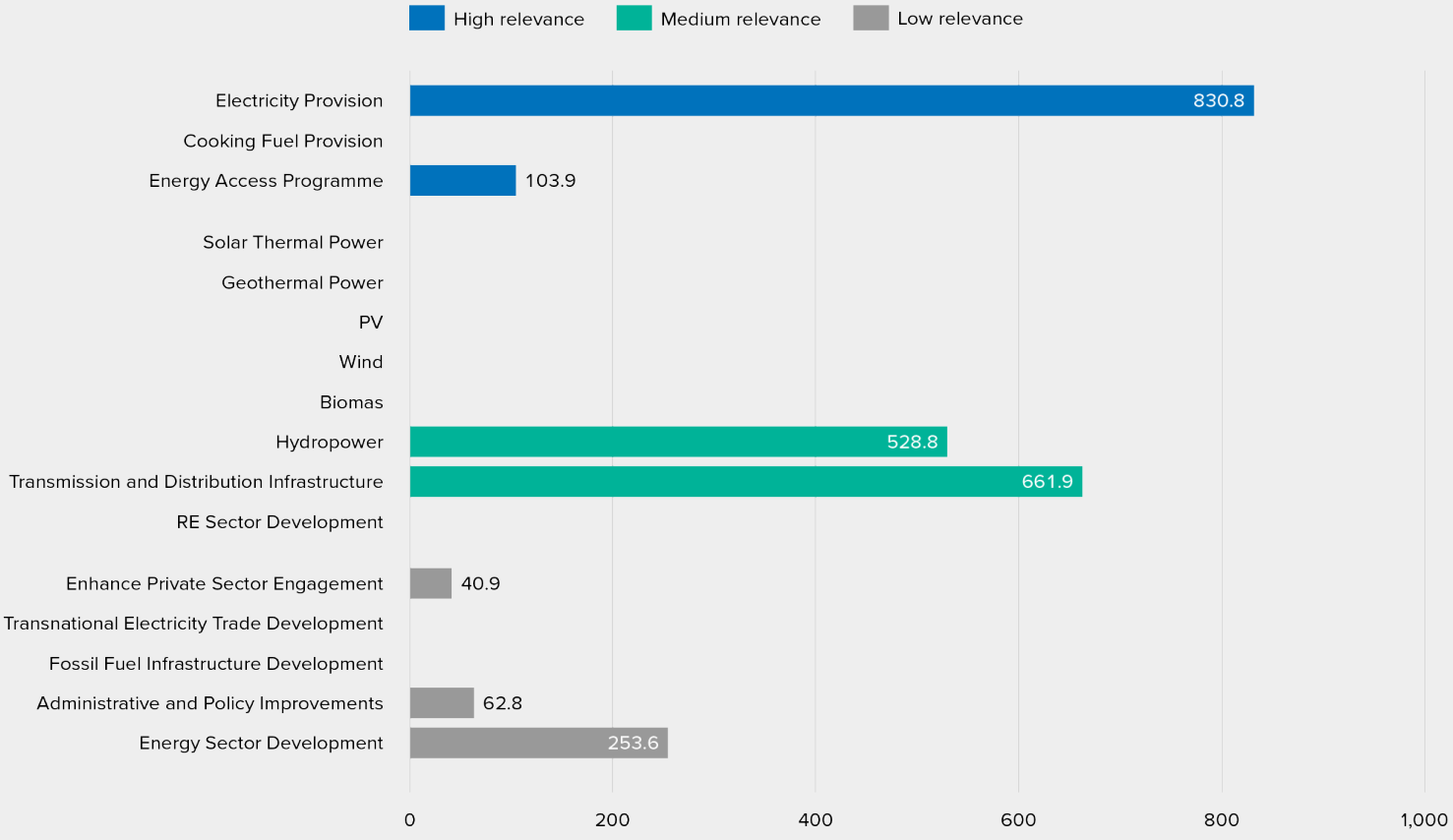


Figure 1 & 2: Results of an online research and mapping of the webpages of the development actors included in the graphs

