Improving Energy Access for Displaced Populations

An institutional analysis for the potential of community solar mini-grids in refugee camps

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Abstract

There is a pressing need for sustainable energy solutions in refugee camps. Community solar mini-grids, with their costs, reliability, and ease of installation can meet this energy need and contribute to the development and empowerment of camp residents. This research aims to answer the question of *To what extent can community-based governance approaches for solar mini-grids provide energy access in refugee camps?*. A case study is conducted by applying the Institutional Analysis and Design (IAD) framework to understand the decision-making processes regarding energy provision in the Kigeme refugee camp. Desk research and expert interviews are conducted to understand the interactions between the actors, outcomes of policy decisions, and challenges of using solar mini-grids in displacement settings. The results show that giving the ownership of the system to refugee communities or a co-operative of camp residents is an ambitious goal due to political and institutional reasons. However, a sense of ownership can be created by using participatory activities during planning, design, implementation, and operation and maintenance of the system to increase the resilience of refugees and improve the sustainability of the system.

Keywords: displacement settings, solar energy, community-based approach, institutional analysis, humanitarian energy

1 Introduction

With the increasing number of persecution, conflict, violence, human rights violation, and natural disasters across the globe, 79.5 million people fled their homes in 2019 (UNHCR, 2020). Camps are established with the purpose of providing emergent and secure spaces for displaced people (Bulley, 2014). The assistance provided in camps by UNHCR consists of shelter, emergency relief items, water and sanitation, food, healthcare and counseling, and registration and legal aid (UNHCR, 2020d). These services might suffice in the immediate aftermath of a crisis but considering that the average lifetime of a refugee camp is 18 years (Grafham and Lahn, 2018), it is expected that additional services will be needed such as energy.

While access to energy is crucial for cooking, lighting, heating, clean water, and most income-

earning activities, the electricity provided in refugee camps is either non-existent or severely lacking in terms of availability, accessibility, and quality (Lahn and Grafham, 2015). Services related to energy are listed as distribution of stoves, winterization kits, charcoal, and solar lanterns while costly and pollutant diesel generators are used for meeting the basic electricity demand of offices (Grafham, 2019). It is estimated that 85% of refugee households use firewood for cooking (UNHCR, 2019). As a result of this use, around 13 million tonnes of CO_2 is emitted for household energy access in refugee camps (Lahn and Grafham, 2015). Even though diesel generators might be practical in the early phases of settlement, solar mini-grids can meet the demand without releasing CO_2 to the atmosphere and incurring high costs. With their higher generation capacities, solar mini-grids increase the chances that the energy can promote resilience of refugees.

In light of the initial literature review conducted, it can be concluded that the potential of community solar mini-grids which takes into account the roles and responsibilities of humanitarian organizations, national and local governments, funding partners, private sector actors, and camp residents and the coordination between them has not been explored. As a result, the main research question is formulated as: *To what extent can community-based governance approaches for solar mini-grids provide energy access in refugee camps?* To answer this question, A case study is conducted by applying the Institutional Analysis and Design (IAD) framework to examine the decisions about energy governance in the Kigeme refugee camp.

This paper is structured as follows. Section 2 provides the theoretical framework that guides the research. Section 3 discusses the research methodology. Section 4 focuses on the Kigeme refugee camp and investigates how energy related problems are handled within the camp by applying the IAD framework. Section 5 provides a reflection on the academic contributions of the research and recommendations for decision makers. Finally, Section 6 concludes the report by providing answers to research questions, identifying limitations, and recommending ideas for future research.

2 Theoretical framework

The successful implementation of energy projects in refugee camps depends on the governance of the system (Fuentes et al., 2018; Ossenbrink et al., 2018). The implementation of community solar mini-grids can be viewed as a polycentric system which deals with authorities from global to local level, stakeholders with public, private, voluntary, and community-based organizational structures, different functions such as the production, provision, coordination, funding, and monitoring of the energy systems (McGinnis, 2011). To ensure that this complexity does not bring out chaos as argued by Hardin (1968) and Olson (2012), one needs to understand what are the practices for governing humanitarian energy sector and how institutions are operationalized (Rosenberg-Jansen, 2019).

The Institutional Analysis and Development (IAD) framework was developed by Elinor Ostrom to study governance of natural resources without the state intervention in the 1980s (Ostrom,

2005). The framework provides a set of variables to consider for identifying the factors that influence complex situations in a manageable manner. According to this framework, action situations, affected by external variables, are in patterns of interactions. These interactions create outcomes whose performance is evaluated by some criteria. The outcomes of policy affect external variables and action situation in the end.

