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# Access to Clean Energy for Refugees

## Rwanda Case Studies

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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 to economic opportunities, all of which are components of UNHCR's mandate to protect refugees.

Refugees worldwide face great challenges accessing energy in displacement settings. 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 transform the lives of those who've been forcibly displaced, helping them to build better futures for themselves and their families.

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 communities, implemented by UNHCR, government, and partners in Rwanda. 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 1: REFUGEE CAMPS IN RWANDA

as of 31 December 2021

# 127,112

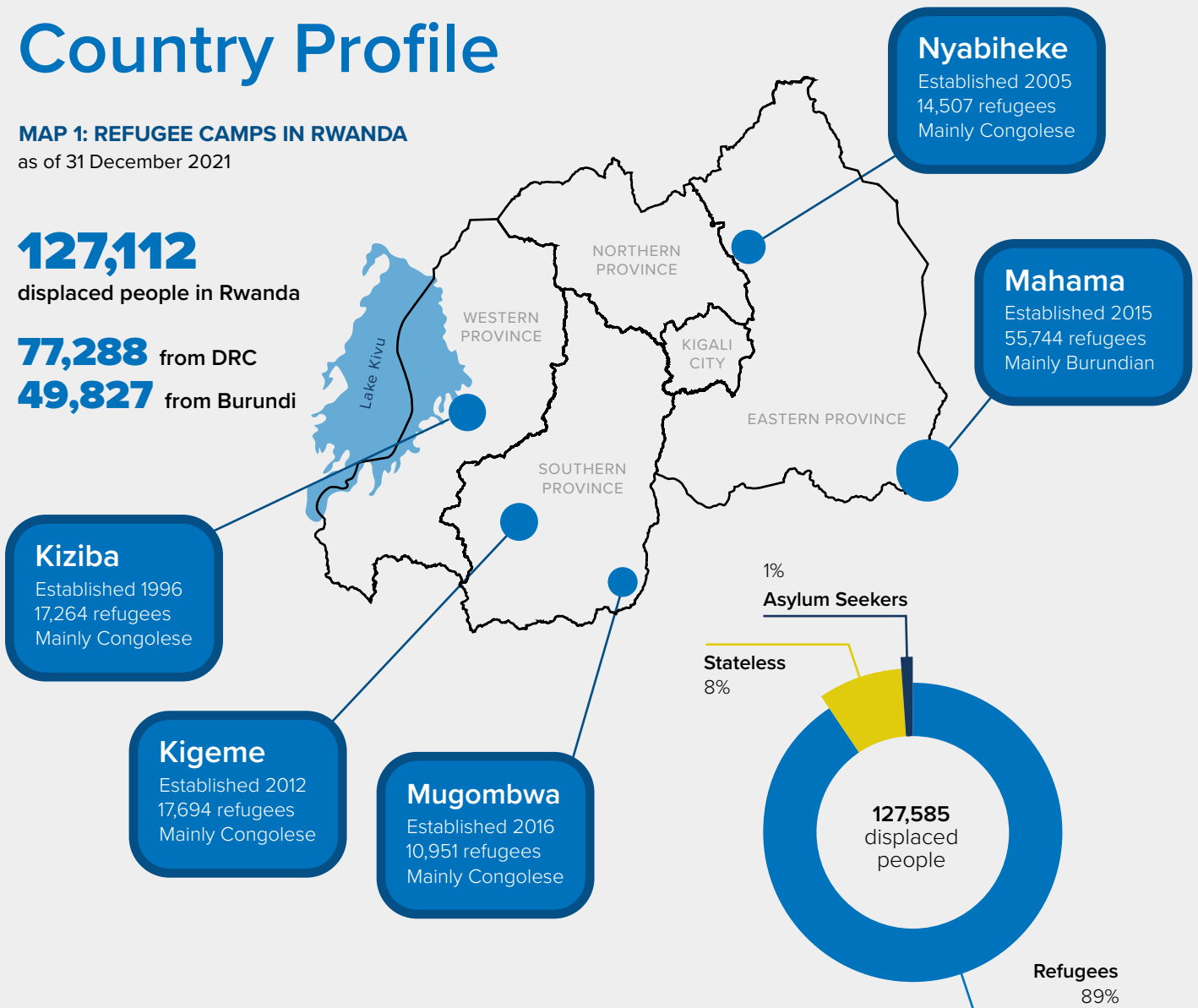
displaced people in Rwanda

# 77,288

from DRC

# 49,827

from Burundi



## COUNTRY CONTEXT

- Small, landlocked, fertile country at 26,338km<sup>2</sup>, dotted with numerous lakes and elevations, called “land of a thousand hills”
- [12.96 million inhabitants](#) form one of the youngest populations in the world, with 59.4% of the population under the age of 24 ([UN, 2019](#))
- Rwandans belong to the culture and language group of the Banyarwanda with the three sub-groups Hutu, Tutsi and Twa
- The most widespread religion is Christianity (46.5% Roman Catholic; 45.4% Protestant), while traditional ancestral beliefs remain an integral part of many people’s lives ([World Atlas](#))
- Rwanda’s Gross Domestic Product exceeds 10 billion US\$ ([World Bank, 2020](#)) and due to economic growth, the population is enjoying significant improvements in living standards, with a two-thirds reduction in child mortality and near-universal primary school enrolment ([World Bank, 2021](#))

## REFUGEE SITUATION

Currently there are 127,585 displaced people in Rwanda, of which 89% are refugees, 8% stateless persons and 1% asylum seekers ([UNHCR, 2022](#)). Most refugees are originally from the Democratic Republic of Congo (77,288 persons) with the second largest group arrived from Burundi (49,827 persons).

90% of the refugees live in the camps Kigeme, Mugombwa, Nyabiheke, Kiziba and Mahama, with the latter mostly housing the Burundian population. Another camp (Gihembe) was closed in 2021, due to the aging of the camp and obsolete infrastructures ([UNHCR, 2021](#)). Former inhabitants of Gihembe have been relocated to the Mahama camp.

There are a number of challenges in Rwanda for refugees and locals alike, including low incomes and difficult living conditions. Host and refugee communities also share difficulties and strained resources that are impacting livelihoods. Over time, however, refugees and host communities have built close social relationships, creating a peaceful and inclusive social environment (Fajth et al. 2019). This social cohesion may be due to the shared cultural heritage of the groups, but also to the inclusive policies of the Rwandan government. Some problems persist, including overcrowding in schools, soil erosion and deforestation near some refugee camps (UNHCR, 2022).

## COUNTRY POLICY FRAMEWORK

### REFUGEE SITUATION POLICIES

Legal Frameworks and policies in Rwanda:

- The [National Asylum Law](#) provides a protective environment for refugees in line with international standards.
- Rwanda has adhered to major international conventions and human rights instruments, including the 1951 Convention Relating to the Status of Refugees, its Protocols and the 1969 OAU Convention on Governing the Specific Aspects of Refugee Problems in Africa.
- Rwanda ratified the 1954 and the 1961 Statelessness Convention, leading to refugees being included in the national birth registration system, thus reducing the risk of statelessness (Rwanda CRP, 2021).
- In addition, the efforts taken to implement the Comprehensive Refugee Response Framework (CRRF, 2017) led to some key achievements in relation to social and economic inclusion and integration into the national system, especially in the areas of health and education.
- Since 2018 and as part of their commitments under the CRRF, the government has taken significant steps to allow refugees access to the national identity card, jobs and services, as well as to provide the possibility of mobility between refugees and the host community.
- An information campaign by the government was initiated in June 2019 to ensure that Rwandan nationals and companies know that refugees have the right to work, open bank accounts, and move within the region. While important advances are being made, some structural and economic barriers remain within the current camp model, possibly hindering long-term self-reliance (HPG Working Paper, 2019).