Figure 2

## Active and proposed projects of medium and high relevance

budget in million USD

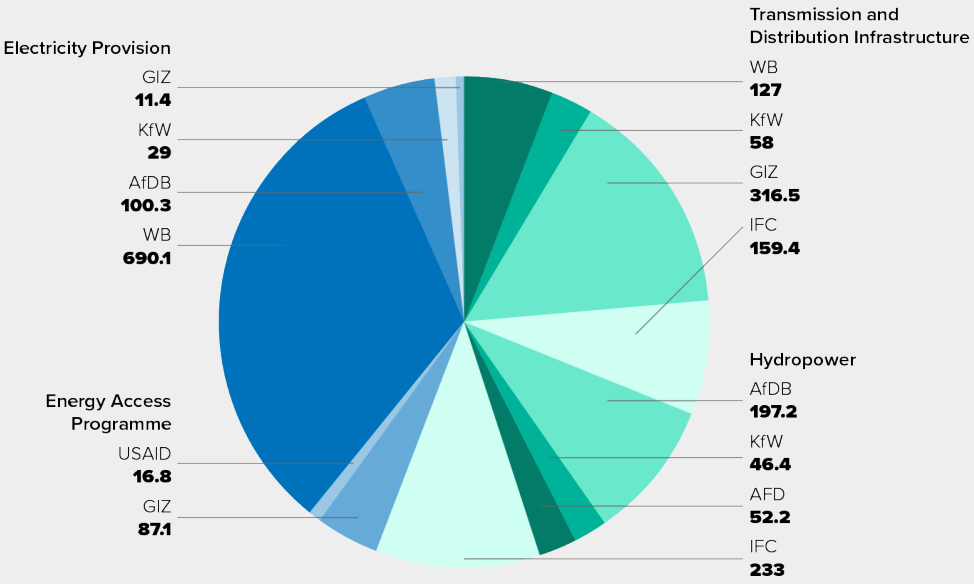


Figure 3

## Active and proposed investment with medium and high relevance

2.28 billion USD

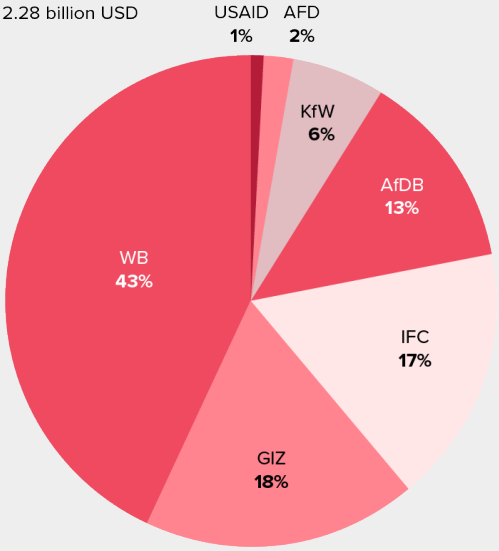


Figure 4

## Type of financing by actor for active and proposed projects of medium and high relevance

in %

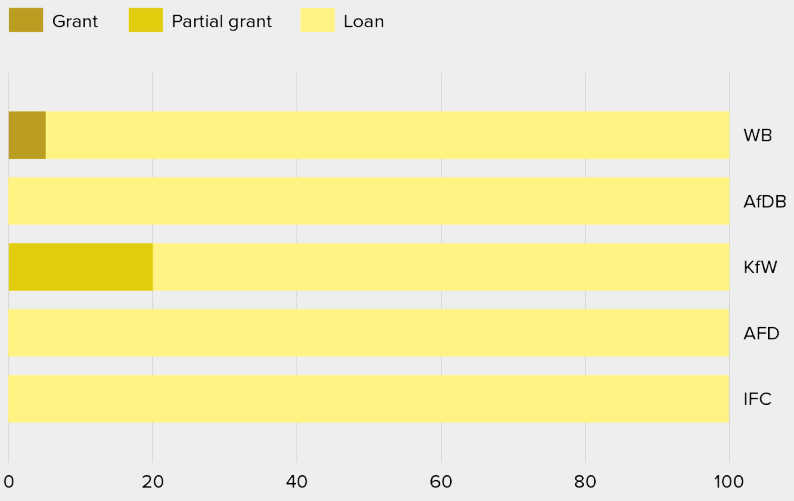


Figure 3 & 4: Own online research and mapping of the webpages of the development actors included in the graphs

## UNHCR ENERGY PROGRAMMING IN UGANDA

Development and implementation of clean energy solutions in refugee contexts has been promoted by UNHCR in Uganda for more than a decade. The interventions have evolved over the years across a wide spectrum, from simply providing energy solutions to integrating concepts of productive uses of energy (PUE), meaning that energy is actually used for manufacturing, business and income generating activities. The step was also made to evolve from distribution of donated energy devices to market-oriented approaches in which devices are purchased by the users. UNHCR has pioneered clean energy initatives in partnerships with government, development actors and private sector partners.

In 2017, the Energising Development (EnDev) Programe began its pilot project with energy access in refugee settlements and host communities to create evidence for market-based approaches – training of local stove artisans, support of local vendors of energy products and setting up of energy kiosks. In 2018, UNHCR, in partnership with GIZ, started the BMZ-funded programme, Support to UNHCR in the Implementation of the Global Compact on Refugees in the Humanitarian-Development-Peace Nexus, with one of its components being Energy Solutions for Displacement Settings (ESDS). It seeks to address the lack of sustainable energy supply in refugee hosting areas through advisory services and the implementation of measures in the following three main areas: 1. Improving the enabling environment for sustainable access to energy, 2. Greening UNHCR infrastructure, and 3. Sustainable energy access for households, social institutions and Small and Medium sized Enterprises.