In order to gain a deeper understanding of the contextual factors and the multiple levels of rules within the humanitarian energy sector, three levels of rules are integrated into the IAD framework: constitutional, collective-choice, and operational level (Ostrom, 2005). Here, the differences between constitutional and collective-choice levels are not very clear because there is not an actor or actor group that is responsible for governing the humanitarian energy field (Rosenberg-Jansen, 2019). Instead, there are several actors from international to local level shaping policies. In this merged level, international agreements signed by states specify who participates in decision-making processes and policies are created to ensure displaced populations have access to energy. These two levels are connected since the constitutional and collective-choice level rules influence the rules-in-use at the operating level. The camps are governed according to the international agreements signed by the countries and implementing organizations that run the camp. The IAD framework integrated with two levels of rules-in-use that guides the research is illustrated in Figure 1.

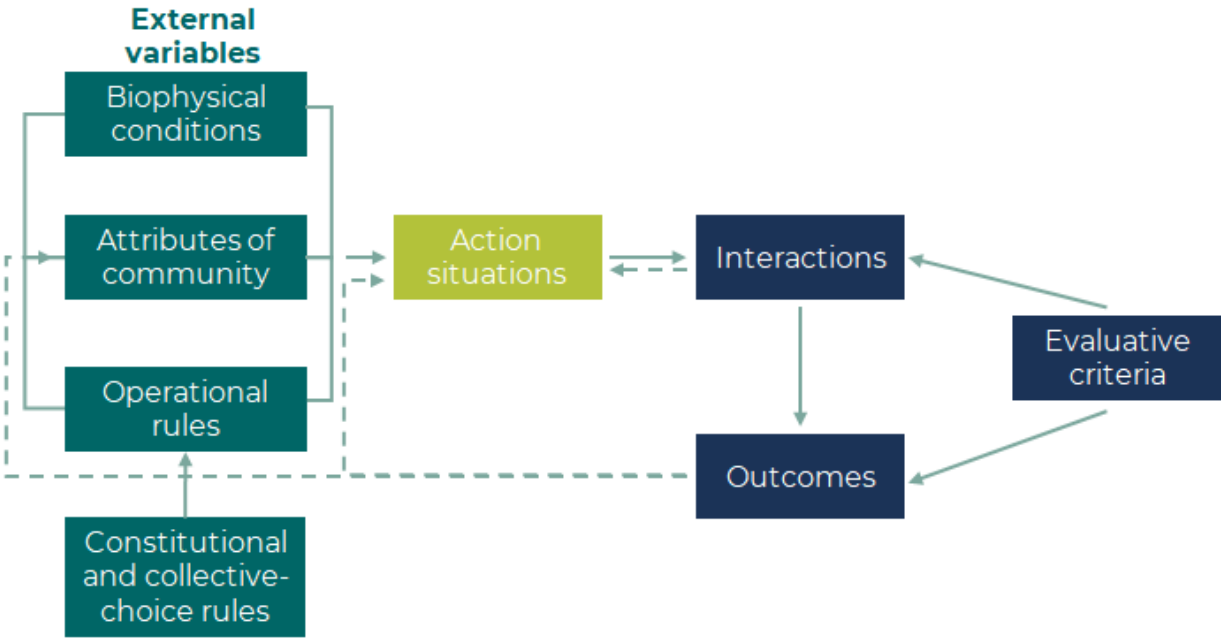

Figure 1: The conceptual framework guiding the research, adapted from (Ostrom, 2010) and Ostrom (2005).

3 Methodology

This research aims to explore to what extent using community-based approaches is possible for governing the solar mini-grids in refugee camps. The research is exploratory in nature since this topic has not been studied in the literature, which brings out qualitative research as an approach (Creswell, 2009). The application of the IAD framework requires interviews and observation of the interactions between participants. Qualitative data describing the biophysical conditions, attributes of community, rules-in-use, interactions between participants, outcomes of these interactions, and evaluative criteria to be used to evaluate these outcomes are needed. Desk research and semi-structured interviews were used to collect data. For understanding biophysical conditions and rules-in-use, secondary data extracted from literature and reports from humanitarian organizations are used. To analyze the attributes of community, interactions, and outcomes, primary data is collected through semi-structured interviews with the participants.

Case study was selected as the strategy to conduct qualitative and exploratory research that this thesis is concerned with. Several criteria were used to select the refugee camp for the case study. It is required that the camps are politically and physically stable through established regulatory frameworks in use for the protection of refugees, which is a necessary condition for the successful implementation of community solar mini-grid projects. There need to be initiatives for improving energy access within the camp. These initiatives might be in the form of distribution of cookstoves running with alternative fuel, building of mini-grids, or utilization of renewable energy technologies. Lastly, since there is a general lack of data on energy access in refugee camps, the most important criterion is the availability of information. Considering the time limitations of the research, it was decided to focus on one camp where information was more abundant: the Kigeme refugee camp.