## ENERGY REGULATION POLICIES

- Rwanda ratified the United Nations Framework Convention on Climate Change (United Nations, 1992) in 1995,
- signed the Kyoto Protocol (United Nations, 1998) in 2004, and
- the Paris Agreement (United Nations, 2015) in 2016.
- To promote sustainability in all sectors and to achieve the goals as set out in these agreements, the country formulated a National Green Growth and Climate Change Strategy (Republic of Rwanda, 2011).
- One of the four objectives of the strategy is “to achieve energy security and a low carbon energy supply that supports the development of green industry and services” (p. 18). This is to be achieved by using clean energy resources and developing a low-carbon national power grid. The use of firewood and charcoal, and thus deforestation, should be curbed.
- The government of Rwanda introduced the gradual [ban of firewood as source of cooking fuel, which was finally formalised in 2020](#). The intention is a transition to a low-carbon economy with benefits of being less vulnerable to oil price spikes and improvement of overall energy security.
- Rwanda submitted its Intended Nationally Determined Contribution in 2015 (Republic of Rwanda, 2015) and followed up with the Updated Nationally Determined Contribution (Republic of Rwanda, 2020), outlining that emissions shall be reduced by 38% by the year 2030. This goes hand in hand with the government ban on firewood in refugee camps and other facilities, such as schools.

## ENERGY SITUATION

### COUNTRY ENERGY SITUATION

In 2018, 81% of refugee households primarily used firewood for cooking and 17% used charcoal, with a similar split in the host community before the ban of firewood (World Bank, 2018). Some households continue to use wood as fuel for cooking and the main source used for lighting of homes is electricity. Dependence on traditional energy poses a major challenge, thus increased use of sustainable biomass is a key priority for Rwanda’s energy policy (Republic of Rwanda, 2020). The national electricity generation capacity is [cur-](#)

rently 238.4 MW, of which about one third is generated through hydroelectric power and the remaining two thirds through fossil power plants. Several small photovoltaic PV and biogas-to-power systems account for about 2 MW. Increasing investment in generation capacity and access to electricity are important energy policy goals that have improved significantly in recent years. For example, between 2012 and 2015, electricity generation increased by 72% and access to electricity improved from around 5% to 36%. As of January 2022, the cumulative connectivity rate is 68% of Rwandan households including 48% of households that are connected to the national grid and 20% accessing through off-grid systems that are mainly solar. Rwanda is also implementing various energy efficiency programmes, including the distribution of compact fluorescent lamps and replacing high-pressure sodium lamps with LEDs in streetlights ([Republic of Rwanda, 2020](#)).

Recently, the [African Development Bank](#) board approved a loan and grants to bring electricity to nearly 80,000 rural homes in southern Rwanda, furthering the country's goal of universal electrification. The project focuses on the modernization, rehabilitation, and expansion of the low-voltage power grid and the distribution of transformers in secondary cities with high loads, thus improving the reliability and sta-

bility of electricity supply and contributing to reducing greenhouse gas emissions. Measures to improve access to clean and affordable energy are particularly important for women, who disproportionately suffer from the environmental and health-damaging effects of using firewood as cooking energy source. The African Development Bank supports with microfinance and training to allow women to participate in small-scale electricity generation through photovoltaic solar panels (PV) and sell electricity to the national grid.

## REFUGEE ENERGY SITUATION

Displaced populations still lack sufficient access to clean, sustainable and affordable energy, despite growing awareness of its importance for well-being and protection. Most refugee households in Kigeme, Nyabiheke and Gihembe camps report little or no access to energy for lighting: 58% either have no lighting at night or use only basic sources such as candles and torches. Small minorities primarily rely on either solar lanterns (21%) or solar home systems (16%), and mobile phone torches and burning sticks are com-

"My Children are now happy. They play. Before they would run into the walls. We have a radio now, we can charge devices. Our children don't have to leave the house to look for light so they can study."  
(Yvonne, Congolese refugee)

© UNHCR/Samuel Otieno



monly used to move around the camps at night. In comparison, 24% of people in Rwanda have access to the national grid network and a further 5% have off-grid electricity access ([World Bank, 2018](#)).

Livelihood improvements can increase household income, enable self-resilience and provide the household budget needed to purchase energy access solutions within market-based approaches. Since higher incomes lead to market growth and increased energy demand, the additional energy needs have to be accounted for when planning livelihood opportunities ([CRRF, 2017](#)).

### DEVELOPMENT ACTORS AND FUNDING OF ENERGY PROGRAMMES

A mapping of development actors in the country shows that the African Development Bank (AfDB), the World Bank (WB), the German Corporation for International Cooperation (GIZ) and the Credit Institute for Reconstruction (KfW) have significant energy programme budgets in Rwanda and ongoing activities for