The main cooking fuels used by refugees in Uganda are firewood and charcoal with increased use of charcoal in urban centres and more reliance on firewood in rural settings. This mirrors fuel usage across Uganda, where the main fuels for cooking in rural areas are firewood (83.9%) and charcoal (15.4%), whereas in urban areas there is a higher use of charcoal (68.6%) and lower consumption of firewood (30.6%). Across the country, charcoal for domestic purposes alone consumes approximately 32% of the average household income (Sustainable Energy Response Plan for Refugees and Host Communities 2022-2025). Briquettes manufactured from carbonised biomass have the most promise as a biomass-based alternative to firewood and charcoal. Firewood is collected by refugees, whereas charcoal is produced at specific production centres by community groups as well as the private sector and provided by UNHCR to new arrivals. Subsidies for briquettes finance the briquetting equipment, the materials used for making the briquettes, as well as the purchase price when briquettes need to reach most vulnerable persons in the camp as donation. In 2021, UNHCR did a small pilot in Kampala to assess the feasibility of including Liquified Petroleum Gas (LPG) as part of the cooking access interventions to decrease the use of firewood.

Since 2012, UNHCR has distributed improved cookstoves (ICS) with a 20-25% fuel efficiency and corresponding to a tier 2 cooking solution as per the access to energy ranking scheme. The stoves have been distributed to new arrivals and most vulnerable people to decrease the amount of firewood required. In 2018, UNHCR and the EnDEV programmes trained households to produce improved cooking stoves, and trained refugees as sales agents in energy kiosks. An energy kiosk is a site in which fuel and electricity, as well as energy products, can be bought.

Since 2013, UNHCR has supported the installation and repair of solar streetlights in communal areas and facilities in settlements. Individual solar lanterns have been distributed since 2016 to new arrivals and Persons with Specific Needs (PSN). Energy items can also be purchased in the local market and in solar kiosks (modelled on the same concept as the energy kiosk but the main items sold are solar products).

Source: https://reporting.unhcr.org/uganda


# Charcoal Briquetting

## Uganda

Briquettes are locally produced by refugees as well as host community members and used for cooking as an alternative fuel to firewood and charcoal. The production of carbonized briquettes is a long-existing approach to increase the energy value of biomass and make use of biomass residues or charcoal powder. In 2020, around 70,000 tons of briquettes were estimated to be produced by briquetting groups in various settlements and camps in Uganda.

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## OVERVIEW

UNHCR has supported the use of briquettes in displacement settings since 2010 through various interventions, including awareness raising, manufacturing training, cash for work and subsidies. The production of carbonized briquettes is a simple to follow and low-budget approach to improve the energy value of biomass. Briquette production takes place at the household and community level, as well as in the private sector, with a production of more than 70,000 tons in 2020. Each household uses approximately 1-2 kg of briquettes daily.

## BRIQUETTE DETAILS

Briquettes of varying quality are produced following different approaches, i.e. through compacting loose biomass and a binder into solid blocks, in a variety of shapes and sizes usually between 5-12 cm in diameter, making them convenient to store, handle and burn in cookstoves. Carbonized briquettes can replace charcoal, while simply pressed-together non-carbonized briquettes are often used instead of firewood and raw biomass (UNHCR Cooking Compendium 2021). The process of carbonization means to decompose the biomass under heat with little air to char it into a more energy dense substance. Sustainably harvested biomass or waste agricultural residues have the potential to form briquettes from renewable sources such as wood, roots and cane sugar residues, as well as dried organic solid waste. Clay as for example anthill soil, cassava flour or ash are usually used as a binder. The removal of previously added water, the pressing and the binder set the quality of the briquette.

### CONSIDERATIONS ON CHARCOAL BRIQUETTING

- The sourcing of raw material in Uganda and its continuous supply from the forestry or agricultural sector is key for sustainable briquetting.
- Potential conflicts for raw material usage between briquetting and other usages such as agriculture can arise.
- Subsidies are essential for raw materials and production equipment. Cash for work at the community center lowers briquette prices, which need to be lower than charcoal prices.
- The sustainable long-term uptake of cooking with briquettes increases with the higher quality of the product.
- Technical briquette manufacturing, sales and distribution trainings for household and community center production is needed.

## DELIVERY AND BUSINESS MODEL

Carbonized briquettes are produced in the country with different modalities: at refugee households for personal use or sale, in community-based production centres by an average of 10 to 25 workers and at private-sector companies. At the household level, briquette making is mainly done by hand pressing, while at the community centres and in the private sector, a manual press or motorised machine allows for higher production numbers, as well as higher energy density and quality products. Prices range from USD 0.18 per kg for household pricing to USD 0.55 per kg for private sector production. In comparison, firewood costs range between USD 0.03-0.1 per kg. Users report that 1 kg of briquettes run a cookstove much longer than 1 kg of firewood, given the higher energy content and more efficient briquette-burning stoves (depending on the quality of the briquettes). UNHCR supports charcoal briquetting through the procurement of production equipment, cash for work at the community centres and vouchers for briquettes for vulnerable persons. Briquette making trainings are offered by UNHCR partners.

## PROTECTION/HEALTH

The need to travel to remote places to collect firewood and associated risks are reduced, since households can produce briquettes from biomass residues in their surroundings or purchase briquettes in the settlement. Briquettes can burn with improved benefits compared to firewood when used in stoves designed for its use. When burnt in traditional stoves, briquettes do not burn efficiently, resulting in low cooking temperatures, and produce smoke that can negatively impact health. To achieve the health improvements and a higher level of efficiency, briquettes and cookstoves should be produced together.