Based on these differing roles and knowledge within humanitarian energy sector, the interviewees were selected purposefully to represent various actors in the system. A limited but highly influential and knowledgeable set of experts were interviewed based on their role within the humanitarian energy sector as shown in Table 1. After the interviews, the qualitative data went through four steps: organization and preparation, a read-through of data, codification of data, and description of data (Creswell, 2009). The questions asked during the interviews were prepared so that they reflect a specific element of the IAD framework. The information gathered from desk research and semi-structured interviews were presented in related elements of the IAD framework.

4 Energy governance in the Kigeme refugee camp

4.1 Introduction to the study area

The Kigeme refugee camp is located in Gakasa Sector, Nyamagabe District in the Southern Province of Rwanda. The report by Ministry in Charge of Emergency Management (MINEMA) explains that the camp was opened in 2012 following an influx of over 35,000 refugees from

Table 1: The list of actors interviewed.

Interviewee	Date of the interview	Actor group that interviewee is involved
1. Anonymous	25/09/2020	Humanitarian and development organizations
2. Anonymous	23/09/2020	Think tanks, funded partnerships and policy bodies
3. Jose Carrasco Montejano	15/09/2020	Think tanks, funded partnerships and policy bodies
4. Anonymous	25/09/2020	Humanitarian and development organizations
5. Bertram Peterson	15/09/2020	Private sector actors
6. Philip Sandwell	16/09/2020	Academic and research organizations

the DRC as a result of conflicts between government forces and militias (MINEMA, 2019b). The camp has an area of 348,414 meter-squares and is located at an altitude of 2,140 meters (MINEMA, 2019b). The camp has two sectors divided by a busy road (UNDP, 2012). According to the Country Refugee Response Plan for Rwanda by UNHCR (2020), shelter, water, sanitation, and hygiene related assistance are lacking due to funding gaps in the camp. Even though services related to these areas are provided as much as possible, the assistance fails at meeting minimum standards (UNHCR, 2020). The camp residents, similar to the host community, live in dwellings with mudbrick walls and a metal roof (Sandwell et al., 2020). Shelters, especially the ones with female-headed households, are old and need to be transformed as shown in Figure 2. With 0.059 person per meter-square, the camp has the highest population density among others in Rwanda (MINEMA, 2019b). The camp is overcrowded which obstructs household access to roads and fire exit routes (UNHCR, 2020). The secondary and tertiary health facilities require upgrades in the structure, staffing, and logistics (UNHCR, 2020). In addition, the land that the camp is located is prone to landslides due to its topography but proper measures cannot be taken due to limited funding (UNHCR, 2020).

4.2 External variables

The utilization of the IAD framework starts with a description of external variables affecting the action situation that is the decision-making process for improving energy access within the camp. External variables such as biophysical conditions, attributes of community, constitutional and collective-choice rules-in-use, and operational rules-in-use comprise of social, cultural, institutional, and physical environment that set the context for the action situation (McGinnis, 2011).

4.2.1 Biophysical conditions

There have been several studies on whether energy can be treated as a common-pool resource (Gollwitzer, 2014; Gollwitzer et al., 2015,0; Maier, 2007; Melville et al., 2017; Wolsink, 2012,0). Based on the recent focus on renewable energy projects and especially solar mini-grids in displacement settings, two arguments should be made for electricity produced via such systems:

Figure 2: The Kigeme refugee camp (UNDP, 2012).

that exclusion is hard and there is rivalry in consumption. The Kigeme refugee camp has limited connection to the main electricity grid and households have no connection at all. Therefore, household cooking and lighting products and services are provided in two ways: donations and sales. Donated cooking fuels like firewood and charcoal and lighting products like solar lanterns are classified as public goods. This is because humanitarian organizations operate by the principle of "Leaving no one behind", thus it is difficult to exclude potential beneficiaries and the subtractability of use is low. Products like solar lanterns and solar home systems are classified as private goods since only camp residents who can afford these services would use them. Lastly, the solar and diesel micro-grids for the community facilities are classified as common-pool resources. The reason behind is that it is not possible to exclude refugees from using the system since everyone is free to use electricity without paying for the system. In contrast, the consumption of one user might reduce the electricity available to others in case of blackouts where the total demand exceeds available supply.

4.2.2 Attributes of the community

There are several actors involved in the decision-making processes on energy provision in the Kigeme refugee camps such as camp residents; MINEMA; UNHCR Rwanda; Refugee Executive Committee (REC); Practical Action and other implementing partners; funding partners like WFP and IKEA Foundation; and private sector actors like Inyenyeri, Bboxx, Ignite, MeshPower and Zola. These actors, their positions, and actions are described in detail within the action situation. Since the camp community is the focus of the analysis, this section describes the quantitative and qualitative features of the Kigeme camp community that impact decision-making regarding energy access. Since field observation was not feasible for the duration of the research, the variables such as demographics, trust, reciprocity, common understanding, social capital, and cultural repertoire are assessed through reports on the energy projects within the

camp and semi-structured interviews conducted with experts. The Kigeme refugee camp has a population of 21,216 which is approximately 14% of the total number of refugees in Rwanda as of 31 May 2020 (UNHCR, 2020b). There are 4,004 households registered and 8 quarters in the camp (Sandwell et al., 2020). Each household has five to seven people on average, including two to three children (Sandwell et al., 2020). Similar to the country-wide statistics, gender is almost equally distributed with 52% females and 48% males (Sandwell et al., 2020). The Congolese refugees constitute the majority of the camp population. Thus, ethnically, the community is rather homogeneous (P. Sandwell, personal communication, September 16, 2020).