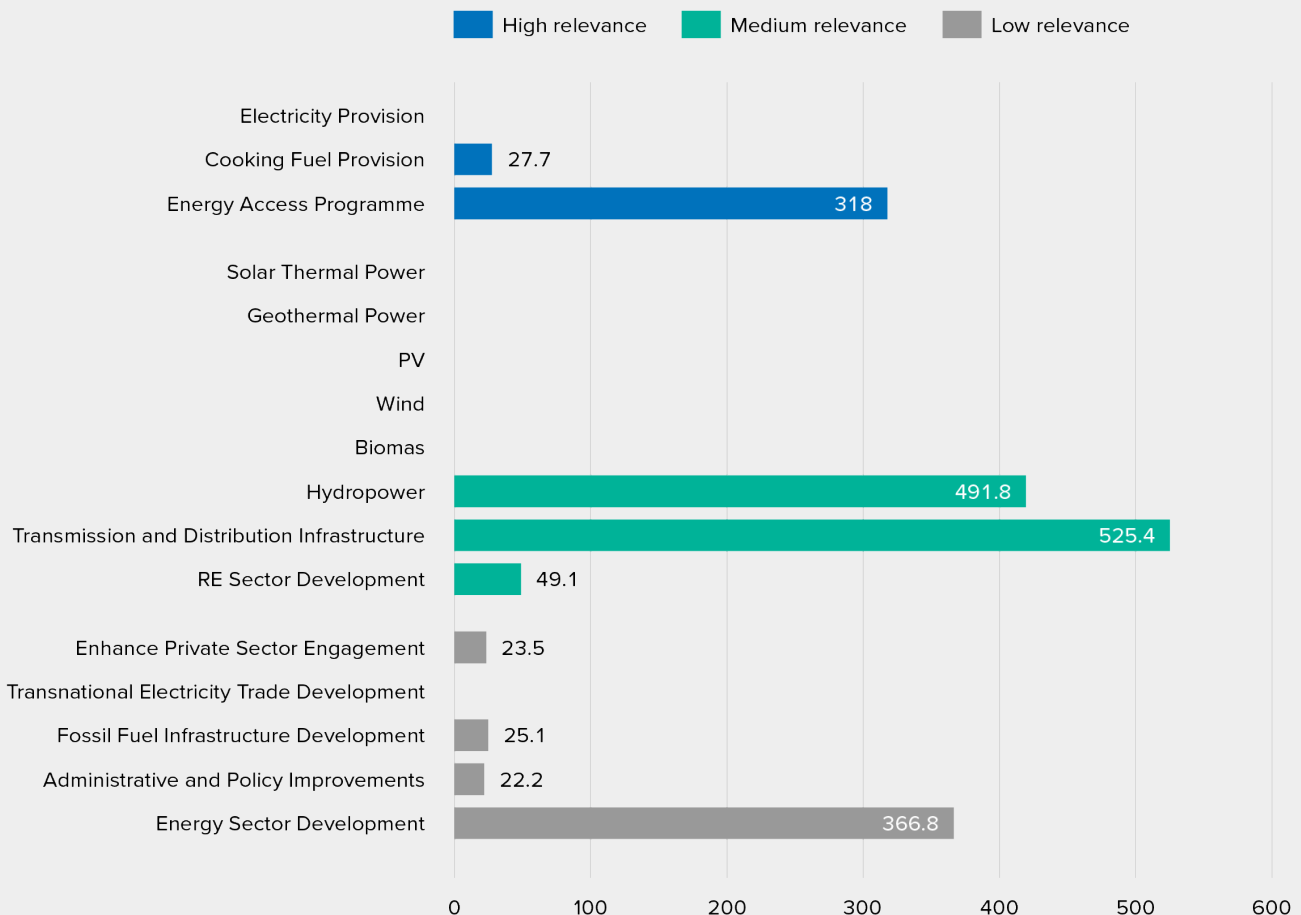
refugee context. The budgets are directed into various energy activities from large scale energy sector market and infrastructure activities to on-the-ground electricity access for remote locations as well as cooking access activities. Large scale and infrastructure activities improve the energy situation in refugee settings in the distant future and provide for a general framework for energy projects. On-the-ground and bottom-up electricity access and cooking access activities however immediately impact the refugee population and provide for improvements in a timely manner. For these reasons, some activities in the following two graphs are ranked “high relevance” and others are considered medium and low relevance for refugee contexts.

Figure 1 shows development programme activities with high relevance to refugee contexts in Rwanda; cooking fuel provision with a budget of USD 27.7 million and general energy access programmes with a budget of USD 318 million, both funded by the World Bank (WB). In medium relevance, we find the development of the national grid, as well as a transnational transmission line as the main activity with a budget of USD 525.4 mil-

Figure 1

### Active and proposed project activities

budget in million USD



lion. Further medium relevance project activities aim at grid, transmission infrastructure and renewable energy development. Main actors for these activities are WB with USD 640.7 million, AfDB with USD 408.1 million, GIZ with USD 318 million and KfW with USD 45.2 million. The budget percentages of actors within medium and high thematic relevance activities can be seen in figure 2. The main financial tool used to finance these projects is included as well. It highlights that the main kind of funding is given out through grants with a smaller amount of loans.

Figure 2

**Active and proposed projects of medium and high relevance**  
budget in million USD

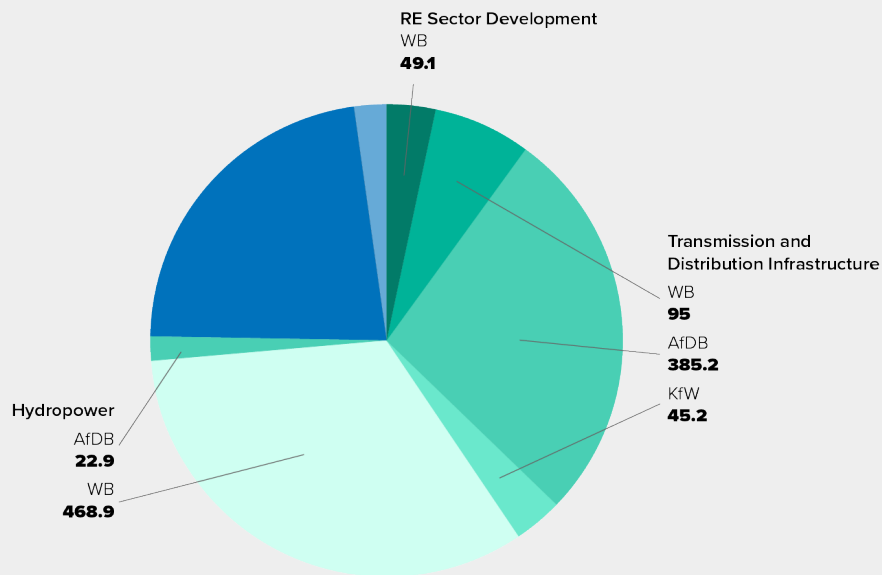


Figure 3

**Active and proposed investment with medium and high relevance**

1.4 billion USD

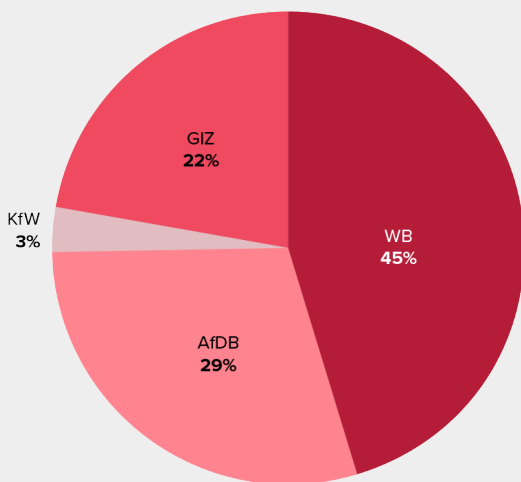
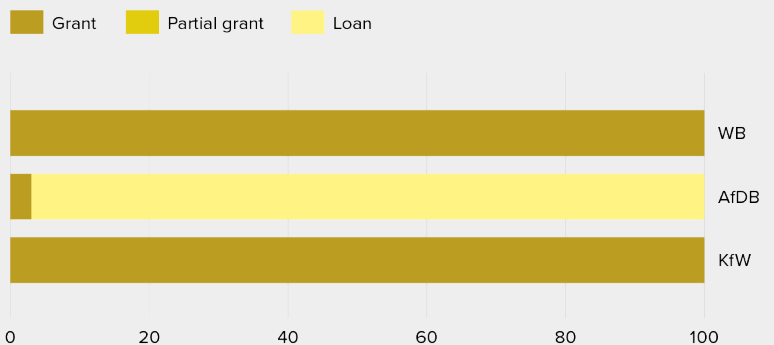


Figure 4

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

in %





## UNHCR ENERGY PROGRAMMING IN RWANDA

UNHCR's energy programming in Rwanda began in 2012 under an emergency response and has been growing in budget and activity diversity since. Innovative approaches of clean energy solutions have been added to the portfolio, including programme activities for cooking at higher tier 3 to 4 as [per the access to energy ranking scheme](#) and for lighting, including solar streetlights and solar home systems. Figure 5 outlines the gradual development of the yearly UNHCR budgets in Rwanda by comparing the total yearly UNHCR budgets in Rwanda to the yearly UNHCR budget for energy in the base year 2012 as well as to the number of refugees in the country. The increase coincides with the change in refugee numbers, the increased awareness of energy for wellbeing, livelihood and self-reliance of refugees, the increasingly innovative energy activities and the countries advancements in the energy sector. The COVID-19 pandemic greatly impacted Rwanda and the ongoing programme activities with regulations. The 2020 budget for energy reflects this fact and the mobilization of additional resources were taken to protect wellbeing and to continue delivering under more difficult circumstances.