## ACCEPTABILITY

The acceptability is directly linked to the quality of the briquettes and the efficiency of the cookstove. Higher quality means better acceptance of briquette use. Higher cooking efficiency with briquettes is reached with improved and briquette-specific sized cookstoves. Cooking with briquettes is similar to firewood or charcoal, and depending on materials used to make them, they may burn cleaner than charcoal and firewood.

## AFFORDABILITY

Biomass can be low cost and locally accessible for making briquettes. However, quality production requires sufficient biomass waste and appropriate briquetting equipment. Operational experience shows that medium income households can normally afford to purchase briquettes, while low-income households cannot afford briquettes without financial support or in-kind distribution. Briquetting groups have been selling to mid-income households in the settlements and into the host community, as well as to UNHCR who subsequently distributes the briquettes to vulnerable households.

## SELF-RELIANCE

Briquettes making can be done by the community since the equipment is easy to handle and generates income. The provisions of trainings and equipment improves independence of households and provides for small-scale income earning opportunities through the selling of surplus production. Micro-entrepreneurs have grown into small to medium scale producers (20 – 200 tons per year), using locally available machinery and support to develop the briquettes' value chain in the camps, both financially supported by UNHCR.

## ENVIRONMENT

The environmental impact can be estimated if assuming that briquettes are replacing charcoal. Furthermore, briquettes can be made of waste material, thus reducing the need for firewood and decreasing deforestation. Briquettes are considered a transitional fuel until cleaner cooking fuels become available.

## HOW TO REPLICATE

**STEP 1** Review the legal, regulatory, and institutional framework in the country and understand if bans for biomass usage or national standards for machinery exist.

**STEP 2** Assess the market in the country for briquettes and the associated equipment to understand the industry structure and forecast the available biomass quantity.

**STEP 3** Map current camp cooking habits, charcoal prices for comparison and household budget situation to understand the best delivery method and pricing for briquettes.

**STEP 4** Coordinate with camp/settlement operation, local authorities and country technical service for implementation and ensure the set-up of reliable production and supply.

**STEP 5** Drive demand for briquettes through financial support for initial investment and through trainings for quality briquette manufacturing and enterprise establishment.

The provisions of trainings and equipment improves independence of households and provides for **small-scale income earning opportunities** through the selling of surplus production.

## LESSONS LEARNT FROM OTHER UNHCR PRACTICES

### TANZANIA

Biomass Charcoal Briquette Project Tanzania

UNHCR, in collaboration with local suppliers, provides refugees and locals with access to alternative cooking energy to reduce the reliance on firewood through briquetting machines, large scale procurement of raw materials and the guidance in setting up the production process. The centralized machine-based production of charcoal briquettes serves 1,635 persons of concern, with an average consumption per person per month of 15.6 kg, equivalent to an average household consumption of 77.7 kg. In parallel, 2,300 persons of concern participated in briquetting trainings for hand-based production of briquettes at the household level. Community activities in the agricultural sector were not extensive, which is why external supply of raw materials and related funding is a relevant point to consider. It is important to plan for sufficient drying capacity, especially during rainy season.

### SOUTH SUDAN

Turning trash into clean fuel, refugees aid environment

Refugee women and their host community in Maban county are turning agricultural waste into clean-burning briquettes in a pilot project that saves trees. The pilot project began in February 2022 in a collaboration between UNHCR and Relief International. The initiative provides persons of concern with a clean and sustainable alternative fuel source to firewood. They sell the briquettes at USD 1 per kg, making it an income-generating activity in addition to acquiring new greener skills. In March 2022, the Gendrassa group produced over 2,000 kg and earned up to USD 2,000 from the sale of the briquettes. As of 30 April 2022, 200 households have been targeted to receive briquettes monthly out of the 35,036 households across Maban's four refugee camps.

Women's group members manufacturing charcoal dust briquettes in a hand-operated pressing machine. After the briquettes have been dried in the sun they are ready for sale.

# Local production of cookstoves

## Uganda

Refugee and host community members are trained to manufacture portable rocket cookstoves and non-portable household stoves from local materials, as well as to maintain and repair the produced units. The clay-made cookstoves are twice as efficient as traditional open three stone fires and increase safety during cooking. Community involvement allows for user-centred design to fit the local needs.

UNHCR
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## OVERVIEW

As per the Safe Access to Fuel and Energy strategy launched in 2014 and through the collaboration with the Energising Development (EnDev) programme in 2018, UNHCR supports the use of improved cookstoves through local production by community members. As part of the cooking programme, community members received training on manufacturing the stoves with local materials. Improved cookstove programmes have been rolled out in all settlements and currently reach almost 30% of households.

