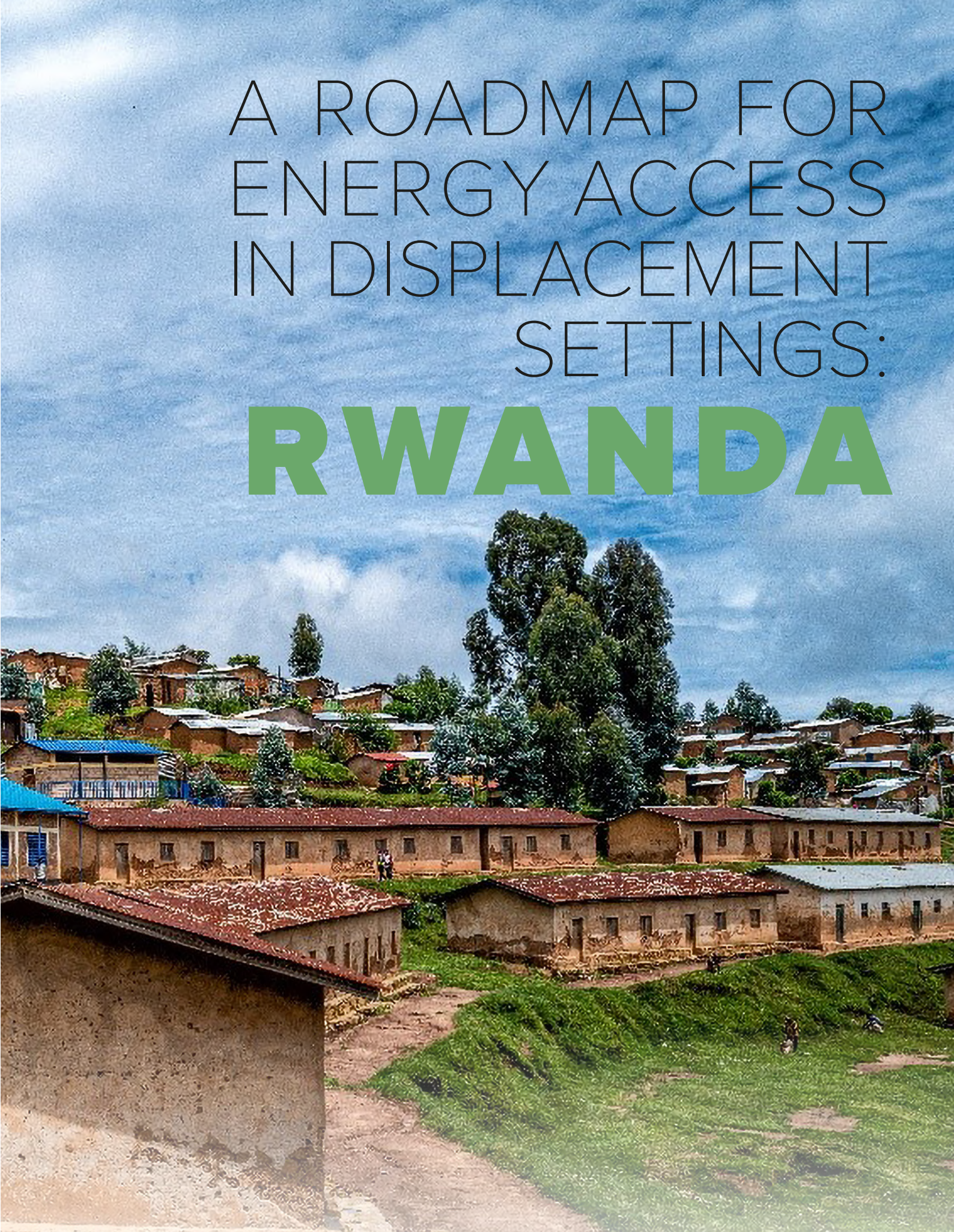
A ROADMAP FOR ENERGY ACCESS IN DISPLACEMENT SETTINGS:

RWANDA



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Acknowledgements

The authors would like to thank all participants of the READS Rwanda workshop for their valuable input:

Aime Rwagasore, Amare Gebre Egziabher, Anaclet Ndahimana, Anastase Sikubwabo, Arcade Mugisha, Augustin Fares Ruyumbu, Augustin Nkurikiyimfura, Baptiste Bagaza, Bosco Maniragaba, Bruno Rugero, Christine Mahoro, Claudine Uwingabire, Cleophas Ahishakiye, Damien Mbarubucyeye, Deborah Binamungu, Devotha Nshimiyimana, Diana Kirezi, Diana Mugire, Edson Sebutozi Munyakarambi, Eliel Sabato, Emile Babu, Emmanuel Gashima, Eric Mutabazi, Evariste Muhire, Jean Bosco Kwishatse, Jean Marie Vianney Twagirimana, Josiane Uwizeye, Noella Buntu, Patrice Habinshuti, Paulin Yamfashije, Pierre Rukundo, Richard Mori, Seif Hamoud, Simon Pierre Ndayisenga, Timothy Kayumba, Venantie Mukahigiro

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GPA Coordination Unit support: Mariana Soto, Sadiq Zafrullah, Mark Gibson, Thomas Fohgrub

Suggested citation: Philip Sandwell, Megan Täuber and Steven Nshizirungu (2023) A Roadmap for Energy Access in Displacement Settings: Rwanda. UNITAR. Geneva, Switzerland.

Donor: IKEA Foundation

IKEA Foundation

Acknowledgements

About the partners

The **Global Platform for Action on Sustainable Energy in Displacement Settings** (GPA) is the global initiative to promote actions that enable sustainable energy access and use in displacement settings. The GPA strives to remove barriers to energy access in humanitarian settings by providing a collaborative agenda for energy, development, and humanitarian partners to deliver concrete actions of Sustainable Development Goal 7 (SDG 7) for displacement contexts. It promotes and contributes to the humanitarian sector's transition to renewable energy, which will increase efficiency and reduce costs and carbon emissions. Hosted by the United Nations Institute for Training and Research (UNITAR), the GPA Coordination Unit galvanises collective action towards the GPA's realisation.

About the READS Programme

The **Roadmaps for Energy Access in Displacement Settings (READS) Programme,** funded by the IKEA Foundation and implemented by the GPA Coordination Unit at UNITAR, will produce a "roadmap report" for each of the ten countries in its scope. The roadmap reports take stock of the state of energy access in displacement settings in each country with a focus on identifying gaps and high-impact project opportunities to increase sustainable energy access for displacement-affected communities.

These reports consolidate existing data and are informed by workshops with in-country stakeholders to develop and refine the research, including representatives of communities which have been affected by displacement, energy companies, humanitarian and development organisations, and governmental authorities, among others. The roadmap reports present project concepts that have been prioritised by local partners as being the most impactful areas for sustainable energy interventions in displacement contexts. Each roadmap report is produced in partnership with an organisation working in displacement contexts in the focus country.

About the READS Partner

Practical Action is an international development organisation putting ingenious ideas to work so people in poverty can change their world. Its vision is a world that works better for everyone. Practical Action helps people find solutions to some of the world's toughest problems, including challenges made worse by catastrophic climate change and persistent gender inequality. The organisation believes in the power of small to change the big picture, and that together we can take practical action to build futures free from poverty. Big change starts small.

About the IKEA Foundation

The **IKEA Foundation** is a strategic philanthropy that focuses its grant making efforts on tackling the two biggest threats to children's futures: poverty and climate change. It currently grants more than €200 million per year to help improve family incomes and quality of life while protecting the planet from climate change. Since 2009, the IKEA Foundation has granted more than €1.5 billion to create a better future for children and their families. In 2021 the Board of the IKEA Foundation decided to make an additional €1 billion available over the next five years to accelerate the reduction of greenhouse gas emissions.

Table of Contents

Abbreviations

BNR	*National Bank of Rwanda*
CBI	*Cash-based intervention*
CRP	*Country Response Plan*
CRRF	*Comprehensive Refugee Response Framework*
DRC	*Democratic Republic of the Congo*
EAQIP	*Energy Access and Quality Improvement Project*
EARP	*Electricity Access Roll-out Programme*
EDCL	*Energy Development Corporation Limited*
EE	*Energy efficiency*
ENDEV	*Energising Development*
EPC	*Electric pressure cooker*
ESSP	*Energy Sector Strategic Plan*
EUCL	*Energy Utility Corporation Limited*
FAO	*Food and Agriculture Organization of the United Nations*
GCO_{2EQ}	*Grams of CO_2 equivalent*
GCR	*Global Compact on Refugees*
GIZ	*Deutsche Gesellschaft für Internationale Zusammenarbeit*
GOR	*Government of Rwanda*
GPA	*Global Platform for Action on Sustainable Energy in Displacement Settings*
HC	*Host community*
HEED	*Humanitarian Engineering and Energy for Displacement*

Abbreviations

ICT	*Information and communication technology*
ID	*Identification document*
KW / KWP	*Kilowatt / kilowatt-peak*
KWH	*Kilowatt-hour*
LPG	*Liquefied petroleum gas*
MFI	*Microfinance institution*
MINALOC	*Ministry of Local Government*
MINEMA	*Ministry in Charge of Emergency Management*
MININFRA	*Ministry of Infrastructure*
MW	*Megawatt*
NFI	*Non-food item*
NGO	*Non-governmental organisation*
O&M	*Operations and maintenance*
PAYGO	*Pay-as-you-go*
POC	*Population of concern*
POR	*Proof of registration*
PPA	*Power purchase agreement*
PUE	*Productive uses of energy*
RBF	*Results-based finance*
RDB	*Rwanda Development Board*
RE4R	*Renewable Energy for Refugees*

Abbreviations

READS	*Roadmaps for Energy Access in Displacement Settings*
REG	*Rwanda Energy Group*
REP	*Rwanda Energy Policy*
RISE	*Regulatory Indicators for Sustainable Energy*
RURA	*Rwanda Utilities Regulatory Authority*
RWF	*Rwandan Franc*
SACCO	*Savings and Credit Cooperative*
SDG 7	*Sustainable Development Goal 7*
SE4ALL	*Sustainable Energy for All*
SHS	*Solar home system*
SIDA	*Swedish International Development Cooperation Agency*
TCO_{2EQ}	*Tonnes of CO_2 equivalent*
UN	*United Nations*
UNDP	*United Nations Development Programme*
UNFCCC	*United Nations Framework Convention on Climate Change*
UNHCR	*Office of the United Nations High Commissioner for Refugees*
UNITAR	*United Nations Institute for Training and Research*
USD	*United States Dollar*
VSLA	*Village Savings and Loans Association*
W / WP	*Watt / Watt-peak*
WFP	*World Food Programme*

Executive Summary

Globally, over 100 million people have been forcibly displaced from their homes. Amongst those living in camps and settlements, more than 80% rely on cooking with firewood over open fires whilst over 90% lack access to electricity. Sustainable Development Goal 7 (SDG 7) calls for universal access to affordable, reliable, sustainable, and modern energy for all by 2030 – including communities affected by displacement. Rapid progress is required to achieve this ambitious goal.

The Roadmaps for Energy Access in Displacement Settings (READS) Programme aims to support the achievement of SDG 7 in ten countries, including in Rwanda. The country hosts a total population of concern (PoC) of more than 130,000 refugees and asylum seekers, with the term 'refugees' used to include all People of Concern throughout this report for brevity. This report consolidates the status of energy access in displacement settings in Rwanda, provides an overview of the stakeholders working towards SDG 7, and presents opportunities for high-impact projects to support increased access to sustainable energy for displaced people and host communities. ››

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Sustainable Development Goal 7 calls for universal access to sustainable energy for all people – including communities affected by displacement – by 2030. Rapid progress is required to achieve this ambitious goal.

Executive Summary

Energy access in displacement settings in Rwanda

Household cooking and electricity

Access to electricity for households varies between locations and communities. While 69% of households in the refugee camps and host communities reported having electricity access, only 24% have access to electricity for more than six hours. In addition, access varies significantly depending on location. Camps which were the focus of the first phase of Practical Action's Renewable Energy for Refugees (RE4R) Project – Kigeme and Nyabiheke – have rates of electricity access above 80%, driven by higher prevalence of solar home systems (SHS), compared to the other three camps (Mahama, Mugombwa and Kiziba) which have rates below 70%. In most cases, camp residents have higher rates of electricity access than host communities, with the exception of those living near Kigeme and Mahama camp who have access to the national grid. Grid connections are not permitted for refugees living in the camps for safety reasons. Average monthly expenditure on electricity is 3100 RWF ($2.75) with 51% of people paying using mobile transfers and 37% using cash.

Obstacles to improving domestic electricity access include the limited availability of high-quality off-grid solar products, and maintenance services for them, compounded by high costs and low abilities to pay. Existing projects which have supported private sector entry to refugee camps, such as that of SHS companies Bboxx and Belecom which supplied 4,279 systems to households and businesses under the RE4R Project, and tested different types of subsidies, revolving funds, and market activation activities. Other companies offer alternative methods of electrification, such as OffGridBox's rechargeable lighting kits. These experiences have highlighted the importance of establishing outlets within the camps and offering flexible repayment mechanisms to increase the long-term sustainability of commercial operations in displacement settings.

Despite high targets for access to clean cooking, most residents in Rwanda's refugee camps and the surrounding host communities rely on mud stoves, three-stone fires and improved cookstoves. The latter are mostly found in Kigeme and Nyabiheke refugee camps, where almost 7,000 improved cookstoves had been sold by two Rwandan companies with support from the RE4R Project, along with biomass pellets for fuel, with most customers opting for a monthly fuel subscription. Following the distribution of LPG stoves and fuel for camp residents in Mahama and Mugombwa camps, most households there (100% and 94% respectively) have access to this high-tier cooking solution; however, the ongoing fuel costs are currently borne by UNHCR which brings the long-term financial sustainability of this intervention into question. Except for these two camps, charcoal remains the most common fuel in Kigeme, Nyabiheke and Kiziba camps, and wood in all host communities. Overall 53% of households in the camps and host communities use Tier 1 or 2 stoves as their primary stoves, with Tier 3 and Tier 4 stoves only being found in Mahama and Mugombwa camps (38% of primary stoves).

Greater access to clean cooking is stifled by the limited options and high costs of improved cookstoves and fuels. On the supply side, most projects have relied heavily on grant funding for stoves, fuels, or both, whilst limited awareness of the benefits of improved stoves – and the risks of traditional cooking methods – affects demand for cleaner cooking methods which often come with high upfront costs. Supporting private sector engagement through de-risking mechanisms, subsidies, and results-based finance, coupled with cash support for households, could make clean cooking more affordable. Awareness-raising campaigns should be designed to appeal to boys, girls, men and women; women typically bear the brunt of all cooking tasks, but previous interventions have found that men expressed pride and interest in acquiring new cooking technologies which increased their involvement in cooking activities. ››

Executive Summary

Businesses and productive uses of energy

Almost all businesses operating in both camps and host communities, including shops, restaurants, tailors, hairdressers and workshops, use energy to support their operations. Across all settings, most businesses (89%) use electricity for lighting whilst using power for entertainment equipment (39%) and energy for cooking (15%) are also common. The forms of enterprises vary by camp location: in Kigeme and Kiziba businesses are more orientated towards hospitality, whilst Mahama and Nyabiheke host more productive uses of electricity (PUE) which generally require more power and offer higher revenues.

There is a desire for better machinery or new appliances with 38% of business owners anticipating that these would contribute to an increase in revenue: radios and phone chargers are amongst the highest priority appliances, followed by televisions, workshop machinery, milling machines, and sewing machines. The RE4R Project established grid-connected business centres in Kigeme and Nyabiheke which supply reliable, metered power to entrepreneurs alongside mentorship programmes and loans for PUE appliances. These provide camp residents with access to higher levels of power for their businesses which would otherwise be unable to access the grid network, unlike entrepreneurs in the host community next to some refugee camps.

Although most businesses have access to electricity, many entrepreneurs believe that their low levels of supply constrains their productivity: 68% of businesses with lighting reported that their level of access was insufficient, for example. PUE appliances which could boost revenues are considered to have high upfront costs, are not widely available, and may not be compatible with commonly-used sources of electricity such as SHS. Supporting connections to centralised electricity sources, such as nano-grids or grid-connected business centres in camps, could help increase productivity if implemented alongside PUE appliance subsidy schemes, mentorship programmes, and partnerships with financial institutions and savings groups. For example, 56% of entrepreneurs supported by the RE4R business centres reported a 50% increase in their income.

Social institutions and public lighting

Access to energy for social institutions (such as schools, clinics and community centres) varies by the type of organisation. Around half of community facilities serve both the refugee and host communities, in particular schools and health centres. Education and health facilities in the camps have access to the national grid or, in a few cases, standalone solar systems or a diesel generator. Religious buildings, on the other hand, generally rely on standalone solar or rechargeable batteries for their source of power, if any. School feeding programmes, meanwhile, use different forms of institutional cooking dependent on their managing authority. Preschools and primary schools in Kigeme, for example, are overseen by UNHCR and use bamboo pellets for cooking with both basic and improved stoves, whereas the secondary school under the remit of the Ministry of Education uses firewood.

The installation of solar street lighting under the RE4R Project in Kigeme and Nyabiheke used community mappings to select the best locations and community cooperatives to maintain the lights. An assessment undertaken two years after installation found that 62% of respondents were able to do business or productive activities after nightfall, for example selling in open-air marketplaces, and that 99% of the units were still functional. This was attributed to the involvement of the community in the initial installations and their ongoing ownership and maintenance model.

Whilst schools and clinics have relatively reliable access to electricity, other community facilities such as religious buildings and community centres are not well served as they have little or no funding for electricity. Institutional-scale clean cooking remains rare, and public lighting in Mahama, Mugombwa and Kiziba camps is currently very limited. Combining grant funding for initial installations with alternative financing mechanisms, such as advertisements or contributions from local businesses, could support further roll-out of public lighting. Meanwhile replicating improved institutional cooking programmes through interorganisational learning could scale up clean cooking in schools. ››

Executive Summary

Humanitarian operations

Humanitarian organisations which provide essential services to displaced people in camps generally have access to reliable and high-quality power, either through the national grid network or standalone solar, diesel, or hybrid systems. Payments are usually through formal channels, such as via metered consumption, costing 230-275 RWF ($0.20-0.24) per kWh. Water pumping stations have diesel generators for backup but rely primarily on the national grid: this is the preferred option of the Government of Rwanda, and UNHCR invested in extending the grid network to Mahama camp to power its operations, but other organisations further away from the transmission lines still rely on standalone systems.

As most operations have access to reliable and low-carbon power from Rwanda's national grid, offsetting or eliminating the remaining diesel generators should be the priority for humanitarian and development organisations. Improved monitoring of power consumption could highlight opportunities for energy efficiency measures, either from behaviour change or improved appliances, to reduce electricity usage and costs. ››

BARRIER	OPPORTUNITY
Limited availability of high-quality off-grid solar products and clean cooking systems in the camps	Support the private sector to set up outlets in or near camps through de-risking mechanisms and simplified regulatory approval
High costs of sustainable energy technologies and reliance on grant funding	Use results-based finance, instalment payments, revolving funds and savings groups to provide support to both customers and companies
Limited awareness of the benefits of clean cooking and PUE appliances	Advertising, demonstrations, and awareness raising campaigns which target men, women, girls, and boys
Displaced people living in camps cannot connect to the national grid	Support grid-connected business centres, solar nano-grids, and standalone solar solutions to provide alternative connections to high-quality power
Little uptake of institutional-scale clean cooking	Replicate existing projects in other settings and promote interorganisational learning

Executive Summary

Stakeholders in Rwanda

The Government of Rwanda's Ministry in Charge of Emergency Management (MINEMA) leads the refugee response in the country, with UNHCR providing operational support and capacity alongside local authorities. MINEMA and UNHCR collaborate to provide multi-sectoral support to project partners in delivering specific assistance, such as for protection, health and nutrition. Displaced people are represented in decision-making through the elected Refugee Executive Committee for each camp, which plays a key role in advocating for the needs of community members, and itself is supported by more local community bodies.

A range of organisations have implemented energy work in displacement settings in Rwanda. Both local and international companies have collaborated with development organisations on several clean cooking projects in different camps, using a range of stove and fuel types, and also on projects to increase access to solar products for households and businesses. Whilst some interventions still rely on traditional free distribution models to provide energy access, especially for cooking, most now focus on market-based approaches and collaborations with the private sector.

Opportunities to improve access to sustainable energy

Rwanda offers high potential to improve access to sustainable energy in displacement settings. The country offers a relatively supportive framework for both displaced people and sustainable energy, and the success of previous and ongoing projects which support market-based approaches – from the wide-reaching RE4R Project to smaller, more focused interventions – provide blueprints to scale up successful work.

The READS Programme, in partnership with Practical Action, hosted a workshop in Kigali, Rwanda in February 2023 which brought together stakeholders working on energy in displacement settings across the country. During a co-design session, participants identified the foundations for high-impact project concepts to improve access to sustainable energy. These concepts were subsequently developed and refined, drawing upon previous work in Rwanda and other displacement settings, to showcase the potential investment opportunities and serve as a starting point for future support. A summary of these project concepts is shown in Table 1. ››

Improving access to sustainable energy in displacement contexts in Rwanda will require a coordinated effort and shared vision among all stakeholders.

Executive Summary

TABLE 1

High-impact project concepts to increase sustainable energy access with estimates of their potential reach, duration, budget, and scalability.

PROJECT	NAME	REACH	DURATION	BUDGET	SCALABILITY
1	*RBF schemes for improved biomass stoves and wood pellets*	*30,000 households*	*4 years*	*$2 million*	*Moderate*
2	*Electric pressure cooker pilot for host community households and businesses and social institutions in camps*	*400 stoves*	*2 years*	*$500,000*	*High*
3	*Modular solar units for businesses*	*100 businesses*	*3 years*	*$500,000*	*High*
4	*Standalone solar systems for households and businesses*	*10,000 households, 125 businesses*	*3 years*	*$1.5 million*	*High*
5	*Grid-connected business centres*	*75 businesses*	*3 years*	*$1 million*	*Moderate*

Improving access to sustainable energy will require a coordinated effort and a shared vision between all stakeholders working in displacement contexts. Based on the findings in this report, the READS Programme has outlined a roadmap for energy access in displacement settings in Rwanda with short (2023-2024), medium (2025-2027) and long term (2028-2030+) goals. These include increasing the use of locally produced improved cookstoves and electric cooking, as well as expanding access to electricity for businesses and households through various solutions.

The challenge is huge: achieving access to affordable, sustainable, reliable, and modern energy for refugees and host communities by 2030 will require more projects, activities, partners, coordination, and investment than ever before. Fortunately, the projects and stakeholders already working in Rwanda offer an excellent foundation to scale up sustainable energy access in displacement settings in pursuit of achieving SDG 7. ●

01

Setting the scene

Overview of sustainable energy in displacement settings in Rwanda

Access to sustainable energy in Rwanda's five refugee camps, and in their surrounding host communities, varies across the country. Previous and ongoing work by NGOs and the private sector has resulted in a mixed picture: some camps have received significant attention in recent years and generally have higher access to electricity, whilst others that have only been focused on more recently, or in which smaller-scale interventions have been implemented, have far lower levels of access. Whilst host communities can access the national grid, households and businesses in the camps must rely on off-grid options such as solar home systems (SHS). Schools and clinics in the camps typically have access to the national grid or standalone systems.