Since the camp has been in place for the past eight years and the current situation does not allow people to go back to DRC, the camp population is relatively stable with established social structures (Sandwell et al., 2020). The people in camps generally speak the official language of Rwanda, Kinyarwanda on top of Congolese languages and French (Sandwell et al., 2020). Sharing a common language makes communication and coordination among the camp residents easier, which is often not the case in other camp settings. The camp residents receive unconditional cash transfers from the World Food Programme (WFP) which can be used for food and other basic items (Sandwell et al., 2020). Since refugees have the right to leave the camp and work, most of them are involved in income-generating activities. In Kigeme, 17% of the heads of households have a wage-earning occupation such as phone charging or haircut shops, 49% are unemployed or looking for a job, and the remaining 34% engage in non-wage-earning occupations as homemaker, volunteer, student, retired, or disabled (Sandwell et al., 2020). Some camp residents have the skills to repair broken electronics at a reasonable price for other residents (Sandwell et al., 2020). Through capacity building activities the knowledge and awareness of camp residents on solar energy products increased (Anonymous 3, personal communication, September 25, 2020).

4.2.3 Constitutional and collective-choice rules-in-use

There are three main regulatory frameworks that give rise to humanitarian energy policies: Sustainable Development Goals (SDGs), the New York Declaration for Refugees and Migrants, and Comprehensive Refugee Response Framework (CRRF).

4.2.3.1 Sustainable Development Goals

The international development that indirectly put energy in humanitarian organizations' agenda is the adoption of 17 SDGs in 2015. SDG 7, as mentioned in Section 1.6.1, aims to provide energy access across the globe in an affordable, reliable, and sustainable way (UN, 2015). Huber and Mach (2019) highlight the link between this goal with SDGs 10.7 on migration, 8.8 on labor rights for migrants, 10.c on transaction costs for migrant remittances, 16.2 on violence against children, and 17.3 on mobilizing financial resources for developing countries. The SDGs created a connection between humanitarian and development organizations through energy access. In parallel with the efforts to improve policies for sustainable development, the New Way of Working (NWOW) is launched at the World Humanitarian Summit in 2016 (Huber and Mach, 2019). NWOW promotes collaboration between actors, long-term planning, local focus, and innovative

financing mechanism (Huber and Mach, 2019). These are exactly what is lagging in the current humanitarian energy policy sphere and can result in tremendous improvements.

4.2.3.2 New York Declaration for Refugees and Migrants

Following the adoption of SDGs and NWOW, the New York Declaration for Refugees and Migrants was endorsed by the United Nations General Assembly (UNGA) on 19 September 2016 (UN, 2018). The declaration points out the importance of supporting refugee-hosting countries, promoting inclusive policies for refugees, and bringing national and local authorities, financial institutions, donor agencies, and private sectors together (UN, 2018). The declaration appointed UNHCR for the development of the CRRF which has four goals: supporting host countries, improving resilience of refugees, easing the process of third-country settlements, and working on improving the conditions in countries of origin to prevent displacement in the first place (UN, 2018). In addition, the Global Compact on Refugees (GCR) was established by UNGA as a framework aiming to create equitable sharing of responsibilities through international cooperation on 17 December 2018 (UN, 2018). Later, CRRF and GCR are brought together and share the abovementioned objectives. GCR explicitly identifies the need to tackle issues such as accommodation, energy, and natural resources as a joint issue for refugee and host communities (UN, 2018). GCR links humanitarian and development organizations and promotes the use of renewable energy technologies and partnerships with private sector.

4.2.3.3 Comprehensive Refugee Response Framework

Rwanda is known to promote policies for the well-being of the refugees (Crawford et al., 2019; Bilgili and Craig, 2018; UNHCR, 2020a). The country signed 1951 Refugee Convention, the 1967 Protocol, and the 1969 Organization of African Unity Refugee Convention (MINEMA, 2019b). The rights of refugees are defined in Law N13/2014 of 21/05/2014 called "Law relating to refugees" (MINEMA, 2019b). This law provides refugees with the right to be protected from discrimination; to own immovable, movable, and intellectual property; to work; to access to justice; and residence (MINEMA, 2019b). The country accepted the CRRF in 2018 and following the CRRF, the Rwandan refugees have the right to work to build self-reliance, use banking services, be covered by the national health system, posses ID cards and travel documents, and get national education (for children) (Crawford et al., 2019). MINEMA, representing the road map defined by the government, created a Strategic Plan for Refugee Inclusion to address these goals (MINEMA, 2019b). The local governments and UN bodies, together with civil society organizations and private sector actors strive to provide sustainable solutions for the displaced populations (Baranda Alonso and Sandwell, 2020).