## COOKSTOVE DETAILS

Two major types of improved cookstove (ICS) clay stoves are produced in the settlements: the larger and fixed household rocket stove and smaller movable rocket stoves. These cookstoves have a 20-25% fuel efficiency and correspond to a tier 2 cooking solution as per the access to energy ranking scheme. They yield an efficiency twice as high as traditional open three stone fire stoves and cut fuel needs of firewood or charcoal in half to 0.85 kg/per person per day. These cookstoves can also be operated with briquettes, if the shape of the briquettes is considered at the cookstove design stage and made compatible. Clay-made improved cookstoves can be built on custom scale by trained camp residents using an insulating clay mixture of mud and organic material such as chopped grass, saw dust or chopped dry banana leaves. In 2020, to decrease fuel consumption, UNHCR started distributing heat retaining baskets which allow for the retention of heat and save between 20% and 80% of the energy normally needed to cook a meal.

### CONSIDERATIONS ON A NEW COOKSTOVE

- Involving users, from product design to its usage, e.g. with cookouts and participatory design processes, ensures the development of tailored stove and fuel types.
- Sustainable uptake increases with increased involvement of community members in the designing of the cookstoves.
- Availability of raw materials and long-term reliable supply for continuous cookstove production is necessary for sustainable production.
- Financial support might be needed to provide for trainings and equipment such as ovens, manufacturing tools, presses and materials.
- A user manual provides guidance on material needs, preparation, construction of cookstoves, usage and maintenance to the community.

## DELIVERY AND BUSINESS MODEL

The cookstoves are produced by trained refugees from locally available materials and sold to the community at prices between USD 1.40-4 depending on the model. While larger damages may require maintenance by trained staff, smaller repairs can be done directly by the users, thanks to the user manuals that have been made publicly available. They provide guidance on material needs, preparation, construction of cookstoves, usage and maintenance. The required oven to solidify the clay stove, as well as the manufacturing tools, presses and materials, were provided to the community through UNHCR at no cost.

## PROTECTION/HEALTH

The usage of improved cookstoves reduces smoke as the fire is contained inside the stove. It also increases safety during cooking in comparison to three stone fires as the risk of burns is reduced by 45%. The need for firewood collection is cut in half given the cookstove's efficient fuel consumption, which reduces risks associated with fuelwood collection and lessens potential competition over scarce resources in the camp/settlement surroundings and between refugee and host communities.

## ACCEPTABILITY

Community members are involved in the design of the cookstove since size and type (portable, non-portable), as well as the kind of fuel to be used, can vary. A custom-made cookstove leads to high acceptance among users. 93% of refugees in the project region are aware of the benefits of improved cookstoves and find fuel savings as the most compelling advantage.
Trainings on smaller self-repairs by the users also increases acceptability.

## AFFORDABILITY

The pricing range of USD 1.4-4 makes the cookstove an affordable product for low-income households and higher fuel efficiency brings substantial firewood savings. Considering fuelwood costs USD 0.043 per kg, the annual costs for fuel wood can be reduced by USD 50-60, leading to annual costs for the cookstove and the fuel of USD 15-20. While the emission rates of improved cookstoves do not meet the level required to be classified as clean technology, the affordability and local production of the improved cookstoves make them a transitional option until cleaner cooking is available.

## SELF-RELIANCE

One of the strengths of clay-made cookstoves is their production, which is based on local materials including anthill soil and sand for the main parts, as well as sawdust, pumice, and vermiculite as insulating materials. Rather than relying on costly infrastructure with external providers and imported materials or cookstoves, local community members can build and maintain the stoves themselves. Community production provides income generating activities and contributes to higher household incomes.

## ENVIRONMENT

The increased efficiency and the reduction in fuel wood consumption lessen the stress on forests and slows down deforestation. The usage of local materials for stove production ensures recycling of the stove and maintaining a circular economy.

## HOW TO REPLICATE

**STEP 1** Hold cookouts to understand current cooking habits, current needs and future cookstove design requirements.

**STEP 2** Assess costs for equipment and materials required in cookstove manufacturing, as well as the long-term sustainable supply of in-country raw materials.

**STEP 3** Map local suppliers for set-up and realization of trainings, and provision of equipment such as oven, presses, tools, and raw materials.

**STEP 4** Identify existing artisans in the community to include into the local manufacturing trainings.

**STEP 5** Drive demand for the cooking solution by lowering manufacturing costs through the provision of equipment and materials, and by organizing awareness campaigns.

The need for firewood collection is **cut in half** given the cookstove's efficient fuel consumption

## LESSONS LEARNT FROM OTHER UNHCR PRACTICES

### ETHIOPIA

Cooking Energy Solutions in Displacement Settings in Gambella

UNHCR, in cooperation with GIZ and within the ESDS programme, piloted a user-centered design process in which communities were put at the centre of the technology design. It started from holding cookouts, learning about preferences and challenges of the current cooking situation and finding solutions together with artisans, local academia and the vocational training centre for advanced and more convenient cooking solutions to community-based design. The design is being refined in an iterative process and production is improved and scaled with the project's support. The local producers are supported in setting up value chains, thus continuously improving and developing new designs. Thanks to high involvement of the refugee and host communities in the project development, the acceptance and adoption of the new cooking solution was high.