The energy programme included the distribution of firewood and the provision of low efficiency cooking solutions in the years while the [SAFE strategy](#) was implemented, from 2014 to 2018, and until [a government decree banned firewood usage](#) for cooking in 2018. This led to the inception of alternative energy solutions and programmes such the [Renewable Energy for Refugees \(RE4R\)](#) in 2018, which aimed at expanding access to energy and improving the energy services quality through the extended use of market rather than donation concepts.

Refugees have used firewood as a cooking fuel which they received through UNHCR's monthly distributions. After the government banned the use of firewood, UNHCR shifted to provide liquid petroleum gas (LPG) to both communal kitchens and households. In 2018, cash assistance was added to the UNHCR programme to ensure refugees could purchase fuel according to their energy needs.

Cooking programmes advanced over the years, beginning with trainings and tools provision to households for building their own mud stove (with 15% efficiency) to the distribution of more fuel efficient cookstoves

(25-27% efficiency). Fuels such as wood, charcoal, briquettes and biofuels are combined with the appropriate cookstove design. The intervention helped to reduce the distribution and use of firewood.

The introduction of the Save 80 stove was accompanied by the generation of CO<sub>2</sub> emission reduction certificates to be sold on the emissions market. The issuance of these certificates generated income which was used to re-finance the stoves. For that matter, UNHCR signed its [first carbon financing agreement](#) with Atmosfair. The implementation of UNHCR's carbon credit project started in 2013 with the distribution of 3,829 stoves in Kigeme camp (100% of the families), followed by the distribution in 2015 of 1,920 stoves and 3,520 stoves in Mugombwa and Kiziba camps, respectively. Compared to a traditional three-stone fire, the Save 80 cookstoves lower the fuel wood consumption by up to 80%. The use of more efficient cookstoves saves money and time spent on fuel collection. It also limits deforestation and soil erosion around the camps and reduces exposure to household air pollution and its related health risks, especially for women and children.

In 2017, a pilot project in partnership with a Rwandan company introduced a gasifier stove using pellets, with an efficiency of 45%, corresponding to tier 4 [in the access to energy ranking scheme](#). This pilot ended in 2018 because of high costs which were due to the high quality solution at tier level 4. Building on the pilot lessons on affordability and self-reliance, a simpler cookstove on a tier level 3 with 35% efficiency was implemented. The cooking solution was linked to support of income generating activities as well as to efforts for in-country production of stoves and fuels. This was conducted under the RE4R programme.

The country operations also conducted solar lamps distributions and solar streetlights installations to provide an immediate solution to increase the protection and wellbeing of persons of concern. Refugees feel safer at night and can perform additional tasks in their households after the sunset. In more recent years, energy programmes related to lighting interventions shifted from distributions of solar lanterns to a market-based approach for Solar Home Systems (SHS).



© UNHCR/Anthony Karumba

# Provision of LPG Cooking Solution Rwanda

More than 18,500 households in Rwanda's largest refugee settlements, Mahama and Mugombwa, use Liquefied petroleum gas (LPG) for clean cooking. The provision of gas cylinders, LPG fillings and cookers as in-kind contributions by UNHCR removes the barrier of high initial investment costs. Reports indicate significant health benefits compared to firewood and higher user acceptance due to handling convenience.



## OVERVIEW

UNHCR responded to Rwanda's 2018 firewood ban by providing LPG cylinders, fillings and cookers to 15,000 households (HH) in Rwanda's largest refugee settlements of Mahama and Mugombwa, supplemented by 3,500 HH using cylinders donated by development partners. The transition to LPG in Mahama camp is being implemented jointly by the Ministry of Emergency Management ([MINEMA](#)) and [UNHCR](#) to provide cleaner cooking for all camp residents.

## DETAILS ON COOKING WITH LPG

LPG cookers emit 50 times fewer pollutants than stoves fuelled by biomass such as mud stoves. However given LPG's fossil fuel production nature, it is considered a clean fuel that bridges the gap until renewable alternatives such as biogas, bioethanol or electricity can be used ([GIZ, 2014](#)). LPG is stored in portable steel pressure cylinders that are commercially available in various sizes and equipped with a pressure regulator and a burner via a hose. With high temperatures of up to 2,000°C and high energy efficiency, LPG is drastically more convenient for cooking ([Energypedia](#)).

## SUPPLY AND BUSINESS MODEL

The domestic LPG market in Rwanda is dominated by importers who buy the technology and the LPG on the global market. Retail distribution happens through a variety of filling stations, independent dealers and supermarkets. In this project, the cylinders, cookers, spare parts and LPG itself were imported internationally and donated to HH. While the supplier organised the delivery of the LPG to the camps, the refugee workers coordinated the receipt of the empty cylinders, refilling and the distribution of the cylinders. A skid tank at the collection point in Mahama camp allowed the empty cylinders to be filled on site. In-kind distribution has provided households with a 6 kg LPG cylinder and a cooker. The equipment is worth USD 14 with refills costs of USD 1 per kg of LPG. The cost of an LPG cylinder and cooker range from USD 18 to 20 for a cooker with one burner and USD 27 to 45 for a cooker with two burners ([Energy 4 impact, 2021](#)). The average monthly consumption of a HH with five to six members is about 12 kg of LPG, which is equivalent to USD 12 (two-cylinder fills).



### PROTECTION/HEALTH

The introduction of LPG improved cooperation and thus coexistence between refugees and the host community ([UNHCR, 2020](#)). Refugee and host communities jointly support LPG distribution operations. While smoky, polluting fires or conventional stoves caused respiratory and eye diseases and affected health, LPG stoves are a clean substitute reducing household air pollution by 90% ([Energypedia](#)). LPG saves household members from the risks connected with firewood collection and reduces harmful emissions in the home.



### ACCEPTABILITY

Community members mentioned high acceptance of LPG cooking due to the fast heat-up time and high temperatures which increase cooking efficiency and comfort. Over 200,000 gas cylinders per year are continuously refilled and provide proof of a sustainable uptake. It remains important to familiarize communities with LPG cooking and to address safety concerns for safe and sustainable usage ([Global Alliance for clean cookstoves](#)).

## CONSIDERATIONS ON COOKING WITH LPG

- Subsidies are needed to overcome the high initial investment costs for the gas cylinders and cookers, as well as for the refilling, transport, and handling systems.
- Resources for the organization of the LPG supply operations are required and they need to be factored into the financial planning.
- Equipment and LPG are mostly sourced from international markets and involve market price developments as well as applicable government LPG regulations.
- Awareness-raising campaigns can help familiarize refugees with the equipment, its handling and use as well as highlighting benefits and safety measures.
- Camp residents' involvement in setting-up of LPG distribution promotes skills development, job creation and self-reliance.