Energy provision for refugees has been neglected at national level in Rwanda until recently. Following the Global Refugee Forum in December 2019, MINEMA announced pledges concerning five issues: education; jobs and livelihood; energy, infrastructure, and environment; protection and solutions; and health (MINEMA, 2019a). With the pledge on energy, infrastructure, and environment, the Government of Rwanda aims to protect and rehabilitate the environment in and around the refugee camps, establish resilient settlements that use land consciously and minimizes adversities on environment, and promote renewable energy solutions in refugee and host

community households to decrease the use of firewood. These commitments show that the government's priority is protecting the land from soil erosion and degradation, putting an end to deforestation, repairing the damage on ravines, managing water more sustainably. The pledge is in line with the Energy Sector Strategic Plan (ESSP) 2018/19 - 2023/24 published by the Ministry of Infrastructure (MININFRA) (MININFRA, 2018). ESSP highlights the importance of harnessing renewable energy sources for sustainable development (MININFRA, 2018). MINEMA expects to work with other stakeholders to switch to alternative fuels, promote environmental awareness among refugee and host communities, and help initiative renewable energy projects in camps.

4.2.4 Operational rules-in-use

Following rules-in-use in constitutional and collective-choice level, operational rules-in-use describe daily activities concerning provision, production, distribution, assignment, and consumption. There are seven different categories of rules: boundary, position, choice, information, scope, aggregation, and payoff. The desk research and semi-structured interviews revealed that not all rules-in-use in the camp are written down as some of the definition of rules and responsibilities "develop organically within the camp" (Anonymous 3, personal communication, September 25, 2020). This situation made it challenging to identify some of the rules-in-use that affect action situation.

4.2.4.1 Boundary rules

Boundary rules define conditions for joining the decision-making processes for energy governance within the camp (Ostrom, 2010). MINEMA is the official manager of the camp with government officials appointed as camp managers (MINEMA, 2020). UNHCR is in close coordination with MINEMA for managing the camp because of its mandate to protect refugees (UNHCR, 2020c). Thus, MINEMA and UNHCR decide which actors can join the energy provision activities (Anonymous 3, personal communication, September 25, 2020). There are several implementing organizations responsible for water, sanitation, and hygiene, education, and infrastructure that are managed by UNHCR. In contrast, Practical Action is not under the mandate of UNHCR but designated as energy implementing organization (UNHCR, 2020). The funding partner IKEA Foundation has a contract with both Practical Action and UNHCR to support provision of energy services and shelter (Sandwell et al., 2020; UNHCR, 2020). Refugee Executive Committee is selected according to the guidelines by UNHCR and camp management (UNHCR, 2003). The guidelines specify that the elected candidates have to leave their positions after their serving time is up (UNHCR, 2003).

4.2.4.2 Position rules

Position rules determine how a set of positions are assigned to the actors (Ostrom, 2010). MINEMA and UNHCR act as co-managers of the energy provision activities based on their mandate to protect refugees (MINEMA, 2020; UNHCR, 2020c). Through their evaluation processes and contracts with funding partners and private sector actors, they determine the positions that these actors can take (Anonymous 3, personal communication, September 25, 2020). Implementing organizations' and Practical Action's roles within the decision-making processes for

energy provision are determined by bilateral contracts with UNHCR signed in 2019 (UNHCR, 2020). In addition, UNHCR and MINEMA decide on the electoral list for Refugee Executive Committee (UNHCR, 2003).

4.2.4.3 Choice rules

Choice rules specify which actions are available to an actor in a particular position (Ostrom, 2010). Similar to boundary and position rules, the actions that actors involved in the energy provision decision-making are determined by the managing partners MINEMA and UNHCR. The Refugee Response Plan states that all "camp-based refugee households will have access to sustainable energy in 2020 and 2021" (UNHCR, 2020). Thus, the actions of the actors are guided by this strategy. The managing partners decide whether a private organization like MeshPower can implement a micro-grid project or how Inyenyeri and Bboxx can sell their clean cooking solutions and solar home systems (Anonymous 3, personal communication, September 25, 2020). Refugees can choose whether or not to buy an energy solution legally but their decision is often guided by their economic status (Sandwell et al., 2020). However, there is also a lack of defined rules on which organization is trying to build a mini-grid in the camp (Anonymous 3, personal communication, September 25, 2020).