### RWANDA

Cookstove supply and carbon credits, Kigali

In collaboration with private sector partners and the Rwandan Women's network, UNHCR has established a supply chain of efficient firewood cookstoves in combination with carbon credit issuances for $CO_2$ emission savings in for Kigali, Rwanda. The upfront costs of the stoves are subsidized for low-income households and fuel costs are reduced due to the higher fuel efficiency of 80% compared to traditional three stone fires.

The emission reductions from the improved cookstove's usages are converted into carbon credits. Since 2013, around 4,000 fuel-efficient stoves have been distributed to refugees. A total of 11,000 are planned to be distributed. The use of these fuel-efficient cookstoves are expected to reduce the emission of approximately 30,000 tons of $CO_2$ per year in refugee settings in Rwanda.


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# Solar lamp lifecycle and market

## Uganda

UNHCR distributed more than 300,000 solar lanterns to new arrivals from 2016 to 2021. To broaden access to sustainable lighting, eight energy kiosks were set up in four settlements selling high-quality solar lanterns and other energy products. The energy kiosks are also planned to serve as an innovative and integrated electronic waste (e-waste) management point.

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## OVERVIEW

The primary source of lighting in Ugandan settlements is solar lanterns, partly due to UNHCR's distribution of more than 300,000 solar lanterns to new arrivals from 2016 to 2021. Lamps can also be bought at four energy kiosks in Rhino Camp and Imvepi refugee settlements since 2021, as well as at four energy kiosks in Bidibidi and Palorinya settlements since July 2022 as part of the Energy Solutions for Displaced Settings (ESDS) programme. The energy kiosk's main purpose is to offer high-quality energy products and additional services, such as basic IT trainings and phone charging. The energy kiosks have sold several hundred solar lamps at prices between USD 7-13.

## DETAILS ON SOLAR LANTERNS

Solar lanterns are lightweight, portable, and easy to use lights that consist of a solar panel, LED light bulb, battery, and charge controller. Portability is a key feature for multiple purpose uses around the home and outside. Solar lanterns usually are water-resistant and can charge mobile phones. The life span depends on the durability of the battery and the maintenance of the lantern. The common warranty period is 2 years and life expectancy is more than 5 years. The average cost of solar lanterns as per the international quality standard (Lighting Global Standard) is around USD 20. Energy kiosks provide support by offering solar lamps, as well as by processing warranty claims, repairs and recycling.

### CONSIDERATIONS ON THE LIFECYCLE AND MARKET OF SOLAR LAMPS

- Acceptability and solution uptake increase with better product quality. Consider the internationally established quality standards.
- Solar lanterns are for basic lighting and phone-charging. For a higher-level of electricity services, Solar Home Systems should be considered.
- Inclusion of various financial mechanisms to purchase the solar lamps can help refugees to increase their capacity to pay for better-quality energy items and reduce e-waste.
- Private sector engagement and related incentives are needed for the set-up of supply and distribution chains into the refugee settlements.
- Implementing e-waste strategies for repurposing, recycling, and disposing of devices through energy kiosks should be part of the implementation and embedded in the community.

## DELIVERY MODEL OF SOLAR LANTERNS

Low quality lamps with short lifetimes aggravate e-waste, which is why the energy kiosks in the settlements facilitate the delivery of high-quality solar products. Each energy kiosk serves approximately 3,500 households and is operated by an association of 10 to 15 members from the refugee and host community, of which 40% are women. Private solar companies were incentivised to set up direct supply chains to the energy kiosks through a results-based financing scheme. Financial subsidies can also be considered to support the production, marketing and sales costs of the supplier.

Solar lamps can be purchased by monthly instalments and an initial deposit to account for the limited purchasing power of refugees. For the most vulnerable refugees, UNHCR uses cash-based approaches to help with energy expenditures.

## PROTECTION

Improved lighting solutions have significant positive impacts on the health and safety of persons when traditional lighting sources such as candles or kerosene lamps are replaced with cleaner solutions. Most people reported their previous source of lighting being a fire and health hazard to their families. The toxic fumes from burning kerosene or wood for lighting pose health risks (30% of the households use firewood for lighting). The availability of handheld lighting reduces the risk of GBV and improves the safety perception of those affected.

## ACCEPTABILITY

The quality of solar lanterns goes hand in hand with their acceptance and uptake. Solar lanterns should be adapted to people's needs to avoid the risk of users reselling or dismantling the devices and misusing the

individual components. In locations where lantern markets are mature and where both high- and low-quality lanterns are available, brand recognition among the high-quality products can be observed.

## AFFORDABILITY

Lighting can make up a significant percentage of monthly spending. Compared to traditional lighting sources, solar lanterns have a high upfront cost but involve savings in the long-term as there are no operational costs. Monthly costs for lighting and phone charging can be six times higher when solar lanterns are not available. Solar lanterns remain affordable to a much greater proportion of households in comparison to advanced electricity production such as solar home systems. The availability of flexible payment mechanisms however increases purchases (SERP 2021-2025).