Household access to clean cooking also varies between different camps. The free distribution of liquefied petroleum gas (LPG) in two camps, Mahama and Mugombwa, in response to a decree by the Government of Rwanda (GoR) to cease firewood distribution means that most households there rely on this form of cooking. In the other three camps, Kigeme, Nyabeke and Kiziba, most households rely on basic or improved cookstoves – along with all host communities – and uptake of improved fuels remains slow. Institutional-scale cooking in schools relies on a variety of cookstoves and fuel types, including firewood and pellets.

Addressing the challenge of achieving universal access to sustainable energy in displacement settings requires coordination at all levels – from global to local [1]. International targets for energy access are met through implementation on the ground with each country, region and community needing its own consideration and planning to reach this shared goal. In Rwanda, stakeholders from across government, humanitarian and development organisations, the private sector, and local communities work together across a range of projects aiming to improve access to sustainable energy.

Practical Action's Renewable Energy for Refugees (RE4R) Project, both in its completed first phase and ongoing second phase, has demonstrated how market-based approaches can increase access to sustainable energy in refugee camps, whilst work by other NGOs and companies has supported electricity access and clean cooking projects under commercial models. Whilst these interventions have reached each of Rwanda's refugee camps, much wider scaleup is necessary at each location and in their surrounding host communities in order to meet the need for sustainable energy for all.

Acknowledging this, the READS Programme aims to provide a country-level overview of sustainable energy in displacement settings, and a focus on individual camps and communities ››

Sustainable Development Goal 7 calls for universal access to sustainable energy for all people – including displaced communities – by 2030.

Overview of sustainable energy in displacement settings in Rwanda

where possible. With the Programme working across ten countries, Rwanda – alongside Uganda and Kenya – is amongst the first to be featured in a READS Roadmap Report.

A goal of the READS Programme is to identify new opportunities for high-impact projects to increase sustainable energy access by consolidating the existing knowledge on sustainable energy in displacement settings. This includes published literature – such as government policies, programme output reports, datasets, academic papers, and press releases – but also the experiences and expertise of practitioners working on project implementation and, most importantly, of community members.

In support of this, the READS Programme hosted a workshop in Kigali, Rwanda in February 2023 to engage with these stakeholders. Participants included representatives of communities which have been affected by displacement, the private sector, humanitarian organisations, and governmental authorities, among others. In addition to this workshop and the literature and reports published on the topic of energy access in refugee camps in Rwanda, the READS Programme also undertook primary research through 33 key informant interviews in Kigeme to hear the first-hand perspectives of displaced people on the impact of sustainable energy projects.

Using published literature, the knowledge and experiences shared during this workshop, and primary qualitative research, the READS Rwanda roadmap report highlights the most pressing gaps, barriers, and opportunities for sustainable energy in displacement settings, as well as the roles of the stakeholders involved. It also provides a spotlight for potential high-impact projects, co-designed in the workshops by stakeholders from different types of organisations, which could rapidly and radically improve sustainable energy access if they received support and investment.

The energy needs of each community, household, business, or institution will vary, as will the most effective ways of addressing them. This report aims to be as broad as possible in covering different kinds of energy access, and as comprehensive as possible in each topic, but is inherently limited by the nascent nature of research on sustainable energy in displacement settings and the uniqueness of each context. The authors hope that further research – perhaps focusing on specific areas of energy access, camps, or the impact of new projects – can build on this report by diving deeper into these areas and promote a greater uptake of sustainable energy in displacement settings.

At the READS workshop, stakeholders shared their experience through co-designing potential high-impact sustainable energy projects.

Market-based approaches have the potential to increase access to sustainable energy in refugee camps, but much wider scale up is needed.

02

Forced displacement in Rwanda

National overview

The Republic of Rwanda is a small, densely populated, and hilly country in Eastern Africa with more than 13 million inhabitants. The country's largest political party, the Rwandan Patriotic Front, leads the governing coalition in parliament and is headed by President Paul Kagame, who has been in power since 2000 [2]. Rwanda enjoys relative political, economic and social stability, particularly compared to its conflict-affected neighbours [3], and it is lauded for its control of corruption, government effectiveness, and strength of the rule of law [4]. Rwanda is classified as a low-income and least-developed country [5] with aspirations to achieve middle-income status by 2035 [2].

Rwanda offers a welcoming environment for displaced people. The country has a total population of concern (PoC) of 127,221, of which 121,280 people are refugees, 449 are seeking asylum and 5,492 are others of concern [6]; around 1% of Rwanda's residents are displaced people. Almost all of these people are from the neighbouring countries of the Democratic Republic of the Congo (DRC) and Burundi with few originating from elsewhere (see Table 1). Most displaced people are resident in one of five camps located around the country and around 10% live in urban centres including the capital Kigali (see Figure 1).

The ongoing instability in DRC, particularly in the eastern and central regions, has meant that some refugees from the country have been resident in Rwanda for more than 20 years [8]. The situation in Burundi which began following political violence in 2015, meanwhile, has now more or less stabilised which has facilitated the voluntary return of some Burundian refugees to their home country. In light of this relative stability, UNHCR estimates an increase in the number of displaced people of around 4% per year in line with natural population growth [9].

Kiziba (established 1996), Nyabiheke (2005), Kigeme (2012) and Mugombwa (2016) camps host mainly refugees from DRC, whilst Mahama camp (2015) hosts mostly people from Burundi [10]. These camps are in rural areas of the country (see Figure 1). Another camp, Gihembe, was closed in 2021 as a result of its aging infrastructure and environmental hazards caused by erosion. The camp residents, mostly from DRC, were moved to Mahama [11], which offers improved facilities and was made possible following some of the Burundian refugees returning home. In January 2023, a transit centre at Nkamira was opened to accommodate new arrivals from DRC [12]. ●

TABLE 2

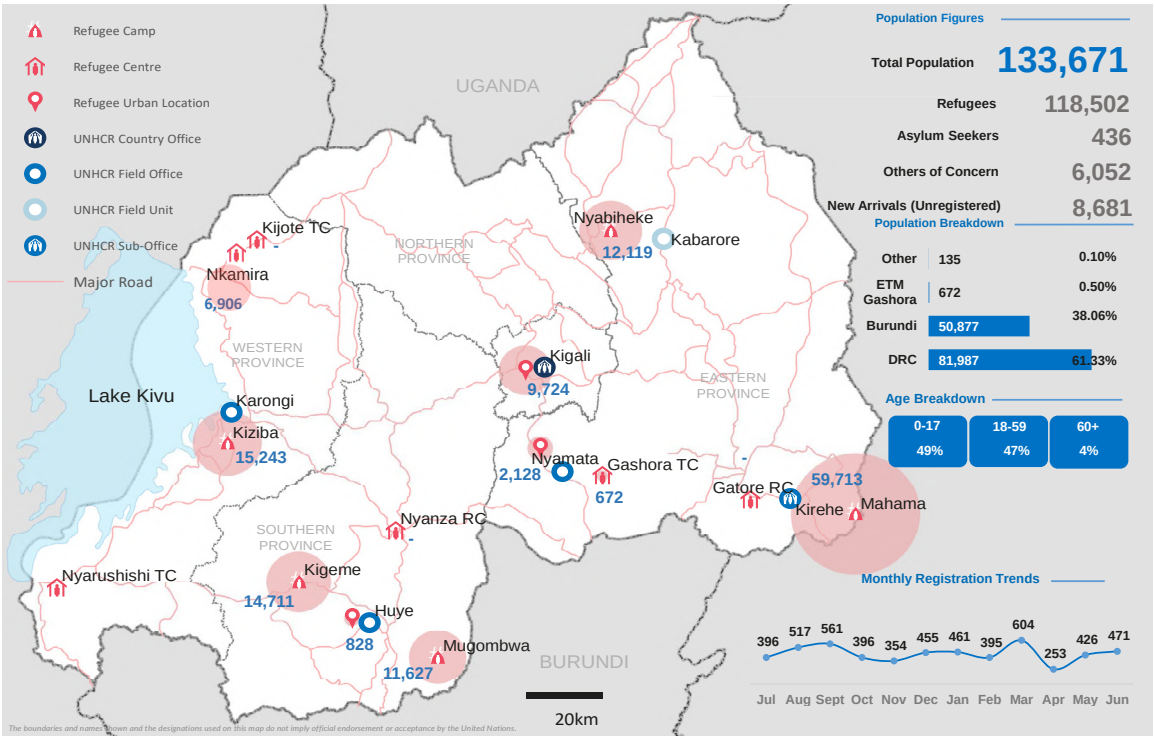
The population of Rwanda [7], the populations of concern and their countries of origin and locations [6].

		PEOPLE	%
POPULATION	RURAL	*10,944,098*	*82*
	URBAN	*2,332,422*	*18*
	TOTAL	***13,276,520***	***100***
PoC BY COUNTRY OF ORIGIN	DRC	*81,987*	*61*
	BURUNDI	*50,877*	*38*
	OTHER	*807*	*1*
	TOTAL	***133,671***	***100***
PoC BY LOCATION	MAHAMA CAMP	*59,713*	*45*
	KIZIBA CAMP	*15,243*	*11*
	KIGEME CAMP	*14,711*	*11*
	NYABIHEKE CAMP	*12,119*	*9*
	MUGOMBWA CAMP	*11,627*	*9*
	KIGALI (URBAN)	*9,724*	*7*
	NKAMIRA TRANSIT CENTRE	*6,906*	*5*
	NYAMATA (URBAN)	*2,128*	*2*
	HUYE (URBAN)	*828*	*1*
	OTHER	*672*	*1*
	TOTAL	***133,671***	***100***

National overview

FIGURE 1

Map of Rwanda with the locations of refugee camps and other UNHCR sites, and a breakdown of the population of concern as of 30 June 2023 [6].



All refugees will live "safe, dignified and productive lives across Rwanda and supported by Government-led services and programs, with camps transformed into integrated settlements".

– UNHCR 2030 Strategic Vision for Refugees

Policy frameworks for displaced populations

Rwanda has one of the most favourable policy environments for displaced people in the world and, along with neighbouring Uganda, offers levels of legal protection and access to social services beyond those elsewhere in the region and more generous than many high-income countries [13]. Rwanda is party to the 1951 Refugee Convention and its 1967 Protocol, albeit with a reservation to restrict the movement of refugees and determine their place of residence. The country is also a signatory to the International Covenant on Economic, Social and Cultural Rights and the Organization of African Unity regional convention. Refugees living in Rwanda have three options for durable solutions: voluntary repatriation to return to their home country, resettlement in a third country, or local integration into national systems.

Rwanda has adopted the Comprehensive Refugee Response Framework (CRRF) and the Global Compact on Refugees (GCR), both of which emphasise the long-term integration of displaced people into national socio-economic and legal systems [9]. This has been particularly successful in the education and health sectors, and refugees are included in the national birth registration system which decreases the risk of statelessness.

In general, refugees have the same levels of access to education, healthcare, and formal financial services as Rwandan citizens. As part of their commitment to the CRRF, since 2018 the GoR has taken steps to increase access to national identification document (ID) cards, jobs and services, and to increase mobility between refugee and host communities [10]. All refugees are issued a Proof of Registration (PoR) document and all refugees above the age of 16 are eligible for a refugee ID card which constitutes legal identity and residence [14]. Refugees have freedom of movement and, whilst the vast majority live in camps, some live in urban areas. While refugees can move freely in the region, for those registered in camp locations movement outside the camp, travel to Kigali or a different district, for example, requires identification and PoR documents, as well as a letter authorising the trip which states the duration of the absence from the camp and the address of where they will be staying. Without the requisite documents refugees risk detention [9], and longer absence periods might result in losing the entitlement to camp-based assistance [14]. In practice most refugees are long-term camp residents.

On paper refugees have very similar or identical rights to Rwandan citizens, including for labour and the right to self-employment [13], and in practice are generally able to access work permits, register businesses, and compete for jobs. To support this, the Government ran an information campaign in June 2019 to ensure that Rwandan nationals and companies knew that refugees have the right to work, open bank accounts, and move within the region [10]. Businesses operated by refugees, however, may face additional scrutiny and refugees have lower employment rates than the rest of the country[1]. Rwanda's National Asylum Law ensures that refugees can own property and engage in contracts, including for land leases; refugees in camps are provided with shelters but are not included in social housing programmes intended for Rwandan nationals, and in practice few refugees can afford to buy a home [15]. ●

1 This could be a result of factors including employers' misconceptions about refugees' rights to work, inadequate skillsets, or a lack of opportunities, amongst others [15].

Support from humanitarian organisations and sources of income

UNHCR's Country Refugee Response Plan (CRP) 2021 highlights seven strategic directions to support displaced people [9]. In addition to their core mandate to ensure the protection of refugees and provide targeted support for the most vulnerable persons of concern, these also include supporting the economic inclusion of refugees, expanding cash-based interventions (CBIs), and rolling out alternative cooking energy solutions. Each of these are in support of the overall 2030 Strategic Vision for Refugees which aims to see all refugees "living safe, dignified and productive lives across Rwanda and supported by Government-led services and programs, with camps transformed into integrated settlements".

All refugees receive CBIs for non-food items (NFI) such as soap, cooking fuel, hygiene kits, clothing, bedding, or other essential items from UNHCR via bank accounts [9]. As of June 2020, more than 40,000 bank accounts for refugees had been opened and two-thirds of households were registered with mobile money providers [15]. CBI for food assistance is provided by WFP and, as of May 2021, this is determined by *ubudehe*, the national categorisation of economic status[2] [17]. Under this system, the households in the most vulnerable category (1) receive 10,000 RWF ($8.80[3]) per person and those in the category above (2) receive 5,000 RWF ($4.40) per person, with those in category (3) not receiving CBI for food. These amounts are susceptible to change based on the availability of funding. Supplementary support mechanisms, such as school feeding programmes run by the World Food Programme (WFP) and supplementary feedings for children under five and other vulnerable groups, are also in place.

A study on financial inclusion, commissioned by the Alliance for Financial Inclusion and National Bank of Rwanda in 2022 [14], found that humanitarian assistance provided through vouchers is a major income source for refugees (77%), with others including small business (53%) and informal labour (26%). A further 4% relied on self-employment, 2% on NGO work, 2% on remittances, and 2% on formal employment. For host communities, major income sources include self-employment (68%, including agriculture), small business (58%) and informal labour (31%), followed by smaller percentages who rely on formal jobs (6%) and remittances (1%).

Another recent assessment by Mercy Corps in 2022 found that the average monthly income for refugee households living in Mahama and Nyabiheke refugee camps was $44 in both camps. Host communities had significantly higher incomes: $81 for hosts in Mahama and $53 for hosts in Nyabiheke [18].

The CRP 2021 includes consideration of energy and the environment as a component of its overall response [9]. This focuses mainly on alleviating environmental degradation from deforestation and aligning with the Government policies by pursuing more efficient cookstoves to reduce firewood consumption and promote clean cooking. The CRP also highlights that sustainable energy sources, such as solar, will be encouraged for lighting and to reduce diesel fuel consumption, and that partners with energy expertise will continue to promote sustainable energy for productive uses through market-based approaches. The CRP 2021 states that 75% of camp-based refugee households will have access to sustainable energy by the end of 2021 (the year of its focus) and that 148,000 tree seedlings will be planted. ●

2 This categorisation, tied to income and land ownership, was introduced by the Government of Rwanda in 2000 and is revised every three years with the goal of providing better social support to those in lower economic categories [16].

3 The exchange rate between the Rwandan Franc (RWF) and the United States Dollar (USD, $) has typically been steadily increasing since 2018 from around 850 RWF per $1 to around 1250 RWF (November 2023). Where possible, both RWF and USD values are taken from the original sources; if not, a conversion rate of RWF 1100 per $1 is used.

The CRP promotes clean cooking and the reduction of firewood consumption, as well as the use of solar to reduce diesel consumption.

Access to financial services

Access to financial services is relatively high across both refugees and host communities. Refugees can use their refugee ID card to open a bank account which they can use to receive cash assistance, and can obtain SIM cards with telecom providers [14]. In a study by the Alliance for Financial Inclusion and National Bank of Rwanda, 93% of refugee and 100% of host community respondents reported having access to a formal channel of financial inclusion [14]. This includes bank accounts, microfinance institutions (MFIs), savings and credit cooperatives (SACCOs), mobile money accounts, insurance providers and pensions. Just 4% of refugee respondents reported only having access to informal channels of inclusion, such as use of shop credit, savings groups, or borrowing from family. The remaining 3% of refugee respondents were considered financially excluded.

The same study found that 91% of refugees and 94% of hosts had access to a mobile money account, while only 25% of refugees and 35% of host community respondents had opened a bank account. In total 63% of respondents had only access to a mobile money account but not a bank account, with 29% having access to both a mobile money and bank account [14]. The gender gap is smaller for mobile money accounts than for bank accounts: 88% of female refugees and 94% of male refugees had access to mobile money (92% and 96% in the host communities). By contrast, just 13% of female refugees have access to a bank account compared to 34% of male refugees (31% and 40% of hosts). Bank loans were less common: only 12% of host community members had obtained one and just 2% of refugees. Only 10% of refugees and 12% of host community respondents used ATMs, although 26% of refugees (compared to 13% of hosts) have some kind of bank cards, mostly to use for vouchers for food and NFIs.

More than 95% of host community members reported saving regularly, compared to under 90% of refugees. Across all settings 22% of respondents indicated that they participated in savings groups, and 43% were part of a village savings and loans association (VSLA). Only 17% used bank accounts for saving, but 20% of respondents had access to MFIs (22% were men and 18% were women) and 26% had access to Umurenge SACCOs (government-supported saving and credit cooperative societies, used by only 6% of refugees and 46% of hosts). Some firms specifically target refugee businesses, as well as those in the host community: Inkomoko, for example, provides access to business advisory and financial services, and 64% of the 41,778 entrepreneurs it serves are refugees [19]. There is a stark difference in access to (or uptake of) insurance and pensions: only 11% of refugee respondents have insurance and 15% have pensions, compared to 98% (as all Rwandese are required to have insurance) and 48% in the host community [14].

The main barriers for refugees' access to finance was unfamiliarity and lack of trust in formal financial institutions, as well as difficulties obtaining a loan. Some refugees were hesitant to opt into longer-term financial products due to their uncertainty about potentially returning to their countries of origin. In addition, only 2% of refugees and 8% of host community members indicated that they almost always pay for all their needs, and only 10% of refugees and 21% of hosts claiming they can normally pay for most but not all of their needs. This means, that for the majority of respondents who cannot usually pay for their needs, access to financial products will also be limited [14].

03

National energy context of Rwanda

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National policy overview

The Government has ambitious targets for access to electricity, clean cooking, and renewable energy generation. The GoR target of 100% electrification by 2024 [20] specifically includes both households and productive uses of energy (PUE), and it also expects that 70% of connections are to come from the national grid and 30% from off-grid access [21]. At COP26 the GoR announced an Energy Compact [22] with a target of 80% of the rural population and 50% of the urban population accessing modern cooking services by 2030, with additional targets for reducing the use of woody biomass and charcoal. Furthermore, the country has a target of 60% of its electricity consumption coming from renewable sources by 2030 [23]. Overall, Rwanda has one of the most supportive policy environments towards sustainable energy in Sub-Saharan Africa and has the highest RISE score[4] in the region [24] (see Table 2).

Rwanda has a series of policies governing different aspects of the energy landscape [25]:

- The Rwanda Energy Policy (REP), which provides high-level guidance on the development of the energy sector and objectives across its subsectors,
- The Energy Sector Strategic Plan (ESSP), which guides the implementation of the REP through more specific reviews and medium-term targets,
- The Electricity Access Roll-out Programme (EARP), which provides a strategy and financial framework for new connections via grid extension and off-grid solutions,
- The Rural Electrification Strategy, which contributes to the EARP in rural areas through mechanisms for electricity access for low-income households and private sector support, and
- Ministerial Guidelines which focus on the processes for implementing specific technologies including SHS, mini-grids, and clean cooking technologies.

These also contribute to Rwanda's other development-focused policies such as the Economic Development and Poverty Reduction Strategy, and also its sustainability commitments under the country's SE4ALL action agenda and Nationally Determined Contribution. ››

TABLE 3

RISE Pillars for Rwanda and the regional and global averages [24]. Scores indicate the relative maturity of the regulatory environment ranging from mature (67 to 100), developing or improving (33 to 66) and early-stage (0 to 33).

RISE PILLAR	RWANDA	SUB-SAHARAN AFRICA	GLOBAL
OVERALL	71	38	61
ELECTRICITY ACCESS	73	51	53
CLEAN COOKING	60	35	37
RENEWABLE ENERGY	90	43	51
ENERGY EFFICIENCY	62	24	48

4 Regulatory Indicators for Sustainable Energy (RISE) is a set of indicators, aggregated across four pillars, which assess a country's policies and regulatory support (0-100) towards sustainable energy.

National policy overview

Despite this policy support, energy access rates are well below government targets [6]. Data from the World Bank, shown in Table 3, highlights how recent progress has increased electricity access rates to above the regional averages, but these remain low overall in rural areas. Rates of clean cooking are much lower: almost all rural households rely on traditional fuels and technologies for cooking. More recent data from Rwanda's Population and Housing Census, conducted in August 2022, found that 61% of households had access to electricity with 53% connected to the national grid, whilst for cooking 93% of households rely on solid fuels such as firewood (76%) and charcoal (17%) [26]. The total energy consumption of Rwanda is dominated by bioenergy for households, classified as renewable despite questions around how these resources are replenished in practice, and the electricity mix has a high share of renewable capacity [27]. Hydropower provides 75% of Rwanda's renewable electricity and solar 24%, with small contributions from biomass.

53%
have access to the national grid

TABLE 3

Selected SDG 7 indicators for Rwanda and the regional and global averages [7].

SDG 7 INDICATOR		RWANDA	SUB-SAHARAN AFRICA	GLOBAL
ACCESS TO ELECTRICITY (%)	***Total***	***49***	***48***	***91***
	Rural	*38*	*29*	*83*
	Urban	*98*	*78*	*97*
ACCESS TO CLEAN COOKING (%)	***Total***	***2***	***18***	***70***
	Rural	*0.3*	*6*	*49*
	Urban	*10*	*35*	*87*
RENEWABLE ENERGY (% FINAL CONSUMPTION)	-	*78*	*68*	*18*
RENEWABLE ELECTRICITY OUTPUT (% TOTAL OUTPUT)	-	*57*	*27*	*23*

Government agencies

The GoR's Ministry of Infrastructure (MININFRA) is responsible for major infrastructure in Rwanda including for energy, housing and human settlement, transport, water supply and sanitation [28]. Through the Energy Directorate, MININFRA has the overarching responsibility for developing and maintaining the generation and supply of energy, as well as for initiating programmes which aim to increase energy access and supervising the implementation of relevant quality standards and environmental sustainability regulations. It also supervises public institutions and agencies, including the Rwanda Energy Group (REG).