4.2.4.4 Information rules

Information rules dictate how and which information can be shared among actors (Ostrom, 2010). There is not an official structure for sharing information and the basis for sharing information is organically developed (Anonymous 3, personal communication, September 25, 2020). Regular meetings between MINEMA, UNHCR, REC, Practical Action and other implementing organizations ensure that available knowledge was shared (Anonymous 3, personal communication, September 25, 2020). These meetings are held every second month to update all stakeholders and work together to find solutions for problems (UNHCR, 2020).

4.2.4.5 Aggregation rules

Aggregation rules shape the level of control each actor has over its actions (Ostrom, 2010). MINEMA has the highest control of their actions as the main manager. UNHCR has to obey the rules set by the government and practices enforced by the ministry (sarah]Anonymous 2, personal communication, September 23, 2020). Practical Action, even though it is not mandated by UNHCR, has to obey the rules set by the camp management. Other implementing organizations and private sector companies operate in coordination with UNHCR as defined in their contract (UNHCR, 2020). Refugees can elect who can represent them but the fact that election candidates are selected by camp management shows that they have limited control over representation (UNHCR, 2003).

4.2.4.6 Payoff rules

Payoff rules determine the distribution of costs and benefits among actors based on their assigned positions (Ostrom, 2010). The pricing mechanisms for energy services are decided (Anonymous 3, personal communication, September 25, 2020). UNHCR spend its budget on making sure that

refugees have access to shelter, water, food, and cooking fuel. WFP's mandate to provide food for refugees give them an option to distribute food or cash. WFP started cash-based assistance program in the Kigeme refugee camp which provides %80 of refugee income (UNHCR, 2020). IKEA Foundation provides monetary assistance to UNHCR and Practical Action so that these organizations would provide sustainable and renewable energy solutions to people in displacement settings (sarah]Anonymous 2, personal communication, September 23, 2020). The contract between Practical Action and IKEA Foundation is valid until February 2022 (sarah]Anonymous 2, personal communication, September 23, 2020). The private sector companies like Inyenyeri and Bboxx have a regular purchasing contract with refugees who wants to buy their products (sarah]Anonymous 2, personal communication, September 23, 2020). Only MeshPower is not getting paid for the implementation or operation cost of the micro-grid (sarah]Anonymous 2, personal communication, September 23, 2020).

4.3 Action situation

The core of the IAD framework is action situation which refers to "the social space where participants with diverse preferences interact, exchange goods and services, solve problems, dominate one another, or fight" (Ostrom, 2005, p. 14). The individuals observe the information provided to them, interact with each other, and observe the outcomes of those interactions in the action situation (McGinnis, 2011). The action situation is the decision-making process for improving energy access within the Kigeme refugee camp. The working elements of action situation, together with external operational rules-in-use that affect them, are described in the following sections.

4.3.1 Actors

There are several different actors operating in the Kigeme refugee camp to ensure that the refugee population is protected. How these actors enter and leave their positions is determined by the boundary rules.

4.3.1.1 MINEMA

Ministry in Charge of Emergency Management (MINEMA), formerly Ministry of Disaster Management and Refugee Affairs (MIDIMAR), is the representative of the Government of Rwanda in executing the humanitarian response to refugee situation. MINEMA has four units: Single Project Implementation Unit (SPIU), Prevention & Mitigation Unit, Response & Recovery Unit, and Finance & Administration Unit. MINEMA has two core working areas: disaster management and refugees management. Disaster management revolves around prevention, preparedness, response, and mitigation activities for disasters like volcanic activity, floods, earthquakes, deforestation, and drought (MINEMA, 2020). Refugees management is concerned with establishing proactive governance mechanisms for dealing with refugees according to the national law and international treaties (MINEMA, 2020). This division is clear from the vision, mission, and core activities of the ministry as well. MINEMA strives for building a nation resilient to disasters and ensuring effective management of refugee-related issues (MINEMA, 2020).

4.3.1.2 UNHCR Rwanda

UNHCR is the body acting under the authority of the General Assembly providing international protection for refugees through long-term solutions (UNHCR, 2020c). UNHCR Rwanda is responsible for the registration and protection of refugees, multi-sectoral assistance such as shelter, water, health, and education, and offering sustainable solutions for refugees (Sandwell et al., 2020). The agency tackles the Congolese and Burundian refugee situations, transfer of refugees and asylum seekers from Libya to Rwanda under Emergency Transit Mechanism, assist voluntary repatriation to DRC and manage Rwandan returnees (UNHCR, 2020).