## SELF-RELIANCE

Households with solar lanterns receive on average 45 minutes more lighting per evening compared to those reliant on candles. The additional lighting allows for reading, studying and occupational activities after dark. Jobs can be created when solar lanterns are provided through a market approach, since energy kiosks need to be operated and sales personnel is needed. Energy kiosks stand as energy hubs and learning centres and they can be incorporated into innovative e-waste management strategies, where refugees can become waste entrepreneurs, providing repair and waste collection services.

Households with solar lanterns receive on average **45 minutes more lighting per evening** compared to those reliant on candles.

### HOW TO REPLICATE

**STEP 1** Define the framework of the solar lantern distribution, including specific purpose of the intervention, the targeted group of persons of concern and the total budget available.

**STEP 2** Map available solar lamp models and their suitability according to the intended purpose and the available budget.

**STEP 3** Evaluate the provision of solar lanterns through local markets, such as energy kiosks, in addition to distribution to target groups.

**STEP 4** Consider various financial mechanisms such as pay-as-you-go (PAYG) and instalments for consumers and subsidies to help business groups sell good quality solar lamps.

**STEP 5** Integrate recycling and disposal procedures, train refugees in repairing and repurposing of non-functioning solar lanterns, as well as promote and sell solar lanterns.

## ENVIRONMENT

Improvised low-cost torches using bulbs and non-rechargeable batteries from various other devices are a common form of lighting source. These do not comply with safety standards and have a reduced lifetime resulting in increased e-waste. Reusable solutions such as solar lanterns are a safer and more sustainable option. Nevertheless, systematic repair and recycling activities, as well as comprehensive waste management strategies, are required to reduce environmental impacts through end-of-life recycling. Around 1% of solar products reach a recycler at the end of their lifetime, requiring comprehensive e-waste management systems to be co-implemented alongside the introduction of solar solutions in displacement settings.

LESSONS LEARNT
FROM OTHER UNHCR PRACTICES

### ETHIOPIA, KENYA & UGANDA

Status of e-waste management in three countries of ESDS

Under the programme ESDS, UNHCR, together with GIZ and a private company, initiated a pilot program to assess e-waste management procedures, map the flow of e-waste, review the legislative framework and map stakeholders in refugee camps in three countries to derive legislative and practical challenges (Ethiopia, Kenya and Uganda). The activities showed a need for the setting up of e-waste management plans to plan for end-of-life treatments and recycling options. Reassembling of e-waste, repurposing and reusing valuable base materials can be financially and environmentally sound. Operational roadmaps for both centralized and decentralized business models for e-waste collection and recycling mechanisms are proposed.

### BANGLADESH

Centre for repair and recycling

In Cox's Bazar, UNHCR, in partnership with several organisations, initiated a pilot project to establish an innovation centre for the repair, recycling and upcycling of solar products. The innovation centre provides vocational training activities on solar energy systems for refugees and locals and aims to reduce e-waste, increase decomposition of the devices, and increase the reusage of the materials in subsequent production processes. Similar small but innovative projects on e-waste recycling and building a green innovation hub are at the pilot stage. The hub will provide 2-3 months of training to refugees and host community members in domestic appliance repair and recycling.

Suchada Bhukittikul of UNHCR Thailand, speaks to Charity Gala, South Sudanese refugee with with special need at her home in Bidibidi refugee settlement in Yumbe district of Northern Uganda.

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# Solarization of health facilities

## Uganda

Solar photovoltaic systems of typically 10 kVA or higher enable health facilities in settlements to operate high-capacity devices and machines such as refrigerators, medical equipment, or ICT equipment, thereby significantly improving the quality of health care. The health facility owns the energy system and can sell excess electricity to another nearby customer, making the solution more affordable.

UNHCR
The UN Refugee Agency

## OVERVIEW

UNHCR supports the provision of solar photovoltaic systems for health care facilities under the Energy Solutions for Displacement Settings (ESDS) programme. These systems of typically 10 kVA or more supply six health facilities in Imvepi and Rhino camps with electricity for light and medical equipment such as refrigerators, microscopes, and baby warmers, as well as for ICT equipment such as mobile phones and landlines. The quality of health care is significantly improved and available to serve an estimated 60,000 refugees and more than 10,000 host community members. One mini-grid supplier was selected through a tender process and is responsible for the system's installation and remote monitoring for a period of two years.

## TECHNICAL DETAILS

A solar photovoltaic system generates reliable and grid-like electricity for a health facility. In contrast to small lighting devices, such as solar home systems, solar photovoltaic systems can produce electricity on a tier 3 or higher as per the electricity access scheme. This high level of electricity generation allows for the operation of various appliances that are common in health care centres. The systems can be combined with a battery or a back-up diesel generator to ensure supply during the night and cloudy days. Solar photovoltaic systems can be ideally sized for communal health facilities while reaching lifetimes of 20 years or more. Batteries will need replacement during this lifetime.