REG is a GoR-owned holding company responsible for the generation, transmission, distribution, procurement, and sale of electricity in Rwanda [29]. It was incorporated to expand, maintain, and operate the electricity infrastructure of the country and is composed of two subsidiaries:

- Energy Utility Corporation Limited (EUCL), which has a mandate for existing energy infrastructure, optimising generation capacity to meet short- and long-term needs, network growth, and executing power purchase agreements (PPAs) with independent power producers (IPPs) and regional utilities;
- Energy Development Corporation Limited (EDCL), which has the remit for increasing the investment in new energy generation projects, expanding electricity supply, developing transmission infrastructure, and planning and executing energy access targets.

The Rwanda Utilities Regulatory Authority (RURA) regulates certain public utilities, including electricity [30]. RURA oversees the laws and regulations related to electricity provision in addition to the remit to ensure fair competition and protecting consumer rights. It approves tariffs and issues licenses and permits for both electricity projects and for the companies and staff that install and operate them. RURA also issues permits for undertaking electrical installations, split into classes depending on installation types, which requires the applicant to hold technical qualifications such as a diploma or three years of work experience [31].

Rwanda treats policy consultations with stakeholders and development partners with high priority and so coordinates regular meetings through the Energy Sector Working Group[5] [32]. Such consultations have been important in achieving consensus for energy reforms in the country, for example in the development of the REP and off-grid electrification guidelines. In addition to policy consultations, the Energy Sector Working Group also serves as a forum for its four technical working groups for generation and transmission, access, biomass, and energy efficiency. The Rwanda Development Board (RDB), meanwhile, is the GoR department responsible for business registration and attracting and facilitating investment in the national economy, including for energy technologies [33]. ●

5 Sector Working Groups are also used in other areas, such as education, health and transport, and are chaired by a Government ministry and co-chaired by an external UN or international donor development organisation.

The Energy Sector Working Group has been important in achieving consensus for energy reforms, for example in the development of the REP.

Electrification policies and the national grid

Rwanda has a national renewable energy target of 60% [23], linked to its Nationally Determined Contributions. In 2020, 63% of its electricity came from renewable sources, mostly hydropower, and the emissions factor of the grid was just 157 gCO_{2eq}/kWh, much lower than both the global and African averages [27].

Private actors are permitted to own and operate renewable generation and there are long-term PPAs available for large- and small-scale producers, with well-regulated competitions are used for cost-competitive large-scale (>10 MW) projects. Small-scale producers (such as residential and commercial rooftop solar) can connect to the grid and different tariffs are available for different technologies and sizes of plant.

The Rwanda Electricity Distribution Master Plan is the officially-approved electrification plan and was based on demand assessment, developed through public consultations, and is periodically evaluated with its progress tracked and published [34]. It considers both on-grid (70% of connections) and off-grid (30%) solutions, with the private sector expected to play a leading role for the latter, and has publicly available geospatial maps with the timeframes of planned grid expansion[6]. The electrification plan includes PUE and community facilities. Tariffs are structured to provide much lower electricity costs to low-usage residential customers (from 89 RWF ($0.09) per kWh) compared to higher-volume customers or non-residential users (up to 227 RWF ($0.21) per kWh) [35].

Displaced people living in camps are generally not able to access grid connections. Shelters in the camps, sometimes built with semi-permanent materials such as plastic roofing, are not considered durable enough for connections owing to concerns around safety and security, especially potential fire hazards. Connections to the grid network are therefore not permitted, although the congested nature of some of the camps makes it difficult to avoid illicit or unapproved connections. Furthermore, to install a new connection REG requires a Unique Parcel Identifier – information related to land ownership – which refugees do not have as they do not own the land in the camps, making connections through official processes impossible.

Energy efficiency (EE) guidelines are in place but, in practice, are not generally supported by monitoring or labelling [36]. There are national plans to increase EE with targets across the domestic, commercial, power, and other sectors with mandates for large energy users in industry but there are no penalties for non-compliance. Binding energy saving obligations are in place for the public sector and there are policies for the procurement of energy-efficient appliances. Mandatory minimum energy performance standards have been adopted for air conditioning, lighting, refrigerators, and other appliances but there is no requirement for periodic reporting to ensure compliance. New and renovated buildings are expected to comply with energy efficiency codes which are verified by third parties. ●

6 Previous targets were for 52% of connections to come from the national grid but this was increased to 70%. Whilst the Rwanda Electricity Distribution Master Plan acknowledges the importance of off-grid solutions in its current strategy, it also states that "After 2024, the existing plan will be revised and consider the new plan of connecting off grid customer to the grid progressively until we have 100% access with grid solution" as part of its long-term investments.

Mini-grids, standalone systems, and off-grid solar products

The policies for mini-grids and standalone systems are relatively strong and well-defined under the Ministerial Guidelines on Mini-Grid Development [37]. Mini-grids can be owned and operated by private entities under clear licencing procedures which differ by mini-grid size, and regulations and technical standards are in place to govern what occurs if a mini-grid is connected to the national grid. Mini-grid operators can charge cost-reflective tariffs, subject to review by regulators, and there are publicly funded mechanisms and subsidies in place to close the viability gap.

New mini-grids can be developed under calls for proposals by REG or through independent developers proposing new sites. Under either route, the technical and financial proposals are reviewed by the GoR, a memorandum of agreement is awarded by MININFRA, a detailed feasibility study is conducted by the developer and reviewed by REG, and the developer's proposed tariffs are negotiated with RURA before a license is granted [37].

For larger-scale electricity projects, RURA is responsible for issuing licenses for the production, transmission and distribution of electricity, nominally striving to complete the consideration of applications for licences within 60 days[7] [38]. Additional legislation applicable to rural electrification simplifies the application process for small (50 to 100 kW) and medium (100 kW to 1 MW) isolated grids and aims to complete the process in 30 and 60 days respectively [39]. Whilst the timelines to gain regulatory approval could take longer in reality, very small (less than 50 kW) isolated grids are exempt from licensing regulations, subject to notifying RURA, which could accelerate the process for smaller systems relevant to displacement settings. Licenses are awarded for the exclusive retail of electricity for between five and 25 years within a geographically determined area but could be made open to competition if the system is not meeting demand.

Solar lighting products and SHS are also supported by the Government through duty exemptions, such as on solar modules and batteries [40]. A results-based finance (RBF) scheme, under the Renewable Energy Fund programme and the Rwanda Energy Access and Quality Improvement Project (EAQIP), is in place which offers eligible households in off-grid areas a subsidy of up to 90% depending on socio-economic status and is expected to facilitate more than 370,000 new connections [40]. Whilst there are no specific provisions for female-headed households in the legislation, since 2018 the Swedish International Development Cooperation Agency (Sida) and the Development Bank of Rwanda have implemented an eight-year, $20 million guarantee facility for energy loans for off-grid customers which offers a 50% guarantee, or 70% for female customers [41].

The GoR has adopted international standards for off-grid solar products under its Ministerial Guidelines for Solar Home Systems [42] and an estimated 99% of products sold were quality-verified[8] in the first half of 2021 [40]. There are also minimum warranty periods for SHS depending on their Tier (one year for Tier 0, two years for Tier 1, and three years for Tier 2+) and requirements for technical servicing and spare parts availability after installation. While there are not yet regulations in place for the safe disposal of solar systems or components specifically, e-waste regulations highlight the responsibility of manufacturers and distributors to ensure their products are disposed of responsibly [40].

7 The licencing regulations include this as an aspiration and provide expected durations for each stage of the application period, but in total these could add up to more time depending on the necessary procedures.

8 Amongst GOGLA and Lighting Global affiliates, certified according to IEC TS 62257-9-8 (standalone systems up to 350 W) and verified by Verasol. Systems above 350 W must comply with a range of other IEC standards.

Clean cooking

Rwanda's cooking energy policies focus mostly on the need to transition away from traditional biomass [43]. The ESSP aims to scale up clean cooking solutions and fuels, with a target to reduce the percentage of households using firewood from 83% in 2018-19 to 42% in 2023-24 [20]. More recently, the GoR has committed to 80% of the rural population and 50% of the urban population phasing out open fires by accessing cleaner fuels and cookstoves [22].

EAQIP also aims to increase access to clean cooking solutions to 500,000 households, of which 25% are to be female-headed, through partial subsidisation[9] [44]. Initially supporting Tier 2+ stoves, the project will transition to supporting Tier 3+ as they become more available in the country. This project is co-financed by ESMAP's Clean Cooking Fund which offers $17 million of financing and a further $3 million for technical assistance. In addition, the European Union has provided more than EUR 5 million through the Reducing the Climate Impact of Cooking in Rwanda (ReCIC), further supported by EnDev, for the sustainable production and dissemination of improved cookstoves and alternative fuels [45]. The ReCIC Project also supports the Rwanda Standards Board to increase its testing capacities.

The use of wood for cooking remains a challenge in Rwanda, both in terms of the low Tier of cooking access and the need for sustainable resource management [35]. The overdependence on fuelwood, rapid population growth and uneven distribution of biomass resources each contribute to the challenge, which is exacerbated by a lack of efficient improved cookstoves and a reliance on traditional methods for charcoal production. Ambitious government targets for improved cookstove penetration aim to alleviate this issue but are reliant on private sector engagement and uptake by rural and urban populations. The Rwanda Standards Board has been tasked with setting standards and certifying cookstoves and a laboratory has been set up which is able to test thermal efficiency [35].

In 2022, MININFRA released its Ministerial Guidelines for Clean Cooking Technologies which aim to guide and enforce the adoption of modern clean cooking practices across the country [33]. The Guidelines provide detailed minimum performance benchmarks aligned with international standards and, for cookstoves which use unprocessed biomass fuels such as firewood, includes a provision that from 2024 only stoves which meet Tier 3 standards will be allowed. The scope of the Guidelines includes households, restaurants, schools, and large institutions, specifically including refugee camps, as well as others such as hotels. Despite support for higher-Tier stoves, including under EAQIP's eligibility requirements, these standards are generally not yet widely enforced, most stoves have not been tested by accredited institutions, and labelling and awareness of stove standards are not widespread [35].

Household firewood consumption shall be reduced to

42%

9 Subsidy levels depend on the socio-economic status of the recipient household, and the Tier and cost of the stove, but a subsidy of up to 90% is available for the poorest households and 45% for those more well-off.

04

Energy needs in displacement settings

Renewable Energy for Refugees (RE4R): Overview

The Renewable Energy for Refugees (RE4R) Project is a collaboration between Practical Action, UNHCR and the GoR's Ministry in Charge of Emergency Management (MINEMA). Funded by the IKEA Foundation [46], the Project originally ran from April 2017 to February 2022 and worked to increase access to sustainable energy solutions in Nyabiheke, Gihembe and Kigeme Camps[10]. The RE4R Project worked directly with refugees, host communities, local companies, the government, and other partners to strengthen and support local energy markets, provide energy access, and promote economic activity and income generation through sustainable energy interventions in the camps. It also produced research, data, policy advocacy and outreach events to foster change at the systems level to share experience and lessons learned from the project with other actors working on energy access in displacement settings.

The project had four primary interventions which promoted different energy technologies through market-based approaches in Nyabiheke, Gihembe and Kigeme: SHS for households and small businesses, clean cooking for households, solar streetlights, and PUE. In 2021, Gihembe refugee camp was closed during the project's implementation due to safety concerns around erosion; residents were moved to Mahama camp and were supported in bringing their SHS with them. A significant number of the streetlights in Gihembe were moved to Nyabiheke refugee camp with the remainder continuing to provide lighting for the host community living in Gicumbi.

In 2022, Practical Action obtained additional funding from Sida to extend the RE4R Project – now referred to as RE4R Phase II – for four more years. In support of this, in late 2022, Practical Action undertook detailed surveys across Rwanda's five refugee camps and their host communities to inform its activities and objectives; these involved more than 1,000 households, almost 400 businesses, and 120 community and operational facilities [47]. RE4R is currently implementing four interventions as part of its second phase: these focus on solar home systems, clean cooking, streetlights, and PUE. These interventions were designed in a participatory way with community members playing a key role in defining and implementing the activities.

This READS report provides a summary of the key findings of the RE4R Phase II assessments [47], as they provide the most comprehensive and recent data available on energy access for refugees and host communities across all five camps in Rwanda.

10 The RE4R Project also had a significant focus on urban displacement in Irbid, Jordan, in its first phase but the two national contexts mostly operated independently and can be treated separately for the purpose of this report. Gihembe camp was open for the majority of the RE4R Project but closed in late 2021.

This section of the report presents the findings of the RE4R Phase II assessments.

Electricity access for households

Rwanda has significantly increased access to electricity in recent years, from 6% for households in 2008 to 61% in 2022, and aims to reach universal electricity access by 2024. Nevertheless, in some parts of the country this target is still far from being achieved. The 2022 Population and Housing Census found that Rwandan households relied on a variety of primary lighting sources: 47% relied on the national grid, 28% relied on flashlights and phone lights, 14% used solar power, and the remainder used basic sources such as firewood and candles [26]. In refugee-hosting districts, however, electricity access is lower than the national average: 57.1% in Kirehe (Mahama), 52.5% in Gisagara (Mugombwa), 50.4% in Karongi (Kiziba), 48.8% in Gatsibo (Nyabiheke), and 46.6% in Nyamagabe (Kigeme) [48].

Prior to the implementation of larger scale energy interventions in displacement settings in Rwanda, refugees primarily relied on the free distribution of energy products such as firewood or solar lanterns from donors. In many cases the most vulnerable refugees, such as disabled or elderly people, were prioritised for donations. Common sources of lighting included mobile torches, candles, burning sticks and, in rare cases, solar lanterns. Phone and torch charging services were very limited, meaning that refugees often had to leave the camps to find places to charge their devices.

Despite the progress made by the RE4R Project in its first phase, many households remain without adequate access to electricity. The RE4R Phase II assessments found that 69% of households reported having access to electricity, including grid connection (10%, only in host communities), SHS (36%), solar lanterns (16%) and rechargeable batteries (6%) [47]. The remaining 31% of surveyed households reported having no access to electricity. Only 24% of respondents reported having more than six hours of electricity per day.

The impact of RE4R Phase I is reflected by the fact that SHS are the most widely used primary electricity source in Kigeme and Nyabiheke camps, with 76% and 78% of respondents having access to one. In Kiziba and Mugombwa however, camps that were not included in Phase I of the RE4R Project, access to electricity is lower at 58% and 59%. Only 36% of respondents in Kiziba and 21% in Mugombwa reported having access to a SHS.

There is also a stark difference between levels of electricity access between refugees and some host communities. Host communities in Kigeme and Mahama have access to the grid, with 80% and 95% of respondents being connected respectively. These households use the grid connection as their primary electricity source and report having access to electricity for 16-18 hours per day. By contrast, access to electricity is very low in host communities near Kiziba (43%), Mugombwa (19%), and Nyabiheke (55%); these communities are not connected to the grid and SHS are not widespread outside of the camps.

Across all settings, 58% of respondents reported that their primary electricity source does not allow them to charge their phones, with the same number of respondents having a system with a generation capacity of less than 10 Watt-peak (Wp). The percentage of respondents not being able to charge their phones is particularly high for Kiziba and Mugombwa host communities (70% and 76%). By contrast, this number is much lower (although still relatively high) for SHS users in Kigeme (13%) and Nyabiheke (29%) refugee camps, places with higher SHS penetration. While 50% of respondents who had purchased a SHS through the RE4R Phase I intervention reported having no issues with their SHS, approximately 40% said the system was broken and 10% said the system had been stolen.

Among respondents who report paying for electricity, the average monthly expense is 3100 RWF ($2.75), with 51% paying using mobile transfers and 37% using cash. More people report paying for electricity in camps where SHS are prev- ››

Electricity access for households

alent. Interestingly, average monthly expenditure is higher in camps with less SHS penetration (Kiziba and Mugombwa) and host communities without access to the grid (Kiziba, Mugombwa, and Nyabiheke)[11]. Lower average monthly expenses in host communities (2000 RWF, $1.75) are explained by the recent arrival of the national grid near Kigeme and Mahama.

11 The RE4R Phase II assessments proposed a potential explanation being that repeated expenditure on lower-Tier sources of lighting, such as candles and batteries, could be more costly in the long run than a SHS.

TABLE 5

Findings of the RE4R Phase II assessments on household electricity access in camps and host communities (HC) [47].

	KIGEME		NYABIHEKE		MAHAMA		MUGOMBWA		KIZIBA	
	CAMP	HC	CAMP	HC	CAMP	HC	CAMP	HC	CAMP	HC
ACCESS TO ELECTRICITY	83%	84%	88%	55%	69%	95%	59%	19%	58%	43%
HOURS OF ELECTRICITY PER DAY	7	16-18	5	5-7	4	16-18	4	5-7	4	5-7
ABILITY TO CHARGE THEIR PHONE USING PRIMARY ELECTRICITY SOURCE	73%	95%	67%	42%	n/a	95%	n/a	24%	n/a	30%

FIGURE 2

Households in Kigeme refugee camp.

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RE4R Solar home systems for households and businesses

The first phase of the RE4R Project enabled 4,279 households and small businesses to access SHS through a combination of subsidies, support for the private sector, and customer awareness programmes [10, 46]. Two SHS companies with different business models, products and purchase models were supported to reach different parts of the target market [49]:

- Bboxx offered a 50 W system for 2,900 RWF ($2.54) per month (subsidised from the usual cost of 4,800 RWF ($4.21)) through a three-year payment plan, which provided three bulbs and a phone charger with the option for further appliances at additional cost; after the initial three years, the customer continues to pay the same monthly rate for up to seven years to cover the warranty and after-sales services;

- Belecom initially offered a 12 W system, and later a 20 W system, for 2,600 RWF ($2.28) per month for three years, which provided three bulbs, a phone charger and a radio[12]; the use of a revolving fund which provided loans to low-income customers helped customers make monthly payments and also aimed to increase income-generating opportunities [10].

The different delivery models used by the two companies highlight the importance of adopting smart strategies for financial support and stimulating the market system in a way which incentivises inclusivity and long-term investment in displacement settings [49]. As the more established supplier, Bboxx was able to achieve its sales targets within three months after operations began in July 2019 [49]. The company's success was attributed to its high-quality product, but new sales ceased once the limited number of subsidised products were claimed: there was limited willingness to pay for the unsubsidised products, which were significantly more expensive, potentially highlighting an issue with longevity of this method of subsidisation. Although Bboxx had permanent shops in proximity of the camps and sent sales agents to visit to provide customer support, the lack of an outlet in the camps was a point of dissatisfaction of customers who claimed that it was hard to get help with their products when needed. Belecom, on the other hand, provided unsubsidised products over a longer period and also invested both in a permanent presence in the camps and in developing their delivery model.

Despite efforts to reduce the costs of purchasing SHS, many low-income or particularly vulnerable households were still not able to afford a system. To address this RE4R Phase I piloted an inclusivity strategy, in partnership with Humanity & Inclusion and Solektra, to support 301 vulnerable households to gain access to a SHS and requiring them to pay only a very small contribution.

As a result of the SHS intervention, 4,279 households and businesses in Kigeme, Nyabiheke and Gihembe[13] refugee camps had purchased a SHS by December 2021. This represented a camp-wide SHS penetration of 54%, inclusive of 12% of households that had one before the project [10], and 99% of SHS customers reported feeling safer in their homes after dark [10]. ●

12 12 W systems were also used but were offered at the same price and provided the same services, and eventually upgraded to 20 W after customers expressed that the 12 W systems had an insufficient capacity.

13 Many households who moved from Gihembe to Mahama after the camp closure brought their SHS with them.

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 [10]

Barriers to household electricity access

AVAILABILITY BARRIERS

Access to electricity remains low for households in displacement settings in Rwanda. Access to the national grid is currently limited to host communities near Kigeme and Mahama refugee camps. While the prevalence of SHS was supported by RE4R Phase I in Kigeme and Nyabiheke camps, there is little penetration of SHS in the other refugee camps and in host communities. Private sector engagement is limited due to the perception that refugee camps are risky markets and logistical challenges with gaining access to the camps, many of which are in remote locations with less infrastructure. In addition, the procedures put in place by MINEMA and UNHCR in order for companies to operate commercially in refugee camps can be challenging to navigate, especially for new entrants.

In addition to the low supply of off-grid solar products in refugee camps, repair and maintenance services are also not always easily accessible. Experience from the first phase of the RE4R Project demonstrated that establishing a sales outlet in the camp, which also provides repair services, helped with quickly fixing broken products and that customers valued this service. Belecom established such an outlet but Bboxx did not; this led to customer dissatisfaction and the perception that it was not possible to get systems repaired. Although Bboxx had sales agents to support with bringing the systems to a larger repair hub, many customers were unaware of this. In addition, sales agents and technicians faced challenges with obtaining permission to enter the camps, particularly after certain hours. Perhaps in part because of this, the RE4R assessments showed that 78% of Bboxx customers in Kigeme reported that their system was broken, even though customers are obliged to pay an ongoing maintenance fee.

Experiences with the two RE4R SHS suppliers showed that different weather and climate conditions across the country influence the functioning of the systems, with some customers reporting that their system worked less effectively on cloudy days. There was also dissatisfaction from Belecom customers because their systems had a lower capacity compared to those of Bboxx, which had a capacity of 50 W. Subsequently, Belecom increased the capacity of their products from 12 W to 20 W.

OPPORTUNITIES

Streamlining of the regulatory process for companies to gain approval to operate in the camps as well as clear communication on the requirements would be important to facilitating increased private sector engagement. Further exposure of companies to challenges and opportunities of displacement settings – by inviting new entrants to learn about them, or for existing companies to develop delivery models specific to refugee markets – could help to scale up access to domestic electricity services in both camps and host communities that do not have access to the grid. Companies should be encouraged to open outlets in (or close to) the camps to demonstrate a long-term commitment to the market and improve customers' ability to access products and receive after-sales support, potentially reducing default rates. This would require substantial upfront investment from the companies in aspiration of a long-term gain and, in the short term, will require external financial support which could be provided in tranches upon companies achieving certain targets, ideally geared towards establishing long-term operational structures.

Each camp would likely require its own approach and so suppliers partnering with development or humanitarian organisations, as well as the Refugee Executive Committee, would be important in establishing these. Beyond more classic solar off-grid products like SHS and solar lanterns, innovative companies like OffGridBox – which provide power banks that are charged at a central station – should also receive financial support to scale up their operations. Establishing operations in the camps also provides an important opportunity to create jobs for local community members. Efforts should be made to train and hire both women and men from the refugee and host community in sales, repairs, and marketing roles.

AFFORDABILITY BARRIERS

For many households, obtaining a SHS remains out of reach because of its cost. Participants who were interviewed by the READS Programme explained that they valued their SHS but also ››

Barriers to household electricity access

thought that the price was too high, preventing others from acquiring them. An interviewee from Kigeme refugee camp shared that, whilst the SHS provided benefits to their family, the cost was at the higher end of their willingness to pay. This suggests that the current repayment duration might be too short, and that lower-income households may not be able to access SHS with the current schemes. In addition, there were issues with misunderstandings about the purchase model and the actual cost of the product. For example, some Bboxx customers believed that they would finish paying off their SHS within three years and not be required to pay anything else, but were unaware of the ongoing maintenance fee that is charged for seven years after paying off the initial purchase price of the product.