## AFFORDABILITY

Incorporating LPG cooking into the camp value chain without subsidies remains a challenge, as the cost of the solution is high compared to camp incomes and opportunities for related business models are limited. There is potential to expand income opportunities of camp residents. Existing businesses that sell food and serve meals can benefit from the switch to LPG by reducing cooking times and cooking-related activities.



## SELF-RELIANCE

The equipment distribution, maintenance and after sales service can be managed by trained camp residents, thus providing them with jobs. Energy companies worked with camp residents as resellers to expand their business across the camp. If country policies allow for it, support to set up and register businesses can encourage camp residents to open LPG shops to supply the camp and host communities ([UNHCR, 2018](#)).



## ENVIRONMENT

Cooking with LPG drastically reduces household air pollution compared to conventional cooking fuels since LPG has very much lower particulate matter emission rates. Compared to charcoal, 5 to 16 times less greenhouse gases are released per meal ([UNHCR, 2021](#)) and switching from firewood to LPG can reduce CO2 emissions by 55% ([Clean cooking alliance](#)). Substituting conventional firewood with LPG reduces environmental degradation around settlements and helps to reduce deforestation and desertification. This contributes to higher soil fertility for agricultural activities in the vicinity of the settlement.

## HOW TO REPLICATE THIS PRACTICE

### STEP 1

Review the legal, regulatory, and institutional framework in the country and clarify whether there are national standards for the distribution and storage of LPG.

### STEP 2

Interview manufacturers or importers and wholesalers in the country to understand the structure of the industry and the cost of importing LPG through a Request for Information (RFI).

### STEP 3

Assess current cooking habits in the camp and the household budget situation to determine the most suitable way to introduce LPG cooking in the community.

### STEP 4

Coordinate with local authorities and the country technical service to implement and establish a reliable supply chain in the camp.

### STEP 5

Stimulate demand for LPG through subsidies for initial investment in refillable gas cylinders and LPG cookers as well as for filling tanks in camps.

While smoky, polluting fires or conventional stoves caused respiratory and eye diseases and affected health, LPG stoves are a clean substitute **reducing household air pollution by 90%**.

## LESSONS LEARNT FROM OTHER UNHCR PRACTICES

### **BANGLADESH**

#### Pressure cooker to reduce LPG consumption

Since 2018, UNHCR has provided refugees with LPG cooking fuel in Bangladesh. To reduce the fuel consumption, environmental impact and procurement cost, UNHCR introduced pressure cookers for households in Rohingya camp and the host community in 2020. The energy efficient pressure cookers reduced LPG consumption by 20-25% and users reported shorter cooking times of about 15-30 minutes less per meal.

### **NIGER**

#### Delivery models for providing access to clean cooking solutions

UNHCR used subsidies to cover LPG equipment costs and fuel for 6 kg cylinders to 25,000 households in displacement settings in Niger to overcome initial investment costs of USD 50. As distribution of the LPG cookers stimulated demand in the community, it attracted a private sector company that set-up 6 LPG stations and 50 LPG selling points across the region to ensure continuous supply. Subsidies are often the initial solution to establish an alternative cooking solution in a context, to then be handed over to local authorities.



Annick Iriwacu from Burundi stands outside her cooking gas retail outlet in Rwanda's capital, Kigali, which she runs with her brother Darcy.

© UNHCR/Anthony Karumba



© UNHCR/Eric Didier Karinganire

# Improved cookstove and pellets through a market-based approach Rwanda

5,611 households in Rwandan camps purchased improved cookstoves with pellet fuel as of Dec 2021. Two local suppliers manufactured the cookstoves and pressed the pellets from biomass residues and sold them to camp residents. As part of the project preparation, suppliers were supported financially to improve their processes, certify the cooking solution and make the products more affordable.



**UNHCR**  
The UN Refugee Agency

## OVERVIEW

UNHCR supported the transition to an improved cooking solution for refugee and host community households in the years 2019 to 2021. **The uptake and usage of 5,611 improved cookstoves and the consumption of 622,903 kg of pellets was facilitated over a 2-year-period** ending in December 2021. The 5,611 households approximate 19,300 persons in reach of the improved cooking solution which was implemented as part of the [Renewable Energy for Refugees \(RE4R\) programme](#).

## COOKSTOVE DETAILS

Natural air draft cookstoves burn solid biomass and are considered improved cookstoves as defined in the [UNHCR Cooking Compendium](#). **The devices are small, ideal for carrying by hand and fit under a cooking pot.** According to the supplier's data certification, these cookstoves have an efficiency of 32.7% and are rated at tier level 3 of the [Multi-tier Cooking Framework](#).

## FUEL DETAILS

Natural air draft cookstoves work with high efficiency when fed with small-sized biomass such as pellets.

**The raw materials of sawdust and forest management residues for the pellets originated from across Rwanda** and were pressed into a cylindrical shape with 20 to 35 mm in length and a diameter of 8 mm. The production was undertaken by local factories.

## DELIVERY AND BUSINESS MODEL

Suppliers received technical and financial support through the RE4R programme to improve their production capacity and product quality as well as to make the solution more affordable. **A market-based approach included the refugees as customers who could lease the cookstoves** ([Energy 4 impact, 2019](#)) and purchase the pellets through monthly payments, a financial modality provided for by [Inyenyeri](#). This financial scheme made the stoves affordable. The cost of a cookstove before this programme was USD 30 and through the financial support to the supplier, it could be lowered to USD 17. UNHCR product subsidies brought the price down to USD 13 which was met by households through monthly payment instalments of USD 1.05. Average household pellet consumption of 26 kg per month equalled USD 8.39. Cookstoves were sold in a targeted and cost-effective manner through 8 to 10 trained refugee sales agents and support staff per camp ([SNV](#) and RE4R). The two Rwandan suppliers provided a one-year warranty and **trainings for 1 to 3 technicians per camp** so that refugees could provide after-sales services and technical support during the warranty period.

## CONSIDERATIONS ON NEW COOKSTOVES AND FUEL

- Cookstove types are distinguished by the ease of use, cultural appropriateness, acceptability, cost, local/international sourcing, financing options and distribution models.
- Suppliers with sufficient production quality and capacities for stoves and pellets in the country are needed.
- Improved cookstoves offer significant health and environmental benefits, but affordability is a key determinant for its uptake.
- Long-term availability and reliability of supply of the pellet input materials in the country are essential for the sustainability of the cooking solution.
- Financial support to local suppliers might be needed to improve capacity, affordability and quality of products.



### PROTECTION/HEALTH

The availability of stoves and pellets in the settlement remove the need for camp residents to travel long distances to remote areas to collect firewood. Camp residents spent up to [3.8 hours per day on cooking related activities](#) and [women and children were particularly exposed to risks](#). Compared to firewood, improved cookstoves have the potential to significantly reduce smoke emissions and are safer to handle, leading to [an 83% decrease](#) of burns and respiratory issues.