### CONSIDERATIONS ON SOLARIZATION OF HEALTH FACILITIES

- High and continuous electricity demand through a main customer, i.e. a communal or health facility, a school or offices is needed for financial sustainability.
- Mini-grid sizing determines the amount of excess electricity that is available for additional customers in the surroundings, but also increases upfront system costs.
- Long-term investment planning should include upfront, maintenance, repair, spare part, replacement and recycling costs.
- Long-term operation and maintenance arrangements can involve local community members for preventive maintenance and remote monitoring for issues beyond.
- Environmental sustainability is impacted by end-of-lifetime reusage, recycling and e-waste processes.

## DELIVERY AND BUSINESS MODEL

UNHCR, in cooperation with GIZ, is exploring market-based approaches for solar photovoltaic systems that have the potential to finance the initial investment and operational costs. The two typical business models for these types of systems, *third party ownership* and *self-ownership,* are under consideration and envisaged for implementation. The expectation is to understand how much of the operation and maintenance costs can be covered by selling excess electricity to other consumers like a school, a canteen or a group of community members.

## PUBLIC HEALTH

Reliable energy, improves the quality of health services to 30,000 patients per health facility per year. It is used for lighting, patient examinations, medical procedures, sterilizations, the running of medical devices, refrigeration of medicines and biologic samples, as well as the facilitation of communication between health care providers. The replacement of diesel generators with solar photovoltaic systems reduces noise and air pollution and contributes to people's wellbeing.

## ACCEPTABILITY

In Uganda, the solar photovoltaic systems can offer grid-like quality of electricity supply and 95% reliability, compared to the national grid's reliability of 50-75%. This can prevent damages to sensitive medical devices through the avoidance of power cuts. The avoided noise and pollution combined with the availability of electricity at staff housing make it an incentive for qualified staff to work and stay long-term at the health centre.

## AFFORDABILITY

Solar photovoltaic systems can reduce costs by 32% compared to diesel-based electricity in the long run. Operational costs are low at 1.8% of the investment amount, however, the systems have higher upfront costs of 3-3.5 USD/Watt. Despite the higher upfront costs, the cost for electricity from a solar photovoltaic system is generally lower than the national ceiling tariff of 0.3 USD/kWh. Existence of productive and income-generating activities during the day generally matches well with solar energy and improves cost-effectiveness.

## SELF-RELIANCE

Health facilities can be independent from a diesel generator and grid electricity and thus face lower risks of service interruptions. Income from selling excess electricity can contribute to covering operational and maintenance costs and lower the price of electricity. Small and medium sized businesses can benefit from solar photovoltaic systems of the health facilities.

## ENVIRONMENT

Renewable solar photovoltaic systems can reduce lifetime emissions by 83% compared to electricity from diesel mini-grids. However, batteries remain environmentally challenging given their reduced lifetime of six years. The implementation of solar photovoltaic systems should therefore be accompanied by an electronic waste management plan. Battery components are valuable and can be repurposed if properly recycled.

## HOW TO REPLICATE

**STEP 1** Identify communal facilities that need high levels of electricity through energy audits (e.g. using the USAID Health Clinic Power System Design Tool).

**STEP 2** Develop a business plan and ownership model, estimate size and costs of the system (e.g. using a software), taking into account main customers and productive use opportunities.

**STEP 3** Develop a long-term operation and maintenance schedule including both modern remote monitoring technologies and preventive maintenance by local community members.

**STEP 4** Identify the funding modality (grant, leasing) for upfront costs, operation, and maintenance. Establish agreements to ensure uninterrupted funding for maintenance.

**STEP 5** Organize a call for tender that covers the entire project lifetime, including equipment procurement, system installation, operation and maintenance, and end-of-life recycling.

In Uganda, the solar photovoltaic systems can offer **grid-like quality of electricity supply and 95% reliability**, compared to the national grid's reliability of 50-75%.

## LESSONS LEARNT FROM OTHER UNHCR PRACTICES

### KENYA

Asset Management in Displacement Settings

Kakuma refugee camp hosts approximately 147,000 refugees from across the region including Burundi, the Democratic Republic of the Congo, Ethiopia, Somalia and South Sudan. In 2018, photovoltaic battery hybrid mini-grids were deployed at medical centres in Kakuma by a private sector company to supply 85-100% of the clinics' power needs. Upfront costs were funded through grants. A private Kenyan energy company was contracted to ensure operation and maintenance. Energy cost savings from the clinics amounted to a 79% reduction compared to the alternative energy supply by a diesel generator. At one clinic, local $CO_2$ emissions were reduced by 49 tons per year.

### ETHIOPIA

Solar cooperatives give refugees and locals clean energy and livelihoods

In 2017, UNHCR provided equipment for solar-powered mini-grids to be established in the five Dollo Ado camps in Ethiopia, reaching 161,000 persons of concern. The 6 kW systems, consisting of 24 solar panels, 2 inverters and 32 batteries, save up to 9,700 liters of diesel fuel, with a payback period of four years (Source: UNHCR Fact Sheet Melkadida mini-grid). Since 2018, the solar mini-grids have been managed by local cooperatives made up of refugee and host community members. While the cooperatives are generating an income for their members through the sale of electricity, they also provide free electricity to vulnerable households who would not be able to afford it otherwise.


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The UN Refugee Agency