On the supply side, fluctuating levels of CBI support creates uncertainty regarding household purchasing power levels and makes it hard for companies to set affordable prices. The relatively low purchasing power of refugee customers skews the market towards lower-cost products. While this is not necessarily an inherent issue, larger and higher-cost systems with additional add-ons, such as televisions or PUE appliances, are typically more attractive to companies as they generally bring in more revenue per unit. Under RE4R Phase I, the default rate for SHS payments was relatively low, between 3.5% and 9% [49], but ongoing perceptions around the ability of displaced people to maintain consistent payments makes new suppliers cautious of offering systems on credit.

OPPORTUNITIES

Experience from RE4R Phase I showed that it was important to have two suppliers offering different products and different prices as they ended up being able to cater to both higher and lower income households. Other lower cost products, like Off-GridBox's power banks, could be more accessible to lower-income households. Instalment payments proved crucial to enabling households to purchase the systems. The revolving fund offered by Belecom, designed to stimulate income-generating activities by providing loans to invest in electric appliances along with a SHS, played a key role in supporting households to make repayments. Enabling PayGo models with mobile payments and built-in smart meters to monitor usage, which can switch off systems in case of non-payment, have proven successful in other contexts, like the BioLite SHS sold through the Mwangaza project in Kiziba refugee camp, and could be trialed in other refugee camps [50].

In general, allowing as much flexibility as possible with the repayment schedule could further support households' ability to pay for electricity. In addition, other targeted support mechanisms for particularly vulnerable groups, like the inclusivity strategy piloted by RE4R Phase I under which customers paid only a very small contribution, will be necessary to ensure that the benefits of electricity access are shared across the entire population.

The building of markets for SHS and other solar off-grid products will likely require a mix ››

I would say that accessing lighting is life. It goes from feeling safer and protected to allowing my children to do homework safely. However, we would be happy if the cost was modified from 2600 RWF to 1500-2000 RWF to meet our purchasing power.

– Kigeme resident

Barriers to household electricity access

of subisidies and flexible repayment mechanisms for customers initially. When more companies have been able to establish operations and a variety of products are available in camps, unrestricted cash transfers which can be spent on energy products could replace the subsidies before markets eventually become self-sustaining.

ACCEPTABILITY BARRIERS

Levels of customer awareness and market penetration for domestic electricity products vary, and are higher in Kigeme and Nyabiheke where the first phase of the RE4R Project was implemented. In other areas, refugee households and host communities who do not have access to the grid may not be as familiar with the benefits and cost-effectiveness of some off-grid solar systems, including newer products like the lighting kits offered by OffGridBox. In communities where access to electricity is low, people will not have had as much exposure to electricity and therefore could be less willing to pay for it.

OPPORTUNITIES

Tailored marketing and awareness raising campaigns, including cost breakdowns and value over time comparisons, are necessary to sensitise people in areas where there is little penetration of off-grid solar products and no access to the national grid. In particular, host communities should be targeted as well as refugees: while previous interventions mostly targeted camp residents, host communities tend to have even lower access to SHS and other off-grid solar systems (with the exception of host communities near Mahama and Kigeme who have access to the national grid). An interesting finding of the RE4R Phase II assessments was that these host communities perceived the value of energy and electricity to be higher, compared to other respondents. It appears that communities come to value electricity and energy services more once they have experienced them.

BARRIER	OPPORTUNITY
Limited availability of high-quality solar off-grid systems and private sector engagement in camps	De-risking mechanisms and RBF schemes to encourage market entry
Unclear regulatory requirements for companies to gain approval to work in camps	Provide clear guidance from camp authorities and streamline the procedures to gain approval to operate in camps
	Targeted communication and liaison support for companies
Limited availability of repair and maintenance services	Establish shop outlets or repair hubs in camps, or roving sales agents that can transport products to larger repair hubs
	Train and hire community members in repair and maintenance services
High costs of purchasing SHS	Instalment payments, PayGo models, flexible repayment mechanisms, loans from revolving fund, inclusivity strategy for low-income households
Low awareness of benefits of off-grid solar systems	Awareness raising campaigns and product demonstrations including cost-value breakdowns

OffGridBox: Rechargeable power banks for household electricity access

Founded in 2016, US-based OffGridBox manufactures containerised off-grid solar systems to provide electricity and water purification in 18 countries. The company has been working in Rwanda since 2018 and, with support from Energias de Portugal's Access to Energy fund [51], rolled out its systems in all of the country's refugee camps in 2021[14].

The OffGridBox systems – comprised of a cubic container two metres in each dimension, topped with solar panels, containing batteries and other equipment inside – are designed to be rapidly deployed in remote and rural areas [52]. These systems provide both off-grid power and water purification to the areas they are implemented in and can also be extended to provide more power or other services. The technology is particularly well suited to the refugee camp context in Rwanda, with their dense populations located in designated off-grid areas.

In the camps these systems charge "family lighting kits": small rechargeable batteries that can supply basic electricity services in customers' homes. Users charge their 40 Wh power bank at the main container system which provides enough energy to use three lights for six to eight hours and charge their phone or power small electronic equipment [51]. Each family lighting kit costs 45,000 RWF, much less than most SHS which typically cost between 120,000 and 170,000 RWF – albeit usually with SHS having higher capacities which can power larger appliances – and can be paid upfront or in instalments over three or 12 months. Avoiding the need for distribution networks and internal home wiring helps to keep costs low. The company also provides power to businesses – including for phone charging, cold storage, and barber shops – which are fewer in number, typically four to six per box, but consume around 60% of the electricity. As well as the jobs associated with managing the systems, these businesses also create jobs for the local community.

Each system employs several members of the refugee community: typically one "box keeper" who oversees the management, two sales agents, and two security personnel. Across the camps around 90% of the employees are women. In the future, OffGridBox also aim to hire a local area coordinator from the host community to oversee operations and liaise with the management team in Kigali.

Setting up a business in Rwanda is a relatively quick process and allows operations throughout the country but, when operating in refugee camps, the authorisations and permissions to access the camps are more geared towards NGOs and humanitarian agencies. Despite both MINEMA and UNHCR expressing their support for private sector engagement, there is a need for clear guidelines on how these regulations apply to companies. Working through these, and after OffGridBox drew comparisons to telecommunications companies' agents and shops like Airtel and MTN which work freely in the camps, the authorities allowed the company to enter and offer their services to refugees. OffGridBox submits regular reports to MINEMA and UNHCR to provide oversight and reassurance to the authorities.

Despite similarities between refugee camps and other rural areas in Rwanda, there were specific challenges once operations started in the camps: OffGridBox needed to overcome the mindset of camp residents thinking that the company was working for UNHCR and that its ››

14 OffGridBox had also deployed a system to Kigeme in 2019 but this could not be supported during the COVID-19 pandemic and became non-operational.

OffGridBox: Rechargeable power banks for household electricity access

products should be free. After overcoming this initial misperception by explaining their for-profit, fee-paying model, demand quickly increased and exceeded supply. Working with the Refugee Executive Committee in each camp was critical in supporting this initial phase, helping the company to hire refugees and understand their new market. OffGridBox has signed a memorandum of understanding with each Committee to share a percentage of its revenue with the community.

Some regulatory issues are still being worked out: REG has not yet classified the family lighting kit as it is neither a SHS nor solar lantern in the traditional sense. Whilst this has not been an issue yet for OffGridBox's operations in the camps, it could limit the company's ability to access traditional financing options if future funds are linked to a specific technology. At a cost of around $25,000-55,000 each [52], the systems could be rapidly deployed in greater numbers in each camp to scale up domestic access to basic electricity services, with OffGridBox estimating that it could supply around 70% of households in the camps if sufficient financing were available. As the systems can generate between 12-30 kWh of electricity per day, they could also provide electricity for health centres and other social applications, as well as households and businesses.

With around 2,000 customers in the camps across Rwanda, the company is still aiming to expand: each box can support around 400 households, but supply issues affecting the import of stock has meant that hundreds of potential customers remain on the waiting list. Future expansion will be under a new brand, Solid Stair, a company founded by two of OffGridBox's team members: in May 2023 Solid Stair took over the company's operations in Rwanda and aims to scale up in both displacement settings and throughout the country. ●

> There is a need for clear guidelines for the private sector to start working in the camps and to get approval, so this was a small challenge for us which required support from the authorities. But once you're approved, there's not much difference between working inside or outside the camps.
>
> – Christian Yesashimwe. Project Manager, OffGridBox

Our boxes fit very well with the refugee camp setup: the settlements are condensed, there are households and productive users, and if the camp closes we can also pack up our box and leave.

– Christian Yesashimwe. Project Manager, OffGridBox

Clean cooking for households

Although Rwanda has great ambitions for increased access to clean cooking, the implementation remains slow. The Population and Housing Census, conducted in 2022, found that 93% of households rely on solid fuels such as firewood (76%) and charcoal (17%), with just 4.6% of households in the country using liquefied petroleum gas (LPG) [26]. Firewood is the fuel that is preferred by most households as it is free, but the GoR aims to reduce its use for cooking to 42% by 2024 [53]. Even though traditional cooking methods are the most commonly used across the country, charcoal and LPG are the preferred fuel for cooking and heating in urban areas [20].

Access to clean cooking in displacement settings in Rwanda is a mixed picture, in part because of policy changes by both UNHCR and the government in recent years. As of 2018, 81% of refugee households used firewood and 17% of households used charcoal, a split that was mirrored in their host communities [10]. Firewood and low-Tier cookstoves were provided by UNHCR in camps, however firewood rations amounted to only half of the average household firewood usage of approximately 25 kg per month [54]. This led many refugees to trade or sell their food assistance to buy firewood or charcoal at the local market. In some cases, refugees used to exit the camp to collect wood which resulted in land degradation and increased the risk of creating conflicts with host community members [6].

In October 2018, a government decree banned the distribution of firewood in refugee camps by January 2019 [10]. This led UNHCR to shift to LPG distribution in Mahama and Mugombwa camps in 2019 [10], and to increase support for improved biomass cooking solutions with tailored cash assistance in the others camps [7]. This included work with the first phase of the RE4R Project and with Inyenyeri, a social enterprise that leased Mimi Moto fan-gasifying stoves using biomass pellets in Kigeme refugee camp from 2016 to 2020. Refugees were provided with cash-based assistance for purchasing cooking fuel. However, this was often spent on buying charcoal or food instead of purchasing pellets from Inyenyeri. While the technology proved to be very popular despite affordability challenges, Inyenyeri did not manage to reach a sufficient scale to make its business model financially viable and had to close in 2020.

As of 2022, access to clean cooking varies significantly across Rwanda's refugee camps and hosting communities. The RE4R Phase II assessments found that in Mahama and Mugombwa, where LPG is distributed and where most households had received their stove for free, LPG stove penetration is very high (100% and 94%), particularly compared to their host communities where penetration is very low (5% and 3%) [47]. In Kigeme, the majority of both refugees (83%) and host communities (68%) rely on improved cookstoves, while in Kiziba and Nyabiheke both refugees and host communities rely on a mix of improved and basic stoves (mud and three-stone-fire stoves). Most of the improved stoves in Kigeme and Nyabiheke had been purchased from an RE4R Phase I supplier and in the other settings people relied on a mix of self-built or purchased stoves.

Across most settings, primary stoves are typically either Tier 1 (32%) or Tier 2 (21%), with Tier 3 (16%) and Tier 4 (22%) stoves almost only being found in Mahama and Mugombwa camps. Most households which use a secondary stove have a mud or three-stone-fire stove, except in Mahama camp where most secondary stoves are charcoal stoves. The most prevalent fuels are LPG in Mahama and Mugombwa refugee camps, charcoal in all other camps, and wood in host communities.

Across all settings, the decision of which stove and fuel to use was taken by a woman in 74% ››

Clean cooking for households

of the cases. Sharing of food, fuel and stoves was found to be common in Kigeme and Kiziba camps, and sharing of stoves was also common in Mahama camp. In all other settings it was less common to share resources. Most households did not report any issues with their stoves but, for those that did, these included that their stove had broken, caused a lot of smoke, had poor combustion, or was too small to meet needs. Around half of respondents (and higher for those in host communities) reported cooking in separate buildings, with the other half of respondents cooking indoors and sometimes in rooms that are also sleeping areas.

Households rely on different coping strategies when there is not enough fuel for cooking, with skipping meals being the most prevalent strategy. Selling of non-food items, cooking food for less time, reducing portion sizes, and exchanging food for fuel are also used. Regarding incidents of violence related to collecting cooking fuels, 11% of respondents reported violence against females and 6% reported violence against males. The introduction of cooking with LPG, meanwhile, has shown great potential to reduce conflicts related to firewood collection.

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After we started using cooking gas, conflicts have reduced between refugees and the surrounding local population. We used to go outside the camp to fetch firewood and ended up in conflict with residents. Such issues no longer exist.

– Pierre, Mahama camp resident [55]

RE4R Improved cookstove and fuels

In 2021, RE4R Phase I began a clean cooking intervention through which two clean cooking companies that sell improved cookstoves and biomass pellets were supported in establishing operations in Kigeme and Nyabiheke. The companies, Urumuri Energy Group and Ecogreen Solutions Limited, both sold natural air draught stoves whose standard price was 35,000 RWF ($30.70) but was lowered to 12,000 RWF ($10.40) through the RE4R subsidy. Customers paid a deposit of 3,000 RWF ($2.60) and then paid the remaining balance of 9,000 RWF ($7.80) spread across six monthly instalments of 1,500 RWF ($1.30); for some households with lower purchasing power, this was extended to nine monthly instalments.

Both companies sold locally produced pellets; Urumuri's were made from a mix of sawdust and crushed shrubs or other biomass residues, and Ecogreen's were made from agricultural waste such as rice husks, coffee husks and wood waste. The price of pellets was also subsidised, from 300 RWF ($0.26) for Urumuri and 250 RWF ($0.22) for Ecogreen to 150 RWF ($0.13) per kg for both companies, with an average household using between 45 and 60 kgs of pellets a month.

In total 6,951 cookstoves and more than 1,200,000 kgs of pellets were purchased by households between July 2021 and March 2022, decreasing their average spend on cooking fuel by 23%. Other benefits reported by customers included reduced cooking times, reduced indoor air pollution, and lower use of firewood.

Two-thirds of customers took the option of a monthly subscription to purchase the stoves, rather than a one-off payment, and 80% of camp residents purchased pellets on a needs basis rather than a subscription [10]. Cookstoves were sold via 8-10 refugee sales agents and the suppliers trained technicians in each camp to provide after-sales service and support during the one-year warranty period [10]. These staff were recruited from the community and existing entrepreneurs in the camps were identified to help run the project with suppliers, rather than establishing new market structures with external partners. This helped to distribute the stoves and pellets more effectively whilst also creating job opportunities for the communities. ●

FIGURE 3

Urumuri (left) and Ecogreen (right) cookstoves.

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Clean cooking implementation projects

Clean cooking with Inyenyeri in Kigeme

In September 2016 a Rwandan social for-profit company, Inyenyeri, opened a retail shop in Kigeme as part of a market-based project to increase access to clean cooking in the camp, supported by the Government of Belgium and the IKEA Foundation. Based on the premise that affordable cookstoves were not clean and that refugee and rural households could not afford to purchase clean cookstoves, Inyenyeri piloted a leasing model in which households leased the stoves for free and bought specialised fuel (renewable wood pellets) [56]. The project introduced Mimi Moto fan-gasifying stoves into the camp by leasing them to 300 households, with participants in the project committing to purchase a certain amount of Inyenyeri biomass fuel pellets per month.

The project appeared to have huge potential to drastically improve the accessibility of improved cooking options for low-income customers. The technology proved to be successful very quickly, with demand far outstripping supply. A social impact study in 2018 [57] found that the Mimi Moto stoves were used as the primary cooking device, although other, lower-Tier stoves were also used. Users reported reductions in cooking times, fuel procurement times, and health problems while cooking. The company applied an innovative barter model through which customers could trade in raw biomass they collected for finished pellets, cutting down on fuel collection time in return for improved fuels [56]. However, refugee customers living in camps did not benefit from this model, and some reported an increase in expenditure on cooking fuel as a challenge, with around half of the respondents stating that the cost of pellets was too high and the main barrier to using the stoves more regularly.

Despite demonstrating much potential, Inyenyeri was ultimately unable to raise the amount of necessary capital to prove its business model at scale. As a result, Inyenyeri peaked at 5,700 customers and closed in 2020 [56].

There are several factors that ultimately led to Inyenyeri's closure. The company made a conscious choice to serve rural and refugee communities, which is inherently more challenging than targeting customers with more disposable income. Relying on a utility model and recurring fuel sales meant that Inyenyeri needed to sustain continuous demand among low-income customers. Furthermore, it took a long time to find the right stove provider, which was a very costly process, even though it was aligned with Inyenyeri's philosophy of promoting an iterative process to find the best solution.

By 2019, 40% of Inyenyeri's customers were based in Kigeme refugee camp, 25% lived in rural areas, and 35% in urban areas, of which only the latter group was able to meet the necessary pellet purchase requirements. An assessment concluded that while Inyenyeri's business model was plausible, the balance of customers was financially unsustainable and a higher share of urban customers would have helped to cross-subsidise those with lower levels of income. Another challenge was that Inyenyeri never managed to scale up its production site to reach utility scale and, without doing so, it could not increase its revenue. Inyenyeri's resources were also heavily stretched with needing to demonstrate the viability of their model, acquire additional funding, raise awareness, and ultimately they were not able to devote enough resources to achieving profitability [56].

Despite its closure, Inyenyeri achieved some important steps which can benefit the wider sector. One such accomplishment was demonstrating that biomass gasification could reach Tier 4 levels of cleanliness. Randomised control trials found that Inyenyeri's pellet-fed stoves cut polluting emissions by 90%, the first time that a ››

Clean cooking implementation projects

biomass solution had neared the performance of LPG stoves. Inyenyeri's purchasing data also made an important contribution to establishing the UNFCCC-approved methodology to issue carbon credits based on pellet sales [56]. To this day, former Inyenyeri customers speak positively about the technology, as evidenced in interviews conducted by the READS Programme. Former Inyenyeri staff have continued the business under the new brand name Biomassters, incorporating lessons learned from their previous experience with Inyenyeri, for example by targeting more urban customers and not using the bartering model.

Save80 stoves in Kigeme, Mugombwa and Kiziba

In three camps, UNHCR distributed Save80 cookstoves, so called because they claim to reduce firewood consumption by 80% compared to a three-stone fire [10]. Starting in Kigeme in 2013 with a distribution of 3,829 stoves and followed in 2015 in Mugombwa and Kiziba with 1,920 and 3,520 respectively, this project aimed to reduce demand for firewood and limit deforestation.

This project was also UNHCR's first carbon financing agreement with a climate protection organisation, Atmosfair, which aimed to capitalise on the greenhouse gas emissions reductions offered by reducing fuel consumption which were initially expected to amount to 30,000 tCO_{2eq} per year [59]. A UNFCCC report in 2014 found that, of 83 stoves that were monitored, only 31% were still being used and the remainder were broken or had been sold. Of those still in use, however, users appreciated the benefits of lower fuel consumption, as well as the time and cost benefits.

The Mwangaza Project in Kiziba

In 2019, Alight (formerly known as the American Refugee Committee) established the Mwangaza Project in Kiziba in partnership with BioLite, through which the company sold SHS and fuel-efficient cookstoves using a PayGo model [58]. The stoves also convert heat from cooking fires into electricity that can be used to charge phones and LED light torches. At the end of the project, 96% of customers reported that the BioLite technology helped them reduce their expenditure on fuel [58]. However, only 20% of customers used the BioLite cookstoves as their primary cookstove, while 80% still used charcoal or mud stoves as their primary cooking method [50]. ››

> Today, I am happy because this (BioLite) stove helps me to save money as I no longer have to buy kerosene.
>
> – Victor, Congolese refugee resident of Kiziba camp [58]

Clean cooking implementation projects

LPG cooking in Mahama and Mugombwa

More than 18,500 households in Mahama and Mugombwa have transitioned to LPG for cooking via support from UNHCR (15,000 households) and other development partners (3,500 households), implemented in partnership with MINEMA [10]. Gas cylinders, cookers and refills are provided to camp residents as in-kind contributions to remove high up-front costs and facilitate cleaner cooking solutions. Empty cylinders can be refilled on site and the average consumption of a five- or six-person household is estimated to be 12 kg per month. Over 200,000 gas cylinders are refilled every year.

In addition to the health benefits of cleaner cooking, camp residents highlighted the fast heat-up times and high temperatures of the stoves increase cooking efficiency and comfort [10]. Involving displaced people in the supply and distribution of LPG also offered opportunities for skills development and employment.

On the other hand, some users reported that the LPG ration did not last until the next filling and LPG shortages could lead to the next filling being delayed. The relatively high cost of the LPG stoves, around $18-20 for a stove with one burner or $27-45 for two burners [35], meant that subsidies were required to ensure widespread uptake across the camps. In addition, the price of LPG – on average around $1 per kg – changes frequently which affects both suppliers and customers. As a result, many refugees still use charcoal, papyrus and firewood while waiting to refill their cylinders. Replication would likely require similar levels of support for market stimulation, along with ensuring that the local LPG supply chains could engage with a potentially large new market. The provision of LPG in Mahama and Mugombwa is currently being reviewed by UNHCR to assess its long-term financial sustainability, with potential alternative cooking fuels being considered.

New RBF initiative by EnDev and Practical Action

The EnDev Programme in Rwanda, hosted by GIZ, and Practical Action are currently developing an RBF scheme for Tier 3+ cookstoves which will be deployed in refugee camps. Building on the market-based approach of RE4R Phase II, the project will increase the affordability of stoves by offering a subsidy for particularly vulnerable refugees, in addition to those available through RE4R Phase II. Predefined eligibility criteria will be used to identify and support refugees who otherwise could not afford the (already-discounted) stove prices. The RBF scheme ensures that the financial incentive is paid to the participating stove sellers only once a set of agreed and well-defined results have been achieved and verified. ●

Barriers to clean cooking

AVAILABILITY BARRIERS

Clean cooking solutions, both for cookstoves and fuels, face several challenges in displacement settings. Prominent amongst them is the lack of options: compared to urban areas of Rwanda, rural and camp settings have far reduced choice for manufactured cookstoves (if any at all) and customers generally have lower purchasing power, making improved cooking options relatively more expensive. Still, the introduction of two suppliers to Nyabiheke and Kigeme camps represents progress, and as part of RE4R II increased private sector engagement will be promoted in the other camps as well.

For suppliers, unclear regulations for gaining permission to operate in camps presents a great barrier to increased private sector engagement. This is further exacerbated by logistical and cost challenges in accessing more remote areas of the country and setting up operations there. The RE4R Phase I suppliers in particular faced challenges with establishing their production of pellets which made fuel unavailable for purchase at times. For the many households that still rely on biomass, increasingly scarce resources for firewood and charcoal due to deforestation impacts households heavily.

OPPORTUNITIES

Streamlining regulatory processes to facilitate obtaining permission to work in the camps for private companies would play an important role in increasing the availability of improved cooking solutions in camps. Sensitising more clean cooking companies to the opportunities of working in displacement settings and facilitating their introduction to working in camps would further support increased private sector engagement. De-risking mechanisms like RBF schemes can play a big role in supporting the market entry of new companies and encouraging a longer-term orientation; this could include the establishment of shops and production sites for integrated cooking solutions, such as a stove and a corresponding alternative fuel like pellets. Repair and maintenance services should also be made available in the shops, and community members should be trained and hired to fix any technical issues with the stoves.