4.3.1.3 Refugee Executive Committee

REC represents the interests of camp communities in decisions concerning the refugee population and works in coordination with UNHCR and MINEMA (Sandwell et al., 2020). The committee members are elected by and among the camp residents and take action as an administrative decision-making body on community-level (Sandwell et al., 2020). The committee consists of a president or chief, a vice president or vice chief, secretary, and other members in charge of specific issues such as gender, youth, and security (Sandwell et al., 2020). There are other committees operating at the village and *quartier* level. Villages consist of tens or hundreds of households whereas *quartiers* are groups of several villages (Sandwell et al., 2020). These committees work on distribution of cooking fuels, assist vulnerable households in reaching products, and guiding community in energy use (Sandwell et al., 2020).

4.3.1.4 Practical Action

Practical Action is an international development organization focusing on improving access to sustainable energy for the refugees. The organization works for the provision of financing, training, and technical expertise in order to supply the electricity needs of households, community facilities like health centers and schools, and businesses in the camp (Practical Action, 2020).

4.3.1.5 Funding partners

Other than donor agencies that support UNHCR and government budgets set for MINEMA, WFP and IKEA Foundation are two actors working with UNHCR to fund the activities related to energy provision in the camp. WFP is responsible for supplying monthly food assistance to the camp residents and host communities living around the camp and providing additional supplements to vulnerable groups (World Food Program, 2020). Vulnerable people are young children, pregnant and nursing women, and people living with tuberculosis or HIV/AIDS. IKEA Foundation, through its partnership with UNHCR and Practical Action, supports assistance operations and energy projects in the camp.

4.3.1.6 Private sector actors

There are several private companies providing products for household cooking and electricity demand. Household cooking products are clean cookstoves to replace traditional cookstoves

that use wood or biomass. Inyenyeri, before suspending their operations in April 2020, offered free lease on clean cookstoves as long as the customers agree to purchase wood pellet fuel that is compatible with the cookstove (IRENA, 2019). For household electricity, technologies such as solar lanterns and solar home systems. Three companies are selected for providing solar home systems: Bboxx, Ignite, MeshPower, and Zola (Sandwell et al., 2020). These companies provide pay-as-you-go (PAYG) and leasing options for consumers (Rosenberg-Jansen, 2018).

4.3.1.7 Positions

In different projects, actors can assume different roles based on how the roles and responsibilities are shared and which business model is selected, determined by position rules. The main actors are MINEMA, UNHCR Rwanda, Refugee Executive Committee, Practical Action, WFP, IKEA Foundation, and private sector companies such as Inyenyeri, Bboxx, Ignite, MeshPower, and Zola. There are other partner organizations that are not included in the analysis of energy provision activities that provide specific assistance within the camps: Alight, formerly American Refugee Committee, for shelter and infrastructure, Africa Humanitarian Action for health, and World Vision for water (UNHCR, 2020). The camp is managed by two actors: UNHCR and MINEMA. MINEMA is the governmental body responsible for the management of the camp. UNHCR is the UN agency responsible for managing and coordinating the humanitarian response activities. Refugee Executive Committee serves as an advisory board in coordinating the needs of the refugee populations with managers. Practical Action is project developer as they initiate research and projects on energy access. IKEA Foundation and WFP are donors as they finance renewable energy projects and cash for energy projects, respectively. Private sector actors like Bboxx and Mobisol are implementers. Camp residents and volunteers from UNHCR and other organizations are the consumers.

4.3.2 Actions

The actions are a set of options for actors to decide, collaborate, and organize in their positions, specified by choice rules. The actions of the actors involved in energy provision in the Kigeme refugee camp are shaped by international policies and national laws and regulations. Based on the law pertaining to refugees, MINEMA has four action points: establishing national policies to improve the efficiency and effectiveness of disaster awareness, preparedness, and management activities and refugee affairs; facilitating coordination between technical ministries and other institutions for disaster awareness, preparedness, and refugee-related issues; monitoring and evaluating all operations; developing institutional and training capacities for disaster management; and mobilizing funds for resources used for disaster management (MINEMA, 2020). UNHCR Rwanda works within the Refugee Coordination Model (RCM) which is a general framework for operating in refugee situations. RCM normally divides humanitarian assistance activities into seven sectors but the recent Refugee Response Plan by UNHCR included energy and environment. The eight sectors that UNHCR works on are protection; education; food security; health and nutrition; energy and environment; shelter and non-food items (NFIs); water, sanitation and hygiene (WASH); and livelihoods and resilience (UNHCR, 2020). UNHCR and MINEMA provide support in operations, capacity development, and technical advice (UNHCR, 2020). MINEMA and UNHCR published a joint strategy aiming for the inclusion of refugees in

economic activities by 2020 (UNHCR, 2020). The strategy aims to increase the self-reliance of refugees by creating livelihood opportunities for them.