### ACCEPTABILITY

Nearly all households reported a significant reduction of cooking time and improved cooking comfort, thanks to the higher efficiency and insulated outer surface of the cookstove. The new stove is used as the [primary](#)

[cooking solution by 56%](#) of the concerned people and only serves as a secondary option when pellet prices increase or a pellet shortage occurs.



### AFFORDABILITY

63% of people made use of the monthly payment subscription, while 37% purchased the stove through a one-off payment. For the pellets, 80% of the camp residents purchased them with cash on a needs basis and 20% used regular monthly payments. All users said they could afford purchasing the cookstove through monthly payments.



### SELF-RELIANCE

Sales and technical support staff was recruited and trained within the refugee community, creating jobs and providing for capacity-building opportunities. Existing entrepreneurs from the camp community were identified and ran the project together with suppliers as an alternative to building a costly and less context-tailored new market infrastructure with external providers. This approach allowed to distribute products in a more targeted and cost-effective manner while creating jobs and income opportunities locally.



### ENVIRONMENT

Pellet cookstoves produce fewer soot and particulate matter emissions compared to firewood cookstoves ([Energypedia](#)). Pellets can be made from a variety of biomass residues such as shrubs, sawdust, and similar wood material, which means that no biomass is specifically harvested, but rather biomass waste is made usable. By sourcing domestically from local timber and forestry industries, emissions from potential imports and transport routes can be kept low.

## HOW TO REPLICATE THIS PRACTICE

### STEP 1

Review the legal, regulatory, and institutional framework in the country and clarify whether there are national standards for fuel distribution and cooking technology usage.

### STEP 2

Assess current cooking habits, household budget situation and requirements for cash assistance and other financial support mechanisms to make the solution viable.

### STEP 3

Map manufacturers and traders in the country and neighbouring countries to understand the structure of the industry and the cost of fuel and cookstoves.

### STEP 4

Ensure that the supplier can scale up production with quality and low-cost products, potentially by financially supporting the supplier.

### STEP 5

Recruit and train staff from the refugee community to enable targeted and efficient distribution, job creation and client services.

Compared to firewood, improved cookstoves have the potential to significantly reduce smoke emissions and are safer to handle, **leading to an 83% decrease of burns and respiratory issues.**



## LESSONS LEARNT FROM OTHER UNHCR PRACTICES

### RWANDA

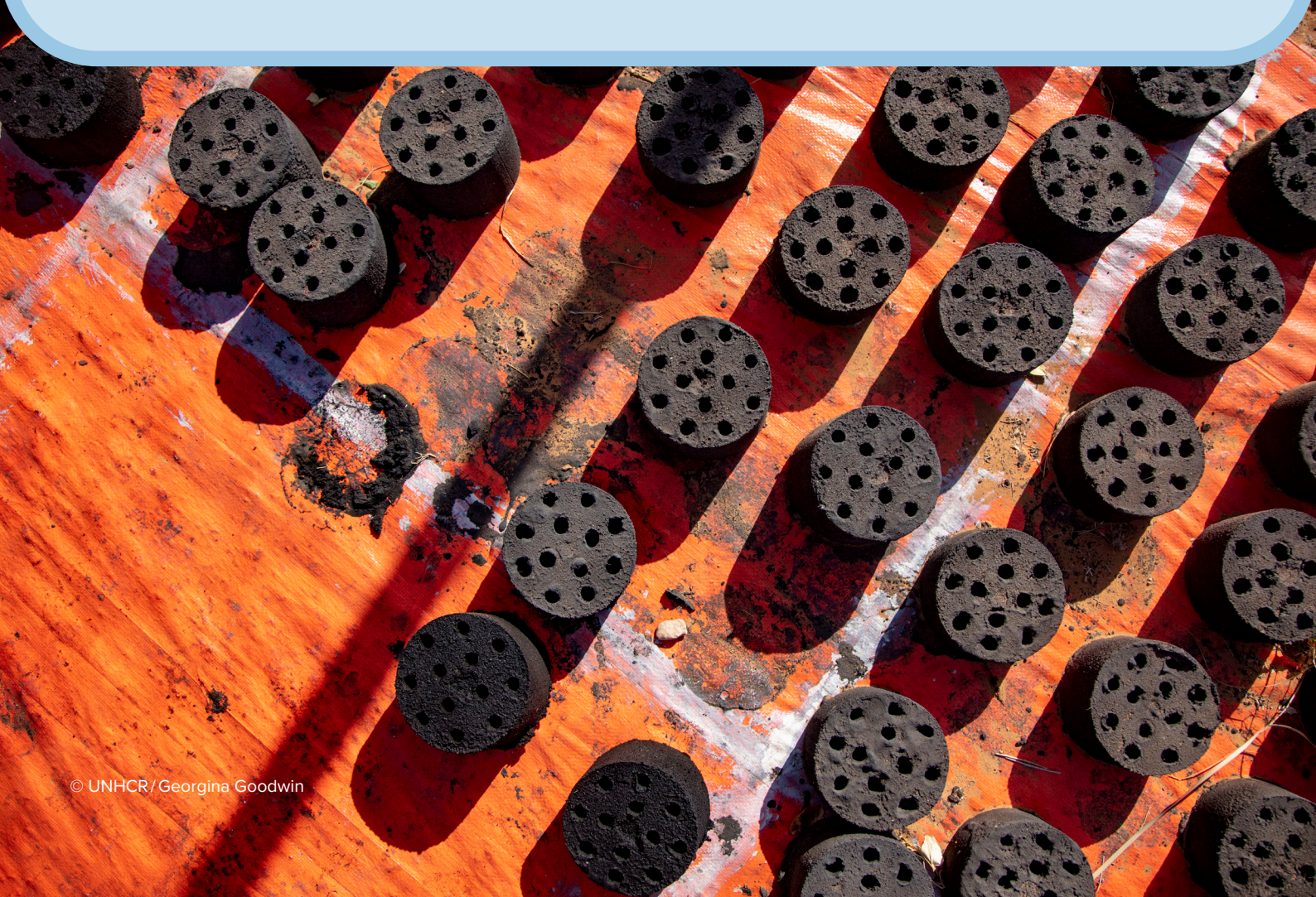
#### [Stoves through social benefit company](#)

In partnership with UNHCR in 2017, a Rwandan social enterprise opened a private sector business shop to offer clean cooking stoves on a free-for-leasing basis while also selling biomass pellets as fuel. The cookstove used pellets and required electricity which was provided by an attached solar panel. The device improved quality of the cooking process, reduced indoor pollution, and provided for lighting and mobile charging at the same time. The project ran for a few years to show the benefits of having an advanced cooking solution linked to an alternative leasing delivery model. The results of the pilot concluded that the devices were in fact leased by refugees and were reported to be affordable, however such interventions need to be linked to income-generating activities and consider subsidies to [initially inject the solution into the market](#) without bearing the upfront investment costs by households.

### RWANDA

#### [Save80 stoves with carbon credits](#)

UNHCR and its partners Safer Rwanda, Rwanda Womens' Network and Atmosfair are replacing traditional stoves with higher efficiency wood stoves. The stoves are easy and intuitive to use and compared to a three-stone fire, they use up to 80% less wood to achieve the same performance. Such a stove has a lifetime of more than 10 years. Previously the stoves were manufactured in Rwanda using imported components, however the entire production of the stove including all its components was set up in Rwanda creating local jobs and income opportunities. The first stove was produced in the new factory in Kigali in March 2020, reducing manufacturing costs. The production is expected to be self-sustaining in the long-term without external funding. Current funding is provided through the sale of [carbon credits](#) generated by certifying the CO<sub>2</sub> emissions that were avoided by implementing this project.