AFFORDABILITY BARRIERS

Some clean cooking projects in the camps have been successful in introducing improved cooking solutions but will always face the challenge that, compared to low- or no-cost traditional cooking methods, the cost and affordability of manufactured stoves and fuels remain a barrier. Companies face high upfront costs of establishing production sites and shops, hiring and training staff, and transporting products, which to a certain extent is reflected in their prices. For many households, improved cooking solutions such as those provided by RE4R Phase I or Inyenyeri were considered too expensive, even though the RE4R stoves were heavily subsidised, were heavily subsidised, raising issues of financial sustainability for suppliers. Like for SHS, fluctuating levels of CBI support also impacts household purchasing power for improved cooking solutions and creates uncertainty for suppliers.

Charcoal stove users have also been significantly impacted by price increases and seasonal charcoal price fluctuations. The uptake of LPG has relied on a free distribution model by UNHCR, another example of how the dissemination of new technologies will initially rely heavily on grants and that financial sustainability will take a long time to achieve. In addition, an assessment on the viability of e-cooking found that the initial cost was currently too high for most households in displacement settings [47].

OPPORTUNITIES

Improved access to finance on the supply side will play a key role in increasing private sector engagement. This could include leveraging carbon financing, grant financing for new companies or de-risking mechanisms like RBF schemes for more established companies to support companies to set up or increase their production capacity and establish operations in the camps. It ››

Barriers to clean cooking

could also allow companies to reduce their prices, although end-user subsidies, flexible repayment mechanisms, pay-as-you-cook, and/or instalment payments will likely remain important to make products more affordable and support widespread uptake initially. The option to purchase fuel on credit also plays a large role in reducing the financial barrier for customers. Inyenyeri's leasing model combined with the sale of specialised pellets would also be worth further exploring. Once companies have established themselves in displacement settings and a greater variety of clean cooking products are available, subsidies could be replaced by cash transfers for households.

ACCEPTABILITY BARRIERS

Even though significant steps have been made in improving access to clean cooking for refugees, continued awareness raising on the benefits of clean cooking solutions and training on their usage is needed to promote uptake. Prospective customers are not always aware of new technologies or the risks associated with traditional cooking methods like health issues such as respiratory illnesses, burns, and eye irritations, as evidenced in interviews conducted through this study. They also do not consider the environmental and economic impacts of using clean cooking compared to traditional forms of cooking.

OPPORTUNITIES

Information from the READS assessment indicates that awareness campaigns and community mobilisation play a great role in promoting the usage of clean cooking in displacement settings. This is also demonstrated by the fact that access to improved cooking solutions is higher among refugees than in their host communities, which is generally a result of programmes and campaigns that have focused on camp residents [47]. Clean cooking customers from the first phase of the RE4R Project indicated that the prospect of saving time and money, as advertised during promotional activities, was what convinced them to purchase the stoves, along with safety and health reasons [60].

Maintaining and building upon existing awareness of the benefits of clean cooking will help support a larger scale-up across all the camps. The RE4R Project's work under its first phase with the advertising company Mashirika, which included radio shows, drama productions, posters, and other activities, could be built on, including the use of influential figures such as celebrities and community leaders. Involving community members in marketing, sales, and other paid positions such as brand ambassadors should also be encouraged. Demonstration activities which explain the cost reduction potential of these clean cooking solutions and allow customers to test cooking with the technologies so that they can experience them for themselves also play an important role in encouraging uptake.

Typically, women bear the brunt of all cooking related tasks, including the procurement of fuels. An unexpected change that was identified over the course of RE4R Phase I was that men expressed their pride and interest in acquiring new cooking technologies, which has led to their engagement in cooking activities to support their wives. Men and women agreed that this change, and increased involvement of men in supporting cooking tasks, has improved family cohesion and led to fewer conflicts in the household [60]. In line with this, clean cooking demonstrations should target boys, girls, men, and women to leverage interest in the new technology. These demonstrations or cooking classes could also be conducted in schools to familiarise male and female children and youth with improved cooking technologies, encouraging boys to become more interested in cooking.

Barriers to clean cooking

> Due to the cleanliness of using clean cooking technology and pride of ownership, men are more interested to support women in cooking. I have now started to cook as well, mostly when my wife is ill or conducting her business. But still, it is a start! We find less conflict in our home as we work together.
>
> – Male resident of Kigeme camp, 56 [60]

BARRIER	OPPORTUNITY
Restrictions on firewood usage and other fuel shortages due to decline of natural resources and production issues	Establish production of alternative fuels from sustainable biomass sources
Limited awareness of benefits of improved stoves and risks associated with traditional cooking methods	Radio shows, TV advertisements, posters, cooking demonstrations, using influential figures such as brand ambassadors
Limited availability of improved cooking options in displacement settings and unclear processes for private companies to obtain permission to work in camps	Support private sector engagement through de-risking mechanisms and through streamlining regulatory processes
Reliance on grant funding for suppliers	Provide RBF, gradually reduce subsidies and increase contribution of households supported by cash assistance
High costs of stoves and fuels	Cash assistance for stoves and fuels, pay-as-you-cook models, instalment payments, ability to purchase fuel on credit
Women typically bear the brunt of cooking	Target boys, girls, men, and women with awareness raising activities and demonstrations, conduct them at schools

Energy access for livelihoods and productive uses

Businesses in both the refugee camps and host communities use energy for activities like lighting their working spaces, cooking, hair dressing services, phone and computer charging and repairing, welding, milling businesses, ironing and tailoring, and meat processing [12]. To promote economic activity, along with social stability, increasing energy access for entrepreneurs in both communities is important.

The RE4R Phase II assessments found that most common businesses across all camps and host communities are trade and retail shops (38%), hospitality ventures (25%), food stalls and other food processing businesses (17%), hairdressers and barbers (7%), and tailors (5%) [47]. Non-commercial enterprises include agro-processing, carpentry, machinery, and metal working. In general, the ratio of female and male employees across all sectors was approximately equal, although women tend to work more in tailoring, food stalls and food processing businesses, compared to men who were more prevalent in hospitality, hairdressing/barber shops, agro-processing, carpentry, and metalworking.

The surveyed businesses generate a monthly revenue of 85,605 RWF ($75) on average. The average monthly revenue is higher for ventures such as metalworking (300,000 RWF, $263), and slightly higher for businesses such as tailoring (130,000 RWF, $114) and in the hospitality sector (106,000 RWF, $93). There is a gender gap when it comes to revenue with businesses that are typically led by women earning less: food stalls and other food processing businesses, for example, earned 57,000 RWF ($50) per month. On average, male-led businesses tend to generate 88,000 RWF ($77) per month, while female-led businesses tend to generate 81,500 RWF ($71) per month[15]. In addition, refugee-led businesses operating from within camps tend to generate a significantly lower monthly revenue (70,000 RWF, $61) than host community businesses (145,000 RWF, $127).

15 Assuming that the gender of the respondent corresponded to the gender of the business owner.

Common electric applications for businesses across all settings, both camps and host communities, include lighting (89% of respondents reporting using it), information, communication and technology (ICT) and entertainment equipment (39%), heating (including for cooking, 15%), motive power (8%) and cooling (5%). Just 7% of the businesses surveyed reported using no applications of energy. Lighting is important for most businesses, especially those operating in the hospitality sector, in food preparation, hairdressing, and tailoring. It is less important for agro-processing and carpentry businesses who tend to work during the daytime. ICT and entertainment, as well as heating, are considered beneficial but not a must for most business owners, except for a blacksmith from Mahama host community for whom heating is essential. The use of motive power is crucial for the blacksmith too, as well as for carpentry and agro-processing businesses. Cooling did not appear to be as important for the surveyed business owners.

The assessments found that 38% of respondents anticipate that the use of better, more powerful, machinery, or more diverse appliances, would contribute to an increase in revenue. When asked which appliances they would acquire if they were to have better access to electricity, the surveyed businesses highlighted the following priorities:

- Top priority or basic needs: radios; phone chargers
- Second priority: televisions; machinery for drilling, milling, sewing, etc.
- Third priority: computers; refrigerators; electric ironing equipment for clothing
- Fourth priority: fans; kettles; rice cookers; freezers
- Fifth priority: printers, scanners, photocopiers

Increased access to electricity and to appliances would potentially also lead to the creation of new ventures, in addition to enhancing existing ones. ››

Energy access for livelihoods and productive uses

PUE in the camps

When comparing the camps [47], the overall situation is similar in Kigeme and Kiziba, with the most common businesses being retail, food stalls, and hospitality-oriented ventures which mostly require lighting, usually powered by SHS. However, there are fewer PUE applications in Kiziba compared to in Kigeme, with none of the businesses using motive power, cooling or heating. More respondents in Kiziba reported that their current electricity access is insufficient.

In Mahama, activities are more diversified and include hairdressing, agro-processing, and carpentry. However, as in Mugombwa, there are limited PUE applications and many respondents reported that their current electricity access is insufficient. Nyabiheke boasts the most diversified range of PUE applications and respondents there seem more positive about the quality of their electricity access.

In host communities, most businesses rely on the grid for PUE applications: 82% for lighting, 52% for ICT and entertainment, 22% for heating, 18% for motive power, and 15% for cooling. Still, many business owners consider their electricity supply as inadequate and constraining productivity (49% for lighting, 39% for ICT and entertainment, and 27% for motive power, cooling and heating). These numbers are lower though than in refugee camps (79% for heating, 73% lighting, 67% ICT, 40% cooling, 24% motive power).

The most common PUE applications were found to be for lighting, ICT and entertainment, motive power to operate machinery (e.g. for agro-processing, metalworking, carpentry, tailoring, hairdressing/barbering), heating and cooling. Table 6 presents the percentage of users of each form of PUE, the breakdown of sources of electricity, and the percentage of respondents which use each PUE application who consider their current access to electricity as insufficient. It also provides the average monthly expenditure on electricity and the average amount of time per day that users have access to electricity for that PUE application. ››

TABLE 6

Forms of PUE, the electricity sources used, and attributes of access across all settings.

FORM OF PUE		LIGHTING	ICT	MOTIVE POWER	HEATING	COOLING
USERS OF PUE APPLICATION (%)		90%	48%	10%	16%	11%
ELECTRICITY SOURCE	GRID	24%	31%	49%	37%	32%
	MINI-GRID	0%	6%	0%	0%	7%
	SHS	30%	27%	10%	11%	11%
	SOLAR LANTERN	19%	0%	0%	0%	0%
	RECHARGEABLE BATTERY	12%	19%	12%	0%	7%
USERS WHICH REPORT THEIR ACCESS IS INSUFFICIENT (%)		68%	60%	24%	60%	36%
EXPENDITURE PER MONTH		4,800 RWF ($4.25)	4,900 RWF ($4.35)	11,700 RWF ($10.35)	9,000 RWF ($8.00)	4,900 RWF ($4.35)
HOURS OF ACCESS PER DAY		8h	10h	9h	5h	8h

RE4R Productive uses of energy

The first phase of the RE4R Project, in partnership with Energy 4 Impact, supported 120 entrepreneurs from Kigeme, Nyabiheke and Gihembe[16] and 30 entrepreneurs from their host communities, of which 40% of all entrepreneurs were female, with a PUE for livelihoods intervention between 2019-2021 [46]. Examples of the types of businesses which were supported included hairdressers and salons, butchers, a cybercafe, phone repair shops, tailoring and shoe repair shops, food production, carpentry, and cafes [46].

The entrepreneurs took part in business mentorship programmes and technical trainings, and they were also supported with accessing finance and electric appliances – subsidised by 70% – such as sewing machines, hair clippers, fridges, egg incubators, meat grinders, and computers [61]. Entrepreneurs were linked to financial institutions to get a loan for the remaining 30% of the cost, although more loans were disbursed by savings and loans groups. Other common sources of finance were personal savings or family support of the entrepreneur. By the end of the programme, 218 appliances had been acquired.

Alongside business mentorship and financial services, RE4R Phase I established a grid-connected business centre in partnership with Energy 4 Impact in Nyabiheke, Kigeme and Gihembe, together hosting 34 businesses. These businesses were selected based on their need to access larger amounts of electricity for more power-intensive equipment, such as hairdressing appliances [61]. Electricity usage is metered and businesses pay for their own electricity consumption. Prior to the business centres, most enterprises had been home-based in premises that were deemed unsuitable for grid connection.

Establishing the business centres helped create a safer working space for businesses and clustering them together allowed them to grow their market base and pool resources [62]. In addition, by avoiding the need to register each individual entrepreneur by clustering them in a centre, the obstacle of ID requirements was removed [61]. In addition to the business centres, the solar kiosks were established to offer phone charging, battery replacement and repair services throughout the camps. These shops were established in most of the key locations within the camps, such as near markets and community centres to ensure easy access for residents [62].

After the RE4R I intervention, 56% of entrepreneurs reported a 50% increase of their income [46]. One successful example was a milk cooling business from Nyabiheke camp: the owner ››

16 Some of the supported refugees relocated to Mahama after the closure of Gihembe camp.

I used to close my business around 6 pm before, but now I can even go beyond 10 pm depending on clients and undoubtedly my income has really increased.

– Female restaurant owner in Kigeme

RE4R Productive uses of energy

was supported to gain access to start-up capital, participated in a business training and one-on-one mentorship, and through power for his milk cooling machine. With this support he improved his business skills, increased sales by 45%, hired five employees, and reduced milk loss [46].

The intervention demonstrated the transformative effect of access to energy on livelihoods, and the importance of providing holistic support through skills training and access to finance. Awareness raising activities were also crucial to demystifying some aspects of PUE, such as the costs of appliances and how they operate, which helped remove some of the uncertainties around starting or growing a business. Currently, refugees operate their businesses primarily within the camps due to concerns about government taxes and higher competition. Exploring market linkages in host community areas might present opportunities to scale businesses and strengthen local economies surrounding displacement settings. ●

FIGURE 4

A solar kiosk established under RE4R Phase I.

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FIGURE 5

A business centre established under RE4R Phase I.

©Energy 4 Impact

Barriers to productive uses of energy

AVAILABILITY BARRIERS

Many entrepreneurs do not consider their current electricity supply sufficient and say that it constrains their productivity. A SHS, for example, is typically insufficient for power-intensive appliances; larger systems may be suitable for televisions to provide entertainment services, for example, but rarely for sewing machines or workshop machinery. The business centres in the camps set up by the RE4R Project have proved to be very popular but reach only a small number of enterprises, with a far greater number of businesses lacking the opportunity to connect to a higher-power source. Similarly, access to electric appliances is also constrained due to a lack of power and a lack of available appliances that sometimes can only be bought in larger towns.

While grid extension plans are being rolled out across the country, most businesses are home-based in housing that does not allow for a safe connection to the grid. Even if this were possible, many grid-connected businesses based in the host community consider their power supply as insufficient. Solar mini-grids, such as the system in Mahama, provide power to a small number of businesses but because of plans to extend the national grid in nearby areas, high upfront capital costs, and challenging authorisation procedures, replicating this approach through further mini-grids appears to be a distant prospect.

OPPORTUNITIES

Despite their limitations, SHS provide an opportunity for businesses in the camps. Expanding SHS interventions to support the specific needs of businesses – for example for larger systems to power larger televisions for entertainment, lower-power PUE appliances, or refrigerators – could increase the profitability of businesses and open up new avenues for income generation. Such support could be developed from existing or planned SHS interventions which have already introduced private sector suppliers to displacement settings, especially those with outlets in the camps or nearby, and build upon this experience.

The construction of business centres through RE4R Phase I demonstrated the value of having a cluster of enterprises pooling resources and being able to avoid administrative hurdles that would be required with individual connections. UNHCR has since begun to replicate these business centres in Nyabiheke and there are further business centres planned in Mahama, Mugombwa and Kiziba under RE4R II. In addition, OffGridBox has deployed solar systems in the camps which allow for higher electricity access and can connect a small number of businesses, currently around five per system, and social institutions to each system. Tailored tariffs could support enterprises through differential pricing depending on the time of day, for example lower rates during the daytime to match solar generation or reduced prices for users with higher consumption.

AFFORDABILITY BARRIERS

Whilst relatively accessible to businesses, owing to their higher income compared to household customers, the recurring costs of SHS can form an affordability barrier for some entrepreneurs. Businesses with variable revenues, for example depending on the season, could struggle to maintain the fixed recurring monthly costs that most PayGo SHS companies offer. This can be further exacerbated by the relatively higher costs of larger SHS used by some businesses.

Despite their benefits, the high costs of electric appliances discourage businesses from making investments to increase their productivity. Low purchasing power among customers in displacement settings further undermines growth projections for businesses [62], potentially affecting their ability to pay off investments in new PUE appliances. These factors suggest that initial subsidies and tailored financial support to businesses will be necessary to support PUE, which in turn increases reliance on grants and impedes the development of other pathways to raise capital [62]. ››

Barriers to productive uses of energy

OPPORTUNITIES

SHS companies could offer flexible repayment terms to business customers to help mitigate the impact of variable monthly revenues. These could include allowing overpayments in some months to cover shortfalls later, increasing the length of time after non-payments before a system is remotely locked or repossessed, or accepting lower payments in some months to accommodate lower incomes. Companies could be supported in these mechanisms through concessional finance from donors to mitigate the risks of non- or under-payment across the lifetime of the systems.

Savings and loans groups are an important source of credit which can be used to invest in PUE appliances. Partnerships with other financial institutions should also be explored to support the acquisition of appliances with tailored loans. In the case of the RE4R I intervention, the cost of the appliances was subsidised by 70% and this played a crucial role in supporting their initial uptake. As appliances become more widespread and people are more familiar with them, these subsidies may be able to be reduced and eventually removed.

ACCEPTABILITY BARRIERS

Many entrepreneurs are unaware of their options for improved energy access to support their livelihoods. They may not be familiar with the possibility of acquiring a larger, customised SHS and other opportunities to access higher levels of electricity access, for example through the solar systems offered by OffGridBox. In addition, many businesses are unfamiliar with PUE appliances, or do not know how to acquire them or use them. Advertising and public awareness campaigns have been run in some camps, for example under the RE4R I Project, but have generally focused on SHS for domestic electricity access and the advantages of clean cooking technologies.

OPPORTUNITIES

Awareness raising activities can demystify some aspects of PUE, such as the costs of appliances, how they work, and their potential benefits. Understanding the opportunities that these appliances bring can play a big role in encouraging entrepreneurs to start or grow a business. Training and capacity building, such as for bookkeeping and entrepreneurship skills, are also an important form of support for new and growing businesses. Scaling up interventions with demonstrated success, such as the entrepreneur support which accompanied the RE4R Project's business centres, and replicating them in other camps could be mutually beneficial alongside investments in infrastructure and technologies.

BARRIER	OPPORTUNITY
Unfamiliarity with appliances and with options for power sources	Awareness raising campaigns and training
High cost of appliances	Subsidy schemes and business mentorship
	Partnerships with financial institutions and savings groups to provide loans
Limited availability of electricity	Construction of grid-connected business centres
	Support connections to OffGridBox's systems
	Support deployment of nano-grids

Mini-grids in displacement settings

Rwanda's electrification policy designates areas for electrification via on- or off-grid approaches. In doing so it specifies the areas that mini-grids can operate in but, in the case of refugee camps, the picture is more complicated. The national grid reaches all five of Rwanda's camps but households within them are not permitted to connect, even if they could afford to: the shelters are usually not considered durable enough to connect to the grid, instances of illicit or unapproved connections have occurred in the past, and – most conclusively – REG requires land identification information which refugees do not have, as they not own the land.

Despite these complications solar standalone systems and mini-grids, or "nano-grids" based on their modest sizes, have been established in some of the camps. In Kigeme a nursery school and a child-friendly space managed by World Vision and Caritas Rwanda are connected to a 2.6 kWp solar mini-grid; in Nyabiheke a community hall was connected to a 2 kWp solar standalone system; and in Kiziba the health centre and primary school had a mini-grid before being recently connected to the national grid.

The systems in Kigeme and Nyabiheke were installed as part of an academic research project[17] by MeshPower, a local solar mini-grid company [63] which has installations in communities in rural areas throughout Rwanda. Building on this work, MeshPower partnered with Alight, at the time UNHCR's infrastructure partner, to implement a larger standalone solar system at the health centre in Mahama [64]. This system, composed of 24.6 kWp of solar and 78 kWh ››

17 The Humanitarian Engineering and Energy for Displacement (HEED) Project was led by Coventry University, in partnership with Practical Action and Scene Connect.

Systems established by MeshPower and OffGridBox demonstrate that initiatives led by the private sector can provide power to refugee businesses through market-based approaches, but more support is needed to replicate and scale these opportunities.

Mini-grids in displacement settings

of battery storage, reduced the reliance on the diesel generator and provides power to the clinic, MINEMA offices and the police station [65]. It also supplies a small number of businesses in the nearby marketplace which pay MeshPower for their consumption. The income from the institutional and business customers is used to cover maintenance costs and to pay a technician to oversee the system operation. Despite increasing its solar generation capacity from its original 18.6 kWp, high electricity demand means that the system still uses diesel generators during the night.

Solar mini-grids could, like the system in Mahama, offer an opportunity to supply reliable power to an institution – providing a valuable anchor load for the system – and refugee customers, for whom a grid connection would be impossible but a privately-operated system would be permitted [66]. The Mahama system presently provides power to only a small number of businesses in the camp, representing only a tiny fraction of the total overall market, and there are several barriers to scale.

The viability of solar mini-grids or other off-grid systems, especially those which primarily serve refugee customers, would likely depend on their location: if the grid is nearby and connection could be extended to a facility or business centre, such as those of RE4R Phase I, then this would most likely be the most effective option for electricity access. For facilities, businesses, and marketplaces far from the extent of the grid network, however, off-grid options such as those offered by MeshPower or OffGridBox could be viable. The present operations of these companies in the camps demonstrate that private sector-led initiatives can successfully provide power to refugee businesses under a market-based approach but more support, and particularly funding, will likely be necessary to replicate and scale them.

Mini-grids have high upfront costs for developers and (unsubsidised) cost-reflective tariffs would be several times higher than that of the national grid. Meanwhile efforts to engage refugee communities in mini-grid development – either in the early stages, or post-implementation – have had limited success, and these projects are typically led by external organisations. For the host communities with access to the grid, the presence of the national electricity network removes any incentives or opportunity for mini-grid developers to install systems.

Mobilising greater financial resources, particularly from external sources such as donors or investment from private financing, will be necessary to reduce the upfront cost for mini-grid developers and the cost of accessing electricity services for customers. Integrating businesses and PUE into mini-grid projects can be an enabler in achieving financial viability: not only would they generally use electricity during the day when the solar resource is highest, they typically use larger amounts and have greater capacity to pay compared to their domestic counterparts. Engaging with communities and businesspeople to understand their needs will be important in developing mini-grid projects and should be closely aligned with PUE activities. ●

Energy access for community facilities

Community facilities in the camps use energy to provide essential services to refugees. Aligning with GoR policy to increase connectivity for education, schools such as Paysannat L in Mahama camp and Groupe Scolaire Gasaka in Kigeme have internet access for refugee students to learn computer skills, as well as providing lighting to study after dark. Hospitals rely on electricity for lighting, vaccine refrigeration, diagnostics, and medical equipment, whilst community centres use electricity for ICT equipment, internet access, entertainment, and library services. Places of worship such as churches and mosques rely on electricity for their audio equipment and lighting.

The REAR Phase II assessments surveyed community facilities in the five camps and the surrounding host communities including schools, religious buildings, community centres, health clinics, and other public institutions [47]. Around half of facilities were found to serve both members of the refugee and host communities, particularly clinics and schools, and that lighting, ICT and entertainment services were by far the most common uses of electricity.

Almost all schools and clinics in the five camps were found to have connections to the grid or, in fewer cases, a standalone solar system or diesel generator. Religious buildings, meanwhile, were rarely connected to the grid network across the camps and instead relied on standalone solar systems, rechargeable batteries, or preferred not to report their source of electricity. These were also the only facilities that mostly reported that a lack of electricity affected their operations.

In addition to electricity, social institutions in refugee camps also need energy for cooking, particularly in schools. School feeding programmes in Rwanda were established to allow students at all ages – from nursery schools and early development centres up to secondary schools – to have meals at school. Both traditional and improved institutional cookstoves are used for cooking at schools, with the types of fuels used varying between the level of education. Preschools and primary schools, such as Groupe Scolaire in Kigeme refugee camp, use bamboo fuel pellets for cooking through a collaboration between the company Bamboo and UNHCR, whilst the secondary school in Kigeme uses firewood for cooking. This is because UNHCR is responsible for primary education, and the feeding programmes in those institutions, whilst secondary schools are under the remit of the Ministry of Education. ››

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RE4R Streetlights

Public lighting is an important and prominent community use of electricity, allowing easier movement around the camps at night and increasing the perception of safety. To support this, and following consultations with camp residents, RE4R Phase I installed 185 solar streetlights in Kigeme, Gihembe and Nyabiheke camps [46]. Refugees identified the areas in which better public lighting was required (including in WASH facilities, markets, playgrounds, and community areas) which were to be prioritised for improved lighting. To promote long-term sustainability the streetlight supplier Solektra trained 17 refugees to maintain the streetlights and each camp has a community group, composed of residents and the local authorities, to oversee their upkeep [10]. A solar streetlight board organises advertising at the lighting locations to provide an income stream for spare parts and payment for the technicians, as well as potential replacements after the seven-year warranty expires.

After two years 99% of the streetlights were still functioning, 91% of residents felt safer after dark and 62% reported that they were able to do business or productive activities after nightfall[18] [46]. The involvement of the camp residents in the placement, ownership model and maintenance of the solar streetlights was critical in their longevity compared to similar projects in other displacement settings [10]. Whilst these positive effects are still felt in Kigeme and Nyabiheke, where the streetlights continue to have an impact four years on from their original installation. There are now plans to install approximately 800 streetlights across all the five camps under RE4R II. ●

18 For example selling in open-air marketplaces, or because of increased footfall after sunset.

FIGURE 7

Public lighting in Kigeme.

©Steven Nshizirungu

Barriers to energy access for social institutions

AVAILABILITY BARRIERS

Grid electricity, or reliable access to off-grid power via a diesel generator, is available to facilities such as health centres, as well as other some social institutions such as schools; if not, these generally have some form of electricity access. Religious buildings, however, generally have lower access to electricity and rely on smaller, lower-capacity systems. Connecting these institutions to the grid could face barriers either though the policies of the network operator, or because these institutions are generally spread throughout the camps and so the costs of extending a connection is prohibitively high.

The relative inaccessibility of some camps further provides a barrier to improved access, as demonstrated through the relatively lower levels of energy access in Kiziba camp. Potential providers of electricity solutions face higher logistics costs for site assessments, equipment installation, and operations and maintenance (O&M), each resulting in higher costs for the institutions that might benefit from them and decreasing the business case for the private sector.

Street lighting has already had a significant effect on perceptions of safety and the ability to do business after dark in Kigeme and Nyabiheke, but public lighting was generally found to be inadequate in the other camps from the RE4R Phase II assessments. The high upfront costs and intensive management of streetlight installations presents a barrier to new projects, especially for community-led projects without the support of humanitarian or government organisations.

Improved cookstoves and fuels are available in primary schools, run by UNHCR, but not yet in secondary schools, run by the Ministry of Education. Despite the similarities in the cooking needs across both types of institutions, the difference in management presents a barrier to replication and greater uptake of clean cooking in institutional settings.

OPPORTUNITIES

Kiziba currently faces the lowest availability of energy amongst social institutions and, owing to its relative remoteness, will likely require grant-funded projects to improve sustainable energy access. This would likely also apply to social institutions in the other camps that do not already have access to high-quality power, either from the grid or a standalone system. If a model for long-term financing can be identified then an agreement with the private sector could be developed to cover long-term maintenance to ensure the longevity of the systems, but grant funding would likely be the source for the initial capital investment.

Similarly, grant funding would be required to replicate public lighting projects in Mahama, Mugombwa and Kiziba camps by covering the high upfront costs. RE4R Phase II is currently installing streetlights in these three camps, as well as installing further lights in Nyabiheke and Kigeme, in order to recreate and expand the reach of the RE4R I intervention, leveraging community engagement and streetlighting cooperatives as before.

Finally, secondary schools in all camps could benefit from replicating the improved cookstoves and fuels used in some primary schools. Given the similar needs, knowledge sharing and inter-organisational learning could lead to relatively similar clean cooking projects being implemented in Ministry of Education-run facilities.

AFFORDABILITY BARRIERS

Paying for power is the main issue limiting access to electricity for those social institutions which have lower access at present. Whilst many institutions reported having metered connections, others shared that they receive electricity or fuel for free – whilst this provides power in the short term, it could prove a long-term issue if this arrangement were to change as a new budget would need to be created and a new source of funding found. Furthermore, if costs were to be covered by collecting payments from people who use their services, this would pass on the financial burden to people ››

Barriers to energy access for social institutions

with little capacity to pay. This is especially an issue for streetlighting where a public service is provided for free – with significant upfront costs, which are usually covered by external grant funding – but is particularly susceptible to damage and vandalism.

OPPORTUNITIES

Innovative options for financing sustainable electricity systems for social institutions, beyond traditional donor funding, could help to promote greater access. Whilst users may be unwilling to pay for electricity directly, participants of the READS workshop suggested that bundling contributions in with other payments, could provide an alternative route for community financing. Alternative sources of financing could come from social institutions offering alternative and income-generating activities as a result of their increased access to energy, for example through offering phone-charging services, selling cold drinks, or serving meals.

Improved public lighting projects could be managed similarly to those under RE4R Phase I, through which community cooperatives were responsible for maintaining the lights and ensuring their upkeep, including through advertising to gain an income to cover costs. For improved public lighting in marketplaces, meanwhile, there could also be opportunities to support projects through contributions from traders on the understanding that these allow for increased incomes through longer operating hours or improved PUE opportunities.

ACCEPTABILITY BARRIERS

Levels of electricity access differ across different social institutions, with health centres and other community facilities near the centres of the camps having a grid connection, while other social institutions in less central locations lack a reliable power source. This can lead to dissatisfaction among users of those facilities. Efforts should be made to harmonise access to electricity for all social institutions, within the constraints of the resource-limited sector.

Solar streetlights are generally susceptible to vandalism, especially when located in more remote areas of camps. Placement of streetlights is critical to their acceptability and should be determined by community members through gender-sensitive mappings. In most cases, the lights are best placed in areas where there is much social activity, such as marketplaces or playgrounds. Community groups should be made responsible for patrolling the area and monitoring the lights to prevent vandalism.

Acceptability might also prove to be a barrier for institutional-scale cooking in community facilities. Traditional forms of cooking, especially when similar to those used in domestic settings, are often more familiar for users and require less training compared to improved alternatives. For electric cooking, and electric pressure cook- ››

©Practical Action

Barriers to energy access for social institutions

ers especially, cooking methods are very different from traditional forms and so could require additional sensitisation.

OPPORTUNITIES

Involving the community from the outset in identifying the locations for the streetlights, in procuring them, and making community members responsible for their maintenance proved critical for the sustainability and longevity of the RE4R streetlights intervention. Any project aiming to enhance energy access for community facilities must consult and collaborate with community members from the beginning to the end of the project. In addition, things like gender-specific mapping exercises allow for the needs of different community members to be taken into account and provide more nuanced information.

For technologies that are unfamiliar, such as non-biomass institutional cookstoves, sensitisation activities will be important to support their uptake. This should be supported alongside training and capacity building for users on both how the new stoves work and the most effective ways of using them to encourage their uptake.

FIGURE 8

Briquettes used for cooking in a school.

©Steven Nshizirungu

BARRIER	OPPORTUNITY
Little uptake and awareness of clean cooking at institutional scales	Awareness raising for different cooking technologies
Clean cooking in school feeding programmes vary by education level	Replication of improved institutional cooking programmes and interorganisational learning in all schools
Mahama, Mugombwa and Kiziba have limited street lighting	Use grant funding and replicate community cooperatives to implement public lighting
Community lighting requires funding for maintenance, yet social institutions have little or no budgets for electricity	Lighting cooperatives, training community members in repair services, contributions from businesses in marketplaces, income generating activities to cover O&M costs
Social institutions have little or no budgets for electricity	Alternative financing and income generating activities to raise funds for O&M

Energy access for operational and organisational purposes

The assessments conducted by the RE4R Phase II surveyed more than 30 facilities operated by humanitarian organisations which provide services to displaced people [47]. Most of these facilities were found to operate either five or seven days a week, and between eight and 24 hours per day. Offices and distribution centres typically operate during the daytime on weekdays, whilst humanitarian operations such as water pumping, security, and the provision of healthcare operated throughout the day and week. Respondents to the survey reported that facilities mostly used electricity for lighting and ICT services and that these were both necessary and available throughout the day. For almost all respondents, unscheduled power outages either did not occur or had no impact on the provision of services.

All five camps have a connection to the national grid and humanitarian operations generally have access to high-quality power. In Kigeme, Nyabiheke, Kiziba, and Mugombwa all operations have a connection to the national grid; in Mahama, meanwhile, they use either the grid, a standalone solar system, or a diesel generator. The water pumping stations in the camps each have both a grid connection and a backup diesel generator to ensure the availability of power for this critical service.

Payments for electricity by humanitarian operations was found to be generally through formal channels. In Kigeme, Nyabiheke and Mugombwa most electricity was reported to be provided through a metered service and operations in Mahama generally paid a flat rate. Amongst those facilities which paid for power, the reported cost of electricity was between 230-275 RWF ($0.20-0.24) per kWh. Generally in Kiziba, however, and for small numbers of organisational facilities in other camps, no payments were made and either electricity or fuel for generators was provided at no cost.

Connections to the national grid network provide high levels of power to humanitarian operations and are the preferred option for the GoR, but this has caused issues for humanitarian energy projects in the past. In its early phases, RE4R Phase I had planned to support a solar mini-grid intervention for Nyabiheke Camp which would replace two 66 kVA diesel generators which consumed an average of 105 litres per day. This would have provided power to institutional electricity users and the water pumping station, as well as a number of refugee-owned businesses [54, 67] but instead the national grid was extended to the camp in late 2020 through a UNHCR-financed project [54]. The mini-grid project was under development but, once the grid extension became a viable prospect[19], stakeholders no longer had any incentive to continue as the grid takes precedence under Rwandan energy policy. Problematically, business users which were connected to the original diesel system were effectively cut off as displaced people are unable to receive grid connections. Whilst the grid extension project was a positive step in terms of providing humanitarian operations with access to high quality and relatively low-carbon power, it highlights the need for better coordination between stakeholders and to provide alternative solutions for displaced people who may be affected by such arrangements.

To reduce expenditure on diesel, UNHCR also invested in extending the national grid to Mahama camp. Most organisations and delivery partners near to the transmission lines in Mahama 1 – such as the Ayateke water pumping and treatment plant and the offices of Plan International, Inkomoko, and World Vision – are connected but also rely on diesel generators for backup as the supply is not always reliable. Other facilities further from the transmission lines – such as the departure centre, and the offices of Humanity and Inclusion, Caritas Rwanda, Maison Shalom, and the Red Cross – were too costly to extend a connection to and rely on standalone systems alone, usually generators. ››

19 The grid extension was completed in late 2020, almost one year after the withdrawal of the solar mini-grid project [54]; discussions for the mini-grid began in 2018 and highlight how much time it can take to develop interventions of this type.

Energy access for operational and organisational purposes

Barriers to operational electricity use

Humanitarian organisations generally have access to high levels of electricity access already, typically either from the national grid network (supplied mostly by renewable sources), a standalone solar system or diesel generator, or a combination. The grid and solar can provide low-carbon electricity and so eliminating the use of diesel generators – even if still present as a rarely-used backup – should be the priority. The existing reliability of high-quality power could act as a barrier to this as there would be little incentive, in terms of potential improvements in electricity access, to switch to a more sustainable source.

Another barrier to a transition to sustainable energy is that some facilities receive electricity or fuel at no cost. Whilst these arrangements work now, if circumstances were to change and the free provision were to cease, then these facilities may be forced to find significant internal funding to cover these expenses or go without power. In addition to the difficulties of economic impact of transitioning to paying for electricity, a lack of metered electricity consumption or bills could create issues when designing standalone systems to meet or support these energy needs.

OPPORTUNITIES

Humanitarian operations which already have access to high-quality, reliable, and metered power can use this relatively advanced position to optimise their electricity usage. Monitoring electricity usage, either through existing meters or new ones, could reveal opportunities to reduce energy consumption through behaviour change (such as closing windows or turning down air conditioning) or technological solutions (such as efficient appliances). For facilities which use a diesel generator, either as a primary source or a backup, monitoring and recording its usage would help to identify ways to reduce how much it is used, for example by replacing it with batteries charged by the grid or solar.

For facilities which do not pay for electricity or fuel it will be important to measure and monitor energy consumption, as this is not likely to be currently recorded. As before, this could identify ways to reduce energy consumption and therefore costs to those organisations which ultimately pay the bills. Furthermore, it would provide a record of previous energy usage from which an alternative electricity system could be designed (for example by the private sector) if the present arrangements were to change.

BARRIER	OPPORTUNITY
High energy usage of humanitarian operations	Implement energy efficiency measures to reduce costs and focus on displacing remaining diesel usage
Electricity or fuel is provided for free to some facilities	Install energy monitoring devices to increase efficiency and plan for the future

05

Present energy solutions in displacement settings

Overview of stakeholders in Rwanda

Sustainable energy in displacement settings in Rwanda is delivered through a complex network of stakeholders, each with their own mandates, projects, and objectives. Some organisations operate across the country or internationally, whilst others focus on issues in specific displacement settings.

The stakeholders working in Rwanda can be classified into broad categories:

- **Government agencies** with mandates and responsibilities defined by the Government of Rwanda.
- **Humanitarian and development organisations** which typically address specific issues including UN agencies operating across the world, international NGOs with projects in Rwanda, and local NGOs working across the country or in certain areas.
- **Community-led organisations** which are owned and managed by members of the displaced or host communities, as well as appointed community representatives.
- **Private sector companies** which offer energy products or services on a commercial basis.
- **Financial institutions** which offer access to banking and other financial services to community members.
- **Other organisations** with a focus on issues that are related to energy in displacement settings.

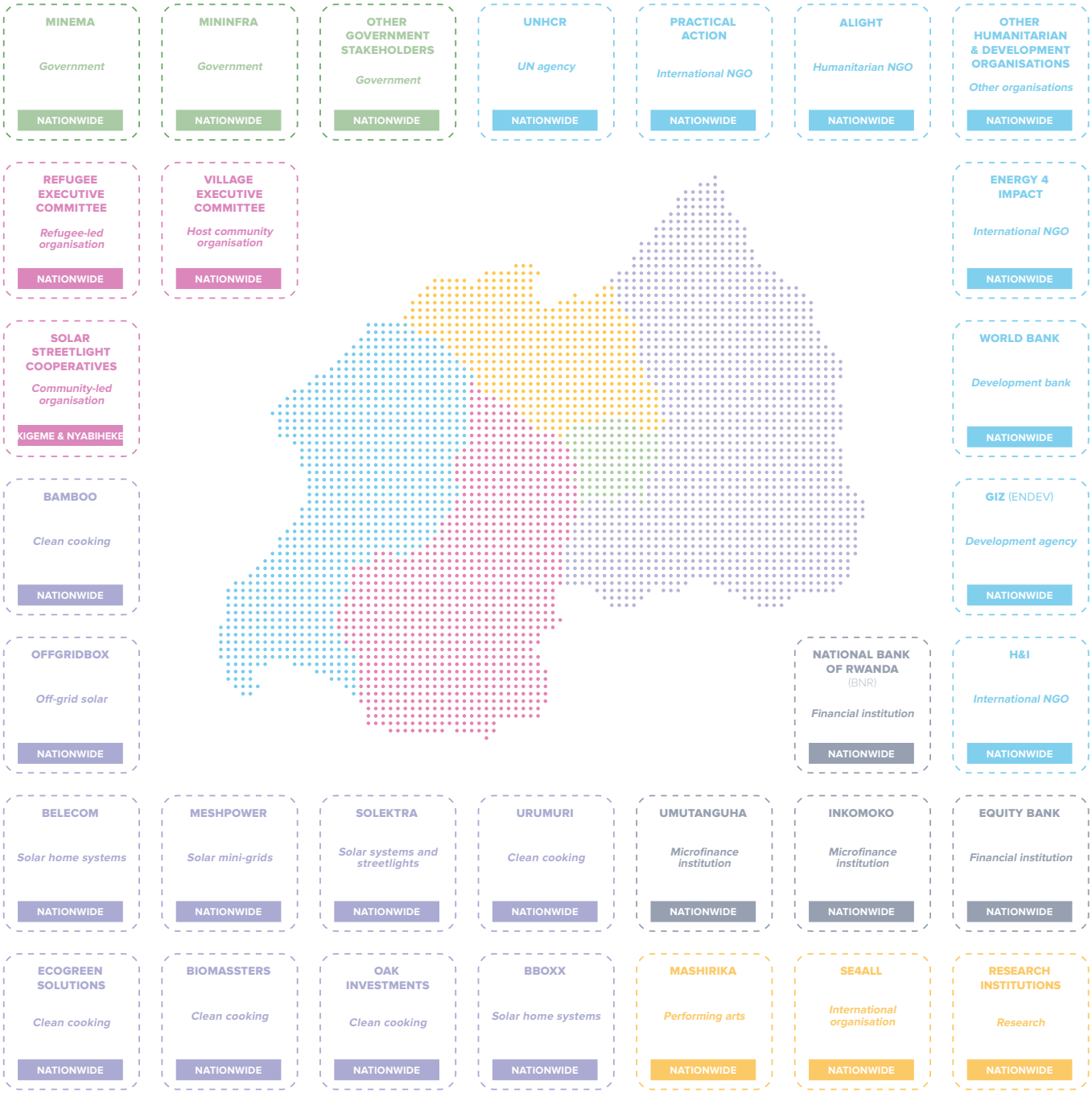
This section provides a short summary of the most relevant organisations working in displacement settings in Rwanda, their work, and relevant partnerships. This directory of stakeholders included in this section intends to be extensive but not exhaustive.

The Government of Rwanda's Ministry in Charge of Emergency Management (MINEMA) leads the refugee response in the country, with the United Nations High Commissioner for Refugees (UNHCR) providing operational support and capacity alongside local authorities [9]. MINEMA and UNHCR co-lead the Refugee Coordination Model and collaborate to provide multi-sector assistance and support for project partners which deliver sector-specific assistance, such as for protection, health, education, and nutrition. This incorporates a range of UN agencies, NGOs, and operational and development partners including the World Food Programme (WFP), United Nations Development Programme (UNDP), and the Food and Agriculture Organization (FAO). A MINEMA camp manager oversees operations in each camp.

Displaced people are represented in decision-making through elected bodies; this is headed by a Refugee Executive Committee for each camp, which plays a key role in advocating for the energy needs of community members, and is supported by local community groups which also participate in energy projects, for example by informing the locations of streetlights.

Several humanitarian and development organisations work on issues related to sustainable energy access as part of the refugee response, mainly focusing on household electricity access, clean cooking, and PUE. These organisations generally work in partnership with the private sector, both local and international companies, to implement projects, thereby seeking to promote market-based approaches to sustainable energy access.

Overview of stakeholders in Rwanda



Stakeholder directory

GOVERNMENT

MINEMA

Government

NATIONWIDE

The GoR's **Ministry of Emergency Management (MINEMA)** takes the lead in coordinating and managing refugee affairs, supervising the provision of humanitarian assistance, and mobilising resources for disaster response, amongst other duties. **MINEMA** collaborates with **UNHCR** to deliver assistance to displaced people living in camps, reception centres and urban areas.

MININFRA

Government

NATIONWIDE

The **Ministry of Infrastructure (MININFRA)** is the government agency responsible for sustainable infrastructure development, including for energy. It has the mandate to initiate, develop, and maintain projects for clean power generation and energy access in Rwanda, as well as policies and programmes to support them. **MININFRA** also supervises other organisations such as **REG**.

OTHER GOVERNMENT STAKEHOLDERS

Government

NATIONWIDE

Other government stakeholders include **REG** (responsible for the generation, transmission, and sale of electricity, as well as infrastructure), **EUCL** and **EDCL** (REG subsidiaries responsible for existing infrastructure and network growth, and for increasing supply, investment, and energy access, respectively), **RURA** (regulation of rural utilities, including electricity, and protecting consumer rights) and **MINALOC** (local governance and community development).

Stakeholder directory

HUMANITARIAN & DEVELOPMENT

UNHCR

UN agency

UNHCR provides protection and assistance for displaced people throughout Rwanda, including the delivery of critical services such as for water, sanitation, health, shelter, and nutrition. **UNHCR** aims to support refugees through ensuring a favourable protection environment, supporting economic opportunities, and finding durable solutions. It leads the response for refugees with **MINEMA**, as well as implementing and operational partners of all kinds, including those focusing on sustainable energy.

NATIONWIDE

PRACTICAL ACTION

International NGO

Practical Action is an international NGO headquartered in the UK and with offices around the world, including Kigali. The first phase of the RE4R Project, implemented in Kigeme and Nyabiheke in partnership with **UNHCR** and involving many other stakeholders, was the largest sustainable energy project in displacement settings in Rwanda, and its second phase will expand this work into the other camps.

NATIONWIDE

ALIGHT

Humanitarian NGO

International non-profit organisation **Alight** provides humanitarian support to displaced people across the world. **Alight** has provided infrastructure support to **UNHCR** in the camps, including for energy, and has partnered with **MeshPower** to solarise a health clinic in Mahama camp, and supported clean cooking in Kiziba under its Mwangaza project. Known as the American Refugee Committee until 2019, **Alight** also works across other areas of the humanitarian response including health, WASH, and shelter.