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# Solar Home Systems through market-based approach Rwanda

Solar Home Systems (SHS) were purchased by 4,279 remote and off-grid refugee households by December 2021. Two purchase models were accessible: a subsidized monthly pay as you go (PAYG) scheme or monthly installments over three years, including a revolving fund to access loans. Using the loans from the fund, households expanded their income-generating activities and could thereby afford the monthly payments.



## OVERVIEW

UNHCR, in partnership with the Practical Action and under the [Renewable Energy for Refugees \(RE4R\)](#) programme, **facilitated access to Solar Home System (SHS) for refugees and their host communities**, expanding the market with additional and affordable products. Two local companies offered their regular products to camp residents and host community members and employed refugees as sales representatives and technical support staff. 4,279 households in Kigeme, Nyabiheke and Gihembe refugee settlements were using SHS as of December 2021, **representing a camp wide SHS penetration of 54%**, including 12% of already existing SHS before ([UNHCR August 2021](#)).

## SHS DETAILS

SHS generate electricity for basic lighting and mobile phone charging, thus providing significantly improved access to electricity for households (HH) previously relying on non-electric forms of lighting. The SHS allow for efficient and cost-effective power generation for remote and off-grid HH at tiers 1 and 2, depending on

the SHS model type. While UNHCR promotes access to electricity at tier 2, meaning at least 200Wh a day ([UNHCR Global Strategy for Sustainable Energy](#)) access to electricity at tier 1 represents an improvement for HH previously lacking any access to electricity. A SHS consists of a solar panel, batteries and a controller that directs the electricity flows and protects the batteries and equipment from damage. The working voltage usually is 12 V and runs small devices such as lamps, radios, and small televisions ([Energypedia](#)). Under the RE4R project, two SHS models were available. The first SHS model was on tier 2 with a capacity of 50W, making it possible to power a phone charger, a radio and three lightbulbs. The second model was on tier 1 with a capacity of 20W, making it possible to power a phone charger and three lightbulbs. SHS can provide about 10 hours of electricity during the day and an average of four hours in the evening.

## DELIVERY AND BUSINESS MODEL

Two innovative financing mechanisms facilitated the purchase of the SHS.

- **Subsidies:** The 50W SHS was available through a three-year payment plan at a monthly rate of USD 3.05, which included a subsidy to reduce the monthly cost from the actual cost of USD 5.05. After the first three years, the customer went on paying the same monthly rate for up to seven years to cover the warranty and after-sales services.
- **Revolving fund:** The 20W SHS had an annual instalment scheme with a monthly rate of USD 2.74. While the larger version received financial assistance to lower the monthly rate, the smaller version was sold at the actual price combined with camp residents' access to a subsidised revolving fund. This fund, initiated by the RE4R programme, provided loans to low-income HH to expand their income-generating activities and therefore be able to afford the monthly installments. The fund is being optimized while in operation and planned to run long-term.

## CONSIDERATIONS ON SOLAR HOME SYSTEMS

- Key parameters of the SHS are power output, system size, local availability of the SHS and spare parts as well as the financing options.
- Uptake of the SHS' among the community increases with quality but higher quality means higher costs. Quality and cost of SHS products need to be aligned with household needs.
- The likelihood of a SHS purchase is strongly linked to household income, meaning that productive use of electricity and income generation should be supported alongside.
- The affordability of the product can be improved through subsidies on the product or on the business model, through longer repayment periods/ lower monthly costs as well as through livelihood activities that increase households income.
- Involving refugees as sales agents and technicians as well as for e-waste collection and recycling during the SHS operation lifetime creates job opportunities and supports project implementation.



## PROTECTION/HEALTH

[99% of community members](#) at Kigeme, Nyabiheke and Gihembe with a SHS report feeling safer in their homes after dark and having less concerns about open fire injuries, falls and criminal activity during the night.

HH otherwise often rely on burning sticks for lighting and try to keep the wood smouldering throughout the night to see inside their homes and light the cookstoves the next morning.



### ACCEPTABILITY

Acceptance of the SHS is high. Nevertheless, it is crucial to ensure that the SHS is adapted to the HH electricity needs and meets the quality standards as per the [Lighting Global Quality Standards for SHS Kits](#). A clear preference is for highest quality product when the HH can afford it, since higher quality products require less maintenance. 88% of SHS owners were able to meet their basic electricity needs and 75% of HH were satisfied with SHS services, resulting in default rates on payments ranging around 30%.



### AFFORDABILITY

The larger version of SHS was mainly purchased by middle-income HH, while the smaller version was suitable for lower-income HH. Most HH financed the monthly payment by receiving cash transfers with 79% of households for the 50W and 66% for the 20W system. A proportion of 27% financed the payments through income from a business and 12% through income from an occupation. It turned out that more than one source of income is needed to cover the cost of an SHS.



### SELF-RELIANCE

Shops and businesses can stay open after dark given 89% of shops operate out of a HH. 707 additional small businesses have been established through the combination of an SHS with the revolving fund and provide income-generation through fruit sales, clothing trading and livestock rearing to name a few. 87% of HH mention studying taking place after dark and 97% enjoy leisure and recreational activities after dark.

## HOW TO REPLICATE THIS PRACTICE

### STEP 1

Support private sector access to camp markets and support assessment of household lighting and electricity needs as well as purchasing power.

### STEP 2

Map available manufacturers or importers and wholesalers in the country to understand the structure of the industry and SHS provision costs.

### STEP 3

Share data on the camp market and arrange for guided camp visits for suppliers to better understand the context.

### STEP 4

Assess suppliers based on their ability to deliver SHS in quantity and quality, availability of spare parts, community engagement plans and financing models.

### STEP 5

Recruit refugee representatives to promote, sell, operate and maintain SHS. Provide trainings on SHS use and maintenance as well as on potential business activities.



### ENVIRONMENT

Community members report improved indoor air quality from replacing traditional light sources with electric lighting and environmental benefits are found during the operation of the SHS given no CO2 emissions. However, local sourcing and local recycling of system components at the end of the lifetime might prove challenging and current e-waste recycling projects are at the pioneering stage.

**99% of community members at Kigeme, Nyabiheke and Gihembe with a SHS report feeling safer in their homes after dark.**

## LESSONS LEARNT FROM OTHER UNHCR PRACTICES

### ETHIOPIA

#### [Distribution and maintenance of SHS by local energy cooperative](#)

In 2019, UNHCR distributed 4500 SHS to persons with specific needs in refugee camps in Dollo Ado. The installation and user trainings were provided by the local energy cooperatives, made up of refugees and host community members. The units were given in-kind as a means to promote the work of the cooperatives and to create a linkage between them and the community. While the cooperatives generate an income for their members through the sale of electricity, they also provide free power to vulnerable households who could not afford it otherwise. UNHCR helps the cooperatives procure spare parts that are difficult to find in local markets, however if repair is needed, the after-service fees are paid by the household directly to the cooperatives.