NATIONWIDE

H&I

International NGO

Humanity & Inclusion (H&I) works to advance the inclusion of people with disabilities in daily life. In Rwanda, the NGO also supports access to education, maternal and child health, inclusive governance, and humanitarian action. **H&I** partnered with **Practical Action** and **Solektra** to deliver the inclusivity strategy of RE4R Phase I which involved providing 301 vulnerable households with a SHS.

NATIONWIDE

Stakeholder directory

HUMANITARIAN & DEVELOPMENT

ENERGY 4 IMPACT

International NGO

Energy 4 Impact is an international development NGO which has merged with Mercy Corps and promotes energy access for livelihoods and PUE. Under RE4R Phase I with **Practical Action**, **Energy 4 Impact** supported 150 entrepreneurs in Kigeme, Nyabiheke and Gihembe with PUE appliances, access to finance, and business mentoring. **Energy 4 Impact** also established business centres in the three camps to provide a space for 34 businesses with higher energy needs, as well as offering an opportunity for them to pool resources and develop a market base.

NATIONWIDE

WORLD BANK

Development bank

The **World Bank** has provided $150 million in financing – half as grants, half as loans – to increase energy access for households, enterprises**,** and social institutions across Rwanda. The Energy Access and Quality Improvement Project (EAQIP) supports both grid connections and off-grid systems, whilst its clean cooking component aims to reach 2.15 million people.

NATIONWIDE

GIZ (EnDev)

Development agency

EnDev, a multi-donor programme hosted by **GIZ**, supports a wide range of energy projects in Rwanda, from implementing on-grid hydropower to RBF for off-grid solar products and mini-grids. **EnDev** also supports clean cooking through the production and dissemination of improved cookstoves, and PUE through entrepreneur training and appliance access for those with mini-grid connections. **EnDev** and **Practical Action** are collaborating within the scope of the second phase of the RE4R Project to provide an RBF scheme for Tier 3+ stoves to be sold in refugee camps.

NATIONWIDE

OTHER HUMANITARIAN AND DEVELOPMENT ORGANISATIONS

Other organisations

Other organisations working on topics related to energy access in displacement settings include **Caritas, UNCDF, World Vision, USAID, Good People International, Enabel,** and **SNV.**

NATIONWIDE

Stakeholder directory

COMMUNITY-LED ENTERPRISES & ORGANISATIONS

REFUGEE EXECUTIVE COMMITTEE

Refugee-led organisation

NATIONWIDE

Each camp has a **Refugee Executive Committee** consisting of community members which were elected to represent camp residents on specific issues, headed by a president. The Committee acts as community-level administration and representation, and also as a liaison between residents and organisations working in the camp, including for energy-related projects. Amongst other roles, this could include engagement on fuel distribution, support for vulnerable community members to access energy products, and discussion on the locations of streetlights. Further committees exist to provide administration at the village level (tens or hundreds of households) and *quartier* level (several villages).

VILLAGE EXECUTIVE COMMITTEE

Host community organisation

NATIONWIDE

Local governance is decentralised through several administrative bodies [68]. The **Village Executive Committee**, composed of five volunteer members, oversees local issues with members responsible for coordination, social welfare, and development, amongst other issues. The village council is composed of all village members and elects the **Committee** members. Similar structures exist at the **Cell** level (made up of many villages) and **Sector** level (composed of many cells).

SOLAR STREETLIGHT COOPERATIVES

Community-led organisation

NATIONWIDE

Streetlights installed by **Practical Action** under RE4R Phase I are supported by community groups to oversee their upkeep and long-term maintenance. Composed of local residents and the camp authorities, these groups use advertising at the lighting locations to generate income. These funds are used to cover costs for spare parts, payments for technicians, and potential replacements after the warranties on the streetlights expire.

Stakeholder directory

FINANCIAL INSTITUTIONS

NATIONAL BANK OF RWANDA (BNR)

Financial institution

NATIONWIDE

The **National Bank of Rwanda (BNR)** is the country's central bank. As well as guiding monetary policy, **BNR** also has a strong focus on financial inclusion. It has commissioned studies to investigate how effectively refugees have been supported under the National Financial Inclusion Strategy 2019-2024 [14], finding that there was both limited knowledge of, and access to, formal financial services amongst displaced people, and providing a series of recommendations to overcome these challenges.

EQUITY BANK

Financial institution

NATIONWIDE

Operating in Rwanda since 2011, **Equity Bank** aims to financially empower communities throughout Africa. Since 2017, **Equity Bank** has partnered with **WFP** and **UNHCR** to provide cash-based assistance, in lieu of in-kind support, on cards which can be used at its agents, ATMs, or over the counter. In 2022 it partnered with FSD Africa, a development agency, to provide refugees with financial services such as mobile banking, digital loans, and insurance.

INKOMOKO

Microfinance institution

NATIONWIDE

Inkomoko provides business advisory support and access to finance for entrepreneurs across Africa. Originally launched in Rwanda in 2012, the organisation began working in displacement contexts in 2016 following the introduction of cash transfers. **Inkomoko** works in all five refugee camps and supports small businesses to start up, grow, and hire displaced people. The organisation is supported by **UNHCR** and **MINEMA**, amongst others. Of the 41,778 entrepreneurs that **Inkomoko** supports, 64% are refugees.

UMUTANGUHA

Microfinance institution

NATIONWIDE

Umutanguha Finance Company (**UFC**) is a Rwandan microfinance company offering bank accounts and loans. In 2019 **UFC** partnered with **UNHCR** and **MINEMA** to open an office in Mahama camp to offer savings and loans and, via a network of agents, serve Kigeme camp through its branch in nearby Gasarenda. **UFC** also offers financial literacy training and top-up loans for small businesses in the camps.

Stakeholder directory

PRIVATE SECTOR

BELECOM

Solar home systems

NATIONWIDE

Belecom is a Rwandan SHS company which was supported by **Practical Action** under RE4R Phase I. **Belecom** offers 20 W systems with three lights, a phone charger, and a radio for 2,600 RWF per month over three years. The company opened shops in camp Kigeme and Nyabiheke and established a revolving fund and provide seed funding for low-income households for income-generating activities. In coordination with the **Refugee Executive Committee**, groups of 10-15 **Belecom** customers were provided with training and loans of between 10,000 and 100,000 RWF.

BBOXX

Solar home systems

NATIONWIDE

With more than 50,000 customers in Rwanda alone, **Bboxx** is one of the largest SHS companies operating in East Africa. It focuses on providing high-quality systems for domestic and business users and, under **Practical Action**'s RE4R Phase I, offered a 50 W system with three lights, a phone charger, and optional extra appliances for 2,900 RWF per month over three years.

MESHPOWER

Solar mini-grids

NATIONWIDE

Based in Kigali, **MeshPower** has installed more than 80 solar mini-grids in rural communities across Rwanda. Under either PayGo or pre-paid models, customers can receive basic electricity services, such as lighting and phone charging, as well as entertainment options such as televisions. **MeshPower** partnered with **Alight** to solarise health clinic in Mahama which also provides power to camp administration offices and refugee businesses in the local marketplace.

SOLEKTRA

Solar systems and streetlights

NATIONWIDE

Rwandan company **Solektra** provides a range of clean electricity solutions including SHS, solar irrigation, and solar mini-grids, and has installed over 6,000 SHS across Rwanda. In partnership with **Practical Action** and **UNHCR** under RE4R Phase I, **Solektra** installed 185 solar streetlights in Kigeme, Nyabiheke and Gihembe camps – with those in Gihembe being relocated to Nyabiheke after the camp closure – and trained 17 people on their maintenance. **Solektra** also installed more than 300 SHS for vulnerable households in the same three refugee camps through RE4R's inclusivity scheme.

Stakeholder directory

PRIVATE SECTOR

URUMURI

Clean cooking

NATIONWIDE

Rwandan company **Urumuri Energy Group** was one of two cookstove companies supported by **Practical Action** and **UNHCR** under RE4R Phase I to provide improved cookstoves and fuels in Kigeme and Nyabiheke camps. **Urumuri** sells Tier 3 natural air draught stoves and biomass pellets sourced from sawdust and shrubs.

ECOGREEN SOLUTIONS

Clean cooking

NATIONWIDE

Rwandan company **EcoGreen Solutions** manufactures and distributes improved cookstoves throughout the country. It offers two kinds of stoves, one featuring forced air draught and one with natural air draught, along with biomass pellets. The company also sells LPG throughout the country. Under RE4R Phase I, **EcoGreen** was supported by **Practical Action** and **UNHCR** to provide cooking solutions in Kigeme and Nyabiheke.

BIOMASSTERS

Clean cooking

NATIONWIDE

Biomassters is a clean cooking company based in Kigali. The company was founded by former Inyenyeri staff and offers pellet fuels and Tier 4 gasification stoves under a lease-to-own subscription contract which removes the upfront cost to customers under a PayGo model. Its pellets are made from biomass waste and sourced from by-products of forest management, reforestation, and furniture production.

OFFGRIDBOX

Off-grid solar

NATIONWIDE

OffGridBox provides solar-powered containerised electricity solutions to rural communities around the world. The company also sells small family lighting kits which provide basic electricity services like lighting and phone charging. The kits use a swappable battery pack which can be charged at the **OffGridBox** centralised box which also has an integrated water purification system. With almost 30 systems around Rwanda, **OffGridBox** has been operating in the country's five refugee camps since 2020 and works with the **Refugee Executive Committee** in each camp. **OffGridBox**'s systems also can power social institutions or businesses.

Stakeholder directory

PRIVATE SECTOR

BAMBOO

Clean cooking

Bamboo sells briquettes made from sawdust as a substitute for firewood and charcoal. The company opened a shop in Kigeme in 2018 and has partnered with **UNHCR** to provide briquettes for institutional cooking in preschools and primary schools in the camp.

NATIONWIDE

OAK INVESTMENTS

Clean cooking

OAK Investments produces improved cookstoves and briquettes with a goal of reducing the usage of firewood and charcoal. Operating since 2020, the company aligns itself with the GoR efforts to combat deforestation through reduced fuelwood consumption and produces 30 to 40 tonnes of briquettes per day.

NATIONWIDE

OTHER ORGANISATIONS

MASHIRIKA

Performing arts

Established in 1997, **Mashirika Performing Arts and Media** uses performing arts for development. Working with dance, music, and drama, the organisation designs and performs community outreach activities to both educate and entertain. The RE4R Project contracted **Mashirika** for awareness-raising activities as part of its clean cooking and SHS interventions.

NATIONWIDE

SE4ALL

International organisation

Sustainable Energy for All (SE4ALL) is an international organisation which works in partnership with the United Nations, governments, the private sector and others to promote sustainable energy worldwide. In consultation with the GoR, **SE4ALL** has developed a four-year (2021-24) "Access Accelerator" programme focusing on enabling universal electrification, PUE, and clean cooking. It is also working on a roadmap for electrifying health facilities. In May 2022, Kigali hosted the Sustainable Energy for All Forum.

NATIONWIDE

RESEARCH INSTITUTIONS

Research

Research institutions that have conducted studies relevant to sustainable energy in, or based on, displacement settings in Rwanda include **Three Stones International**, **Chatham House**, **Imperial College London**, **Coventry University**, and **Colorado State University**.

NATIONWIDE

06

Potential high-impact projects

Potential high-impact projects

Effective long-term solutions cannot be implemented in isolation. Close coordination among stakeholders and fostering learning between different organisations is essential to use resources as efficiently as possible and to scale up existing work. Designing potential energy interventions together – bringing together the experience and expertise of many different stakeholders – can help to identify the most impactful areas of programming as well as the potential barriers and enablers that will affect its implementation.

In support of this, the READS workshop featured a session in which groups of diverse participants came together to learn about each other's work and co-design potential high-impact projects, building on the experience made with existing interventions. Each group focused on a different energy issue with the goal of outlining a viable project opportunity that would directly address some of the greatest issues currently faced in displacement contexts in Rwanda.

By involving a range of stakeholders in the collaborative co-design process, and crucially refugee and host community representatives who are integral to any project design, the project concepts aim to address the barriers and gaps that the participants identified as the most pressing. They draw on approaches that have already been piloted that show potential to be either replicated in different locations or scaled up.

Following these initial designs, and incorporating ideas from previous work in displacement settings in Rwanda and elsewhere, these ideas have been further developed into the project concepts presented in this section. These summaries provide an outline of the potential projects including:

- The proposed location and scale,
- The project activities and potential implementation partners,
- Enablers and barriers which could affect its realisation,
- How these projects link to previous work through replication and scaling, and
- Ideas for community engagement, gender mainstreaming, and inclusivity.

The estimated costs of the projects are included as a guide and will vary significantly depending on their scale and complexity. The project concepts are designed to be a starting point to further develop interventions, scope out potential partnerships, attract investment, and ultimately increase access to sustainable energy.

The READS workshop featured a co-design session for stakeholders to develop viable, high-impact projects to increase access to sustainable energy for their specific area.

Important considerations for project design

There are considerable differences between refugee camps across the country and between displaced and host communities. Variations in the amount of existing infrastructure, levels of economic activity, distances to towns, culture, and local needs and priorities will determine what kinds of interventions would have the greatest effect in increasing access to sustainable energy in each location. In all interventions, efforts must be made to address both the needs of host communities as well as refugees to not disadvantage one group and to promote social cohesion and peaceful coexistence.

A one-size-fits-all approach will not be able to account for these nuances. Before beginning any of these projects, further research and detailed assessments at the local level will be necessary to better understand the specific and unique situations on the ground. Such assessments should also be independent, objective, and afforded appropriate time and resources to best develop long-term implementation plans. These should be done with stakeholders which best understand their energy needs and are therefore best positioned to shape the proposed interventions.

Many of the project concepts aim to use market systems to better integrate the private sector in the provision of sustainable energy in displacement contexts. For this to work in the long term, national or international companies should set up operations with supply chains to outlets in refugee camps and host communities – and be adequately supported in doing so, where required – to establish a permanent presence which endures after external funding ends. Local companies in the camps, meanwhile, should be supported to conform with national and international product standards to ensure quality for customers. All companies and organisations which implement sustainable energy technologies should facilitate ongoing and independent evaluations to assess their benefits to the user in the field, not just under laboratory or ideal conditions, to monitor their continued usage and long-term benefits.

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Community involvement

Refugee and host communities should be involved from the outset when designing sustainable energy interventions as they best understand their own energy needs and priorities. Community members are particularly well-placed project partners owing to their networks and knowledge of the context, and so should have important roles to play in the design and implementation of interventions. Some potential opportunities to involve the community include:

- Working with community groups and a range of leading figures to gather input on design of intervention plans, and to advocate for sustainable solutions with other stakeholders and within their communities,
- Consulting with different community segments during the design phase of interventions and for delivery model development, such as through focus group discussions, co-design workshops and community mapping interventions, whilst coordinating with other organisations to minimise overlap and survey fatigue,
- Hire community members as sales agents, community mobilisers and product ambassadors,
- Equitably target both refugee and host community members for employment and sales targets,
- Providing training and capacity building for community members, such as on the installation or maintenance of energy technologies and customer services,
- Involving or creating cooperatives to oversee and manage community-wide or public projects and their locations, such as streetlights, and
- Direct collaboration between community groups and humanitarian and development actors, the private sector, and other organisations for project planning, management, auditing and other key activities.

Inclusivity strategies

Achieving sustainable energy for all requires understanding and meeting the needs of every member of the community. In displacement contexts some people may have specific vulnerabilities or require different considerations to access sustainable energy, for example if they have a disability. Including these people in project design, and offering strategies for their inclusion during implementation, can mean that energy interventions meet their needs more effectively. Some inclusivity considerations could include:

- Holding focus groups with people with specific vulnerabilities to ensure an intervention will be accessible to them and meet their needs,
- Include people with disabilities in trainings and employment opportunities whilst accommodating any specific needs,
- Engaging with microfinance companies to develop services which make upfront costs more accessible to low-income customers, such as for connections to mini-grids,
- Use voucher systems for vulnerable customers to access technologies within a wider market-based approach, such as for solar products or improved cooking solutions, and
- Promote technologies, products and designs which accommodate users with specific vulnerabilities or disabilities.

Gender mainstreaming

Sustainable energy interventions could have different implications for women and men. This can be exacerbated when decision makers, typically men, are not the same gender as the primary users of energy technologies, for example typically women with regards to domestic responsibilities. Considering these differences and the effects they may have during both the design and implementation of energy projects can allow them to better meet the needs of all community members and promote gender equality. Gender mainstreaming will vary depending on individual contexts and communities but could be integrated into projects by:

- ☑ Using single-gender focus groups during initial scoping phases to identify gender-specific concerns, for example around the locations of public lighting,
- ☑ Targeting equal opportunities for training and employment for both women and men,
- ☑ Increasing opportunities for training and employment for women in roles that are traditionally seen as “men’s work”,
- ☑ Identifying employment opportunities for women which are compatible with family, childcare or household responsibilities, for example near to their homes,
- ☑ Schedule engagement events at convenient times of the day and/or provide stipends to avoid conflicting with childcare responsibilities and allowing mothers to participate,
- ☑ Using awareness-raising campaigns for energy solutions that target men and women to promote interest in the new technologies,
- ☑ Offer cooking classes in schools to both boys and girls to raise awareness of clean cooking solutions and encourage both boys and girls to learn how to cook, and
- ☑ Highlight the needs of different household members during product sensitisation campaigns and encourage joint decision-making.

Project concepts

RBF SCHEMES FOR IMPROVED BIOMASS STOVES AND WOOD PELLETS

1/2

LOCATION

Kiziba, Kigeme, Nyabiheke camps and host communities, with wider operations in urban areas

BACKGROUND

A variety of biomass stoves using wood pellets have been sold in the camps. These include the natural air draught stoves sold through the RE4R Project, as well as the fan-gasifying stoves sold by Inyenyeri. The latter technology in particular was popular among users and managed to cut emissions significantly compared to other biomass stoves. With more financial support to both establish operations and further develop their technologies, companies could provide similar products which use locally-produced fuels.

ACTIVITIES

Feasibility study and supply chain analysis (Y1)

Establishment of stove and pellet production site near camps (Y2)

Contract stove companies through RBF schemes (Y2-4)

Establishment of sales outlets in refugee camps (Y2)

Training and hiring community members as sales agents, community mobilisers, pellet and stove manufacturers (Y2-4)

Marketing campaigns (Y2-4)

Subsidise stove purchases and use flexible instalment repayment model (Y2-4)

Allow purchase of fuels on credit schemes (Y2-4)

ENABLERS

RE4R II suppliers are developing fan-gasifying stoves

Ongoing popularity of similar stoves from previous projects

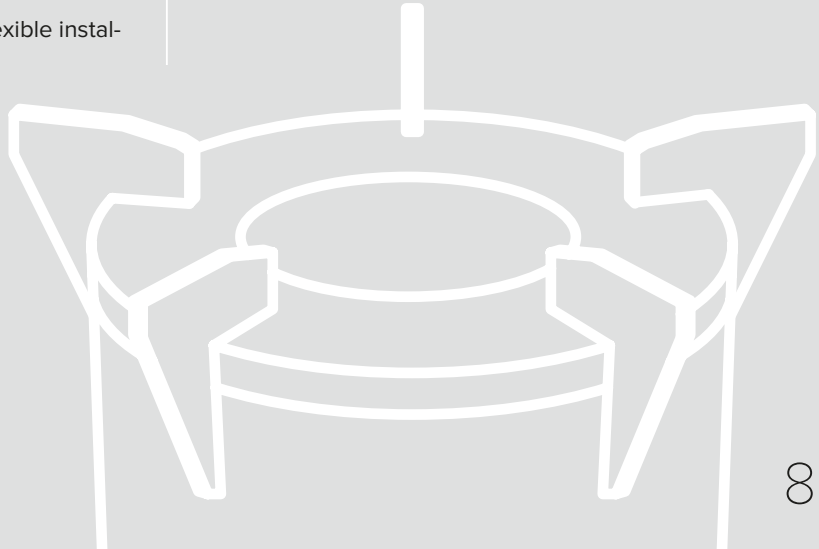
Experience from RE4R and Inyenyeri's work provides valuable lessons learned

BARRIERS

Expensive unit price of stoves

Cost of establishing pellet production site and manufacturing technology

Recurring costs of purchasing fuel for customers and low purchasing power



Project concepts

PROJECT REACH, TIMELINE & BUDGET

Large

$2 million

30,000 households

Year 1: Feasibility study, supply chain development, establishment of production site ($750,000)

Year 2: Commencement of sales ($500,000)

Year 3: Scale up and continued operations ($500,000)

Year 4: Continued operations and evaluation ($250,000)

FURTHER INFORMATION

The Mimi Moto stove, leased to customers by Inyenyeri, was designed in the Netherlands and produced in China. Compared to other stoves on the market it was much pricier (around $85 per stove) and so these stoves will require a substantial subsidy to make them affordable enough for customers. Locally produced natural air draught stoves were sold under the RE4R Project in its first phase. The clean cooking suppliers are now using the funding they received through the project to develop fan-gasifying stoves which are currently undergoing testing. Lessons from Inyenyeri's work showed that beyond serving refugee and host community clients, the companies should consider serving urban areas with customers with a higher amount of disposable income for cross-subsidisation.

REPLICATION & EXPANSION

Builds on work done by RE4R Phase I with RBF schemes and Inyenyeri's technology and elements of its business model

STAKEHOLDERS AND ROLES

Companies to manage production, distribution and sales of stoves and pellets, as well as training and hiring community members

Humanitarian or development actor to provide RBF schemes to company and support with business development and awareness raising activities

Community leaders to support with awareness raising activities

SCALABILITY

Moderate: Scalable throughout the three focus camps and host communities, and also urban areas if sufficient support is provided for widespread scaleup.

RBF SCHEMES FOR IMPROVED BIOMASS STOVES AND WOOD PELLETS

2/2

Project concepts

ELECTRIC PRESSURE COOKER PILOT FOR HOST COMMUNITY HOUSEHOLDS AND BUSINESSES AND SOCIAL INSTITUTIONS IN CAMPS

1/2

LOCATION

Host communities in Kigeme and Mahama, business centres and social institutions in all camps

BACKGROUND

Electric pressure cookers (EPCs) are a promising technology which can be powered through electricity and avoids the need of purchasing fuel. Due to high upfront costs and low access to electricity in displacement settings, it is not a common cooking method. EPCs could be introduced on a pilot scale amongst users with a grid connection, such as businesses and social institutions in refugee camps, as well as households in the host communities. EPCs could also be powered by mini-grids, if available.

ACTIVITIES

Assessment of household cooking needs and preferences, particularly focusing on interest in electric cooking (Y1)

Work with companies and government partners to design suitable tariff structures designed to accommodate electric cooking (Y1)

Roll out EPCs to households, businesses and social institutions (Y1-2)

Run information and training sessions for potential customers to learn how to use EPCs and let them experience the advantages for themselves (Y1-2)

Support purchase of EPCs through instalment payments, flexible repayment schemes or pay-as-you-cook models (Y1-2)

Provide end-user subsidies for stoves (Y1-2)

Research the impacts and long-term uptake of electric cooking as a replacement to (or when used alongside) traditional methods (Y1-2)

ENABLERS

Aligns with national objectives to reduce reliance on biomass for cooking

High potential for cutting emissions from cooking

BARRIERS

Limited familiarity with electric cooking

Preferences for familiar traditional cooking methods

Limited supply chains for EPCs

EPCs require a reliable source of electricity with a relatively high capacity, such as a grid or mini-grid connection

Project concepts

PROJECT REACH, TIMELINE & BUDGET

Small

$500,000

400 stoves

Year 1: Needs assessment, feasibility study and business case development ($150,000)

Year 2: Roll out of technologies along with market activation campaign, evaluate activities and plan scale up ($350,000)

FURTHER INFORMATION

Electric cooking is novel in displacement settings, with only a few pilots being implemented in comparable contexts in Kenya and Uganda. Electric cooking has significant potential as a cooking method which is powered by renewable electricity and does not rely on ongoing fuel purchases. However, the high upfront costs and reliance on a reliable electricity source will likely be significant barriers initially, as well as the unfamiliarity with this cooking method. With time and increasing access to electricity, it may incrementally be adopted and become increasingly common, potentially used as a secondary cooking method initially.

REPLICATION & EXPANSION

Replicates an EPC pilot conducted by SNV in Kalobeyei, Kenya which uses power from a large-scale solar mini-grid

STAKEHOLDERS AND ROLES

Electric pressure cooker company to provide technology

Humanitarian and development organisations to support pilot with feasibility studies, business case evaluation, awareness raising and market development

Companies to lead on business model development, sales, promotion, and after-sales support

Community leaders to support marketing and demonstration activities

SCALABILITY

High: Uptake is likely to be slow initially but the technology may prove to be very popular and more cost-effective in the long-term.

ELECTRIC PRESSURE COOKER PILOT FOR HOST COMMUNITY HOUSEHOLDS AND BUSINESSES AND SOCIAL INSTITUTIONS IN CAMPS

2/2

Project concepts

MODULAR SOLAR UNITS FOR BUSINESSES

1/2

LOCATION

All camps

BACKGROUND

Refugee businesses currently have few options for higher levels of electricity access: larger SHS may be appropriate for some enterprises, but refugees are typically not permitted to connect to the national grid. Connections in business centres (such as under RE4R Phase I) provide high-quality power but only to tens of businesses each, far lower than the demand throughout the camps. Modular solar units, which could be scaled to meet demand, could provide an opportunity for improved electricity access alongside other activities to stimulate PUE.

ACTIVITIES

Undertake surveys of present (and potential new) businesses in the camp and their present/future electricity needs (Y1)

Value chain analysis for outputs of PUE activities to ensure demand for products or services (Y1)

Gain permissions, authorisations, and approvals for operations (Y1)

Engage technology provider to sell systems (Y1-2)

Train and hire local technicians and sales agents to manage operations in the camp (Y2)

Provide business training support for entrepreneurs (Y2)

Support purchase of units using RBF (Y2-3)

Offer subsidised financing for PUE appliances to businesses which purchase systems (Y2-3)

Monitor electricity usage and business growth to share learnings and support future projects (Y2-3)

ENABLERS

Low existing access to electricity for businesses with limited options for higher levels of power as they cannot connect to the national grid

High solar resource

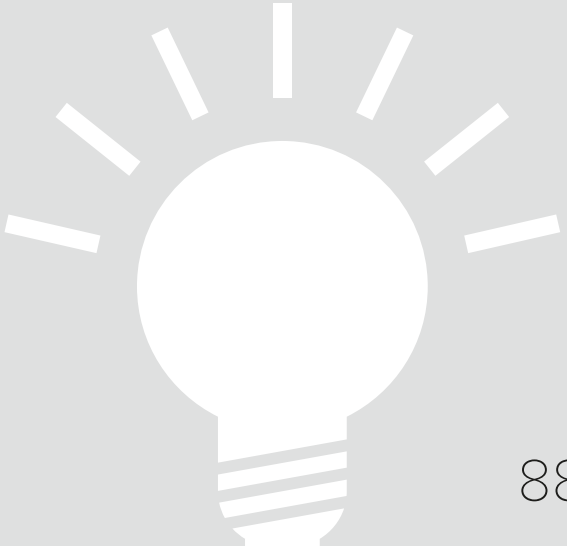
Makes use of technology which can easily be scaled and removed

BARRIERS

Unfamiliar technology in displacement settings

High upfront costs for systems

Requires subsidies and flexible repayment schemes to be affordable



Project concepts

PROJECT REACH, TIMELINE & BUDGET

Medium

$500,000

100 x 500 W systems to supply 100 businesses and other connections

Year 1: Surveys of current electricity use and planning of pilot, contracting of technology provider ($150,000)

Year 2: Sale of technology, hiring and training of sales managers and technicians, PUE training ($250,000)

Year 3: Continuation of operations and evaluation ($100,000)

FURTHER INFORMATION

Modular solar units, which can be owned by individual home-based businesses, offer access to higher levels of electricity compared to SHS. They can be scaled by combining units, and also avoid safety and regulatory issues associated with connections to the grid or mini-grids. These systems can be used for businesses who currently consider their electricity access levels to be insufficient, but do not have access to the grid-connected business centres.

REPLICATION & EXPANSION

Replicates a pilot project implemented by Power-Blox and International Lifeline Fund in Kiryandongo and Rwanwanja refugee settlements in Uganda

STAKEHOLDERS AND ROLES

Modular solar unit company to sell technology and establish operations

Development and humanitarian organisations to support with business development for the company and entrepreneurship and PUE trainings for the entrepreneurs

Community leaders to mobilise businesses to purchase the systems

MFIs to manage PUE appliance financing schemes

Government agencies to provide permissions, regulatory oversight and authorisation

SCALABILITY

High: Depending on the popularity of the technology and the successful establishment of the provider, many businesses may gain access to these systems.

MODULAR SOLAR UNITS FOR BUSINESSES 2/2

Project concepts

STANDALONE SOLAR BATTERY CHARGING SYSTEMS FOR HOUSEHOLDS AND BUSINESSES

LOCATION

Kigeme, Nyabiheke, Mahama, Mugombwa and Kiziba camps

1/2

BACKGROUND

SHS can provide domestic electricity services but, even when subsidised, these can be unaffordable for households with low-incomes or specific vulnerabilities such as the elderly, people at risk, or people with disabilities. Meanwhile, grid connections which could provide higher levels of electricity access are not available to most businesses. OffGridBox has already deployed standalone solar systems which provide power to businesses, community facilities, and have an integrated water purification system. The company also sells rechargeable power banks to households which can be recharged at the main system. These standalone systems could offer an alternative and lower-cost route to electricity for households, businesses and social institutions.

ACTIVITIES

Gain authorisations and permits for systems (Y1)

Install systems and hire local technicians and system managers (Y1)

Awareness raising and community engagement (Y1-2)

Subsidised support for vulnerable households to access domestic electricity services through RBFs and/or community groups (Y1-3)

Connect business customers (Y1-3)

Train local technicians and sales agents for long-term maintenance and operations (Y1-3)

ENABLERS

Existing OffGridBox operations in all camps

Present gap in the market for lower-cost domestic electricity services

Opportunities for multiple income streams across households, businesses, and other services (such as clean water)

Similar subsidies schemes have been implemented under RE4R Phase I

BARRIERS

Competition with relatively well-established operations of other companies in the camps, especially for SHS

Large upfront costs of OffGridBox systems

Project concepts

PROJECT REACH, TIMELINE & BUDGET

Large

$1.5 million

Five standalone solar systems reaching 2000 households and 25 businesses in each camp

Year 1: Assessments, permissions, and equipment deployment ($1 million)

Year 2: Scale-up customer base and roll out technologies, selling kits to households and connecting businesses ($300,000)

Year 3: Continue operations and evaluate pilot ($200,000)

FURTHER INFORMATION

Whilst these systems could provide lower-cost power for households for phone charging and lighting, they would likely need to be supported by flexible repayment mechanisms in order to reach the most vulnerable or lowest-income households. Similar mechanisms would also be necessary to support business connections, and these would require detailed consultations with community leaders and groups. The system supplier would also need financial support to deploy systems and scale up operations.

REPLICATION & EXPANSION

Replicates existing OffGridBox activities in the camps and elsewhere in Rwanda

STAKEHOLDERS AND ROLES (WITH EXAMPLES)

Companies to sell charging systems with flexible repayment mechanisms and to train and hire community members to operate and maintain the central systems

Humanitarian and development organisations to support with authorisations and awareness raising

Refugee Executive Committees to support with hiring community members and awareness raising, and to manage a percentage of revenues shared with the community through signed Memorandum of Understanding

SCALABILITY

High: The systems can be moved between locations as necessary and can be tailored to the local demand.

STANDALONE SOLAR BATTERY CHARGING SYSTEMS FOR HOUSEHOLDS AND BUSINESSES 2/2

Project concepts

GRID-CONNECTED BUSINESS CENTRES

1/2

LOCATION

Construction of a new site in Mugombwa and Kiziba, expansion or replication in Nyabiheke, Kigeme and Mahama

BACKGROUND

Replicating work done under RE4R Phase I, business centres (compounds hosting around 12 businesses) connected to the grid could help enterprises access a reliable source of electricity and create an active marketplace. Crucially, it enables the businesses to access the national grid safely while avoiding ID requirements for individual connections. The use of PUE appliances can greatly increase the productivity and revenues of small businesses and restaurants. Providing these entrepreneurs with business mentorship, access to finance, and training on using electric appliances also play a key role in improving incomes and livelihoods.

ACTIVITIES

Identify businesses which could benefit most from accessing higher levels of power and PUE appliances to increase their productivity (Y1)

Construct business centres powered by grid (Y1)

Work with MFIs to develop tailored financial products for entrepreneurs to buy appliances (potentially combining a subsidy and a loan) (Y1-3)

Work with specialised NGOs to provide business mentorship and training, such as bookkeeping, marketing, financial literacy (Y1-3)

Run awareness raising and promotional campaigns for PUE appliances (Y1-3)

Conduct training programmes on the use of PUE appliances (Y1-3)

ENABLERS

Grid connection provides opportunities to boost productivity and stimulate local economies, in line with government and humanitarian objectives

Clustering businesses allows users to circumvent obstacles associated with ID requirements for grid connection

Economies of scale could allow savings on equipment and project costs

BARRIERS

High upfront costs and land acquisition for business centre construction

Relatively high cost and limited availability of PUE appliances, as well as limited ability of entrepreneurs to take on large upfront expenses

Sensitivities of only being able to select a limited number of businesses to operate from each business centre

Project concepts

PROJECT REACH, TIMELINE & BUDGET

75 businesses

Year 1: Land acquisition and permitting, construction of business centres ($250,000)

Year 2: Selection of entrepreneurs and move into business centres, business mentorship, appliance acquisition and training ($500,000)

Year 3: Business centre operation, oversight and monitoring ($250,000)

Medium

$1 million

FURTHER INFORMATION

Electricity can offer new opportunities for entrepreneurs, both for new kinds of businesses and the types of activities available to them. PUE appliances can increase production and profits through reduced labour, whilst skills training can help entrepreneurs grow their enterprises. Concentrating many businesses in a central area, and providing reliable electricity, could catalyse growth for individual businesses and the local economy. The business centres constructed during RE4R I cost an average of approximately $25,000.

REPLICATION & EXPANSION

Replicates existing work by the first phase of the RE4R Project

Could expand existing marketplaces in the camp

STAKEHOLDERS AND ROLES (WITH EXAMPLES)

Development agencies and NGOs to provide business mentorship, develop appliance acquisition scheme, and commission business centres

Companies to build the business centres and to sell appliances

National utility or private developers to supply power to the centres

Government agencies to provide permissions, regulatory oversight and authorisation

MFIs to provide microloans for businesses

SCALABILITY

Moderate: Investing in new infrastructure comes with high costs and only reaches a limited number of businesses. However, the centres can create thriving marketplaces that have a catalysing effect on the local economy and encourage more entrepreneurship.

GRID-CONNECTED BUSINESS CENTRES 2/2

07

Conclusions

Key issues for energy access

Displacement settings in Rwanda offer an exciting potential to scale up access to sustainable energy. Rwanda has a relatively welcoming environment for the integration of displaced people and clearly defined policies for sustainable energy technologies. Existing and ongoing projects which have used market-based approaches to support energy access, such as the RE4R Project, demonstrate how the private sector can provide these solutions. Previous work has focused mainly on Kigeme and Nyabiheke, and the newer Mahama camp, and so an increased focus will be required to initiate and replicate projects in Mugombwa and Kiziba.

Access to electricity is generally low across displacement settings in Rwanda. Assessments undertaken by Practical Action in late 2022 as part of the second phase of the RE4R Project found that around one third of households have no access to electricity and, for those that do, 58% were not able to charge their phones using it. SHS interventions have been successful in the past, however, and combining RBF schemes with a greater private sector presence in the camps could help to scale these up.

Access to clean cooking, meanwhile, varies significantly between camps. LPG stoves are commonly used in Mahama and Mugombwa, supported by free distribution, but refugees in other camps rely predominantly on firewood and either improved or traditional stoves. Improving the availability of improved cooking options, both for stoves and fuels, alongside financial assistance for households and awareness raising would help to increase clean cooking access.

Refugee businesspeople use energy for lighting, charging, hairdressing, and entertainment services, with some also using electricity for more power-intensive applications such as agro-processing or carpentry. The RE4R Phase II assessments found that entrepreneurs generally feel constrained by their limited access to electricity and appliances and, while some opportunities have been made available by connections in business centres and to off-grid systems, 38% of entrepreneurs anticipate that the use of better or more diverse appliances would contribute to an increase in their revenue.

Most clinics and schools have access to the national grid network, a standalone solar system, or a diesel generator which provides reliable power. Religious buildings typically have lower electricity access than other community facilities and, as in domestic settings, institutional-scale clean cooking is rare. Public lighting projects, overseen by community groups, have generally been successful in Kigeme and Nyabiheke and offer good opportunities for replication; these would require upfront capital investment and implementation support to increase coverage and replicate in the other three camps.

Humanitarian organisations have high levels of electricity access for their offices and administration, as well as for critical services such as water pumping. Most have metered connections to the national grid; monitoring electricity usage could provide opportunities to identify potential energy and cost savings from the implementation of energy efficiency measures, rather than (or in addition to) installing on-site renewable energy generation. ●

Projects using market-based approaches have demonstrated how the private sector plays a key role in providing sustainable energy solutions.

The first phase of the RE4R Project has helped to increase energy access in Kigeme and Nyabiheke; the market-based approaches it supported should be scaled up and replicated in the other camps and host communities where access to energy is lower.

The road to sustainable energy in displacement settings

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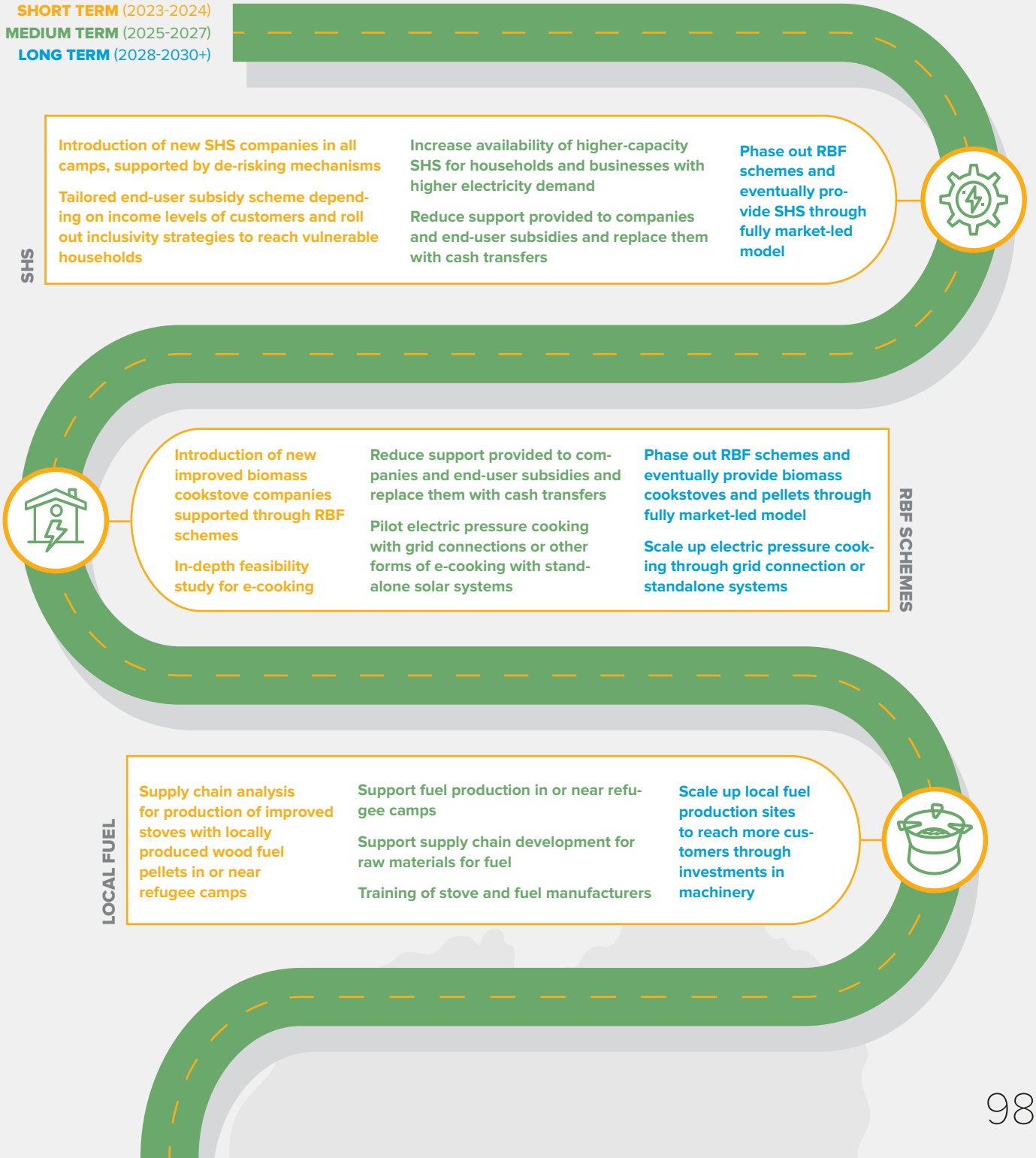
Improving access to sustainable energy will require a concerted effort from all stakeholders working in displacement contexts, with refugee and host community members having a central role in the design and implementation of any intervention.

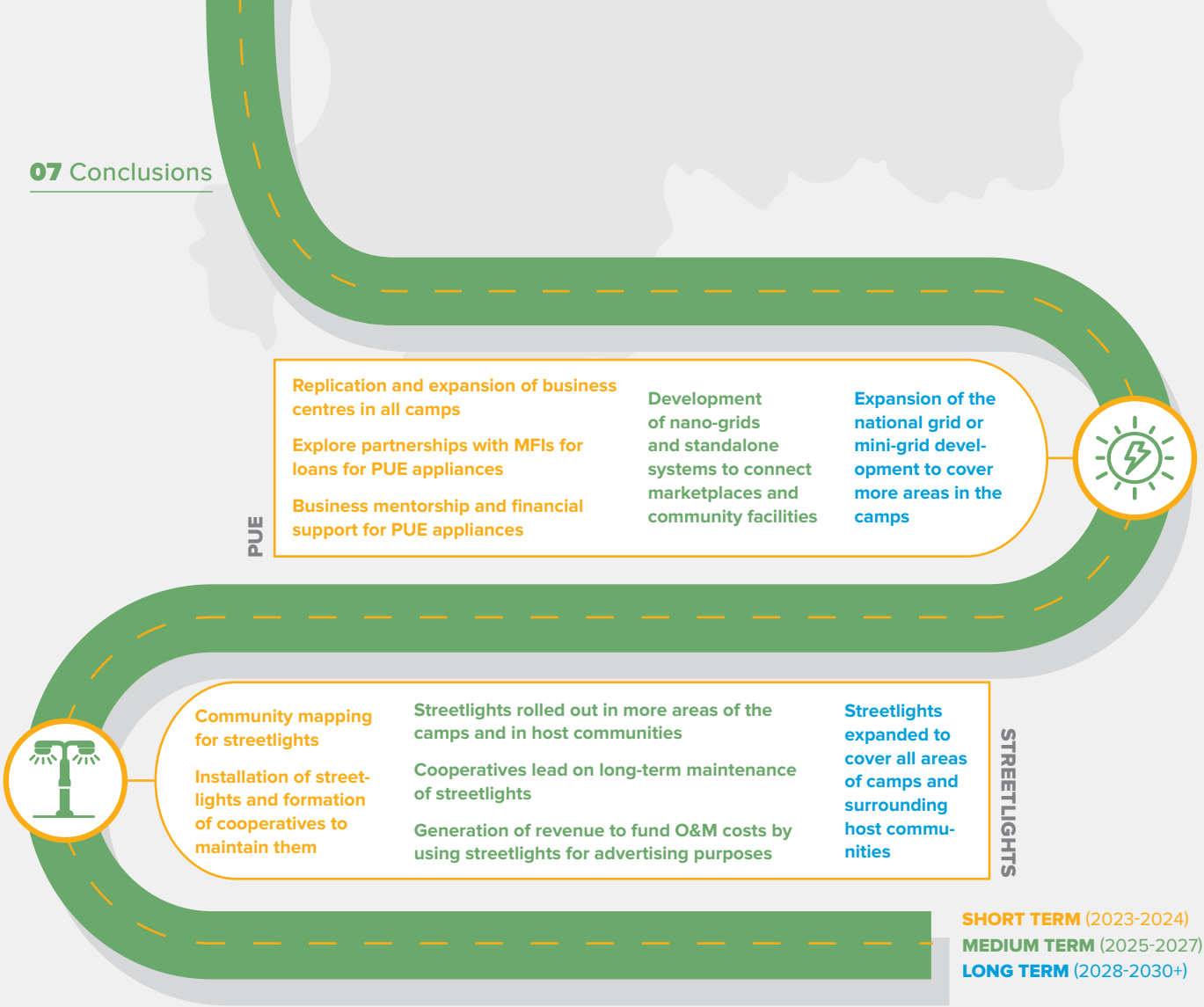
The READS workshops brought together a diverse range of stakeholders to co-design potential high-impact projects. Whilst these are presented as individual opportunities – and would each merit investment and implementation on their own – rolling out coordinated interventions addressing several energy themes together could have a truly catalytic effect on increasing sustainable energy access across displacement settings.

Acknowledging this, and the work of other initiatives, the roadmap below presents a vision of how access to sustainable energy in displacement settings could develop in the short, medium, and long term. ››

All stakeholders will need to play a role, with refugee and host communities in the centre, to improve access to sustainable energy.

The road to sustainable energy in displacement settings





The challenge is huge: achieving access to affordable, sustainable, reliable, and modern energy for refugees and host communities by 2030 will require more projects, activities, partners, coordination, and investment than ever before. Fortunately, existing market-based solutions for household lighting, clean cooking, and large-scale electrification projects for businesses and community facilities provide a blueprint for scaling up, replicating, and innovating on sustainable energy solutions in displacement settings throughout Rwanda. ●

Rwanda's supportive policies towards sustainable energy, welcoming environment for refugees, and existing projects provide a strong foundation for scaling up sustainable energy solutions.

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