### AFGHANISTAN

#### [Large-scale provision of SHS](#)

UNHCR implemented a large-scale project to supply returnee households with SHS across the country and by the end of 2019, a total of 3,438 households had solar home systems. Persons mention benefits from extended productive hours into the dark, income savings from fossil fuel reductions, less health hazards which were previously caused by fuel fumes and safety improvements during the night. The provision of SHS joins a bigger effort for [projects to deploy solar](#) solutions in order to improve the wellbeing of displaced persons in Afghanistan, such as the installation of solar-powered water pumps at wells.



"My Children are now happy. They play. Before they would run into the walls. We have a radio now, we can charge devices. Our children don't have to leave the house to look for light so they can study."  
(Yvonne, Congolese refugee)

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# Solar Streetlights with community ownership

## Rwanda

Since 2017, UNHCR has installed solar street lights (SSLs) in refugee locations to improve the feeling of safety when moving around after dark. These complement the individual solar lamps and provide lighting of public spaces. SSL are normally installed by humanitarian actors with the intention to put their maintenance and replacement in the hands the community. To showcase this, UNHCR in 2019 facilitated the installation of an additional 185 SSLs under the [Renewable Energy for Refugees \(RE4R\) programme](#) that included ownership by the community.



## TECHNICAL DETAILS

SSL are elevated light sources powered by a solar panel and usually attached to a lighting structure or integrated into the pole itself. The solar panel feeds a rechargeable battery that powers a LED lamp during the night. Most **solar lights turn on and off automatically by a sensor that detects the outdoor light** based on the voltage of the solar panel. The four main components of the lighting solution are a pole, a solar panel, a lighting fixture and a rechargeable battery, with the latter three components often integrated into one unit. These lights have an average lifespan of 10-20 years and a warranty period of 7 years ([UNHCR](#)).

## DELIVERY AND BUSINESS MODEL

The supplier imported the SSL and spare parts from Europe. Together with the camp community through a participatory and [Safety Map Exercise](#), the priority areas were identified and the right size of lighting option was selected. The single light SSL costs EUR 1,159 and a larger double light system amounts to EUR 1,595. The **SSL were handed over to the camp community as a donation and for ownership by a community fund consisting of camp residents and local authorities**. To ensure the sustainability of the

units after installation, the supplier **trained 17 camp residents** to keep them operational and allow for easy on-site troubleshooting. The local community reports the malfunctioning lights to the technicians, who then provide the maintenance and repair. Several spare parts were kept at a storage location in the country to allow for timely replacement. A Solar Streetlight Board is made up of six members and organizes advertising at the lighting locations as a source of income into a community fund. The fund is operational and being tested as a mechanism to collect funds for the payment of the technicians, for the purchase of spare parts and for the potential replacement of the SSL beyond the project duration.



### PROTECTION

91% of residents say they feel safer after dark, compared to 12% before SSL installations ([UNHCR EIS data-base](#)). Lighting transforms life after dark - shops stay open, children continue to play and residents feel safer moving around the camp. Intimidation and theft decrease when lighting around WASH facilities is provided and residents do not have to rely on their own lighting via mobile phones, simple torches or nothing at all.

**91% of residents say they feel safer after dark, compared to 12% before SSL installations.**



### ACCEPTABILITY

Community members appreciate the value of the SSL due to the possible additional activities ([Renewable for Refugees Settlement, 2019](#)). The joint selection of SSL sites and the maintenance of the SSL by the community reinforce the desire for the SSL to continue to function. For example, almost all the streetlights were still fully functional 24 months after the installation, due to the good quality of the unit and the community's commitment to maintain the lights. None of the lights have been vandalized or tampered with.

## CONSIDERATIONS ON SOLAR STREETLIGHTS IN REFUGEE SETTINGS

- Initial capital costs are high and require financial subsidy or grants, especially if SSL are procured internationally.
- Replacement of the batteries is required during the SSL lifetime. Spare part availability in-country is necessary for cost-effective and timely maintenance.
- Affordability can be improved through inclusion of camp residents in maintenance and repair as well as advertising at the poles.
- Camp residents' involvement in selection of lighting locations, ownership and operation of the SSL is essential.
- SSL require regular cleaning and maintenance especially in dry and sandy locations. Trained camp residents can maintain and repair the systems to ensure proper functioning.



## AFFORDABILITY

SSL costs consist of initial investment costs and operating costs for cleaning and maintenance. The high initial cost remains a challenge for the refugee community and, in general, needs humanitarian funds. On the other hand, the operating costs are cheaper. With proper planning, the community can find a way to take care of them, such as using the warranty period for maintenance, collecting a communal contribution for the technician's salaries, stocking spare parts, etc.



## SELF-RESILIENCE

Technicians in the community have employment opportunities and earn an income. Camp-based businesses can extend their business hours and increase their sales. Beyond the maintenance aspect of the system, SSL facilitate livelihoods by encouraging a greater number of customers to visit the marketplaces in the evenings. In Rwanda, [62% of refugees](#) reported being able to continue being productive after dark.



## ENVIRONMENT

Electricity from solar panels is clean with no operational CO<sub>2</sub> emissions. SSL can offer environmental benefits in comparison to grid-connected streetlights with a smaller overall environmental impact for both land-filling and recycling scenarios. However, this depends on the supply chain of the SSL and the electricity mix in the grid to be considered on a case by case basis. The main portion of the negative environmental impact is created through the transportation of the units when internationally procured and when they are disposed.

In Rwanda, 62% of refugees reported being able to **continue being productive after dark.**

## HOW TO REPLICATE THIS PRACTICE

### STEP 1

Involve the camp community in prioritising SSL sites and select the appropriate SSL solution from international standards.

### STEP 2

Identify in-country manufacturers (or importers) and wholesalers to understand the industry structure and estimate SSL costs.

### STEP 3

Ensure sufficient technicians and spare parts are available to maintain the SSL functionality, as poor maintenance and cleaning will affect longevity and performance.

### STEP 4

Support income-generating activities in the community, such as promotional activities, and the establishment of a community fund to finance repairs and replacement of SSLs.

### STEP 5

Review financial sustainability of the SSL through spare parts, technician fees after initial lifetime of SSL.



## LESSONS LEARNT FROM OTHER UNHCR PRACTICES

### **ETHIOPIA**

#### SSL maintained by a local energy cooperative

UNHCR installed 1,700 SSL in five refugee camps in Dollo Ado, serving 70% of the camp's population. Local energy cooperatives of experts, refugees and host community members manage monitoring and maintenance of the SSL as well as of other solar products in the camps. The sustainability of the project is improved by a community-based mechanism that includes a voluntary and highly effective monthly contribution by the households for small maintenances around the camp. A board made up of various camp representatives is responsible for managing the fund and the repairs.

### **BANGLADESH**

#### SSL placement through strategic tool

UNHCR installed 1,600 SSL in both refugee settlements and in the host community. The selection of the most suitable locations was made in close collaboration with the local community and it included a series of street light mapping exercises. A coordination tool was developed to ensure equal community lighting coverage among settlements, as well as for monitoring and evaluation purposes. The [tool](#) is used in UNHCR projects with international funding agencies.

Installation of streetlights powered by solar energy has improved security at night and enabled businesses to operate for longer hours.

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