The HEED project aims to provide innovative solutions for meeting the energy needs of people in three refugee camps Nyabiheke, Gihembe, and Kigeme in Rwanda and internally displaced people in Nepal following the 2015 earthquake. The project brings together researchers at Coventry University and renewable energy experts at Practical Action and SCENE and is funded by the EPSRC Global Challenges Research Fund (Grant NEP/P029531/1) (HEED, 2020). An off-grid PV system is installed by MeshPower to supply electricity to two nurseries and a playground (HEED, 2020). The system is connected to lighting and sockets for entertainment, phone charging, and educational devices. The micro-grid is composed of solar panels of 2.55 kW power and 21.1 kWh GEL battery storage as shown in Figure 3. A distribution and metering system with GSM connection was included in order to measure the electricity production and consumption. The purposes of installing a monitoring system were to collect evidence on the benefits of using community micro-grids in camps, to evaluate optimal design features that gave negotiation options over energy use by camp residents, and understand how community priorities grow with energy provision (Nixon and Gaura, 2019).

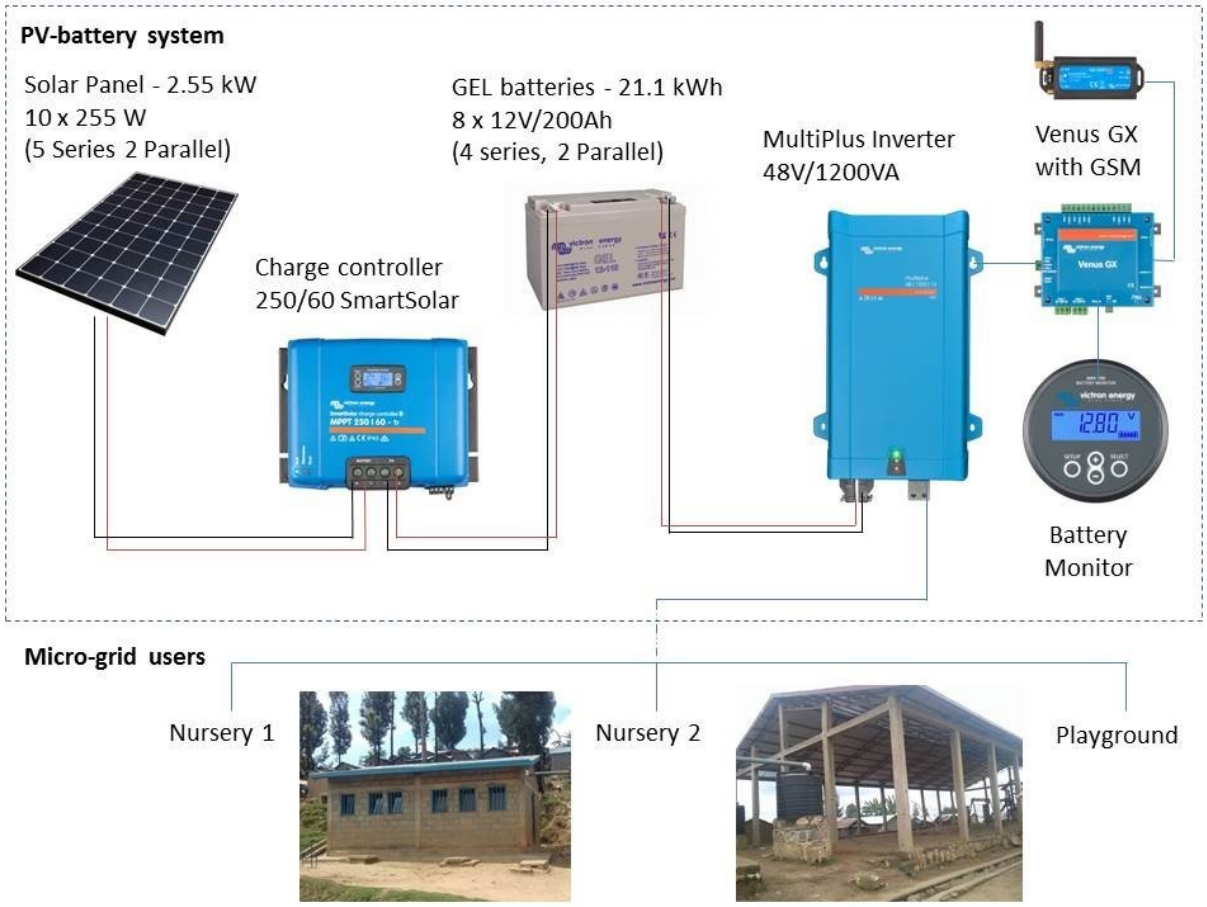

Figure 3: The micro-grid system components in the Kigeme refugee camp (HEED, 2020).

Practical Action, together with UNHCR, initiated the Renewable Energy for Refugees project to improve access to renewable energy in Rwandan refugee camps so that camp residents can be more resilient and less reliant on aid provided by humanitarian organizations (Practical Action, 2020). The Renewable Energy for Refugees (RE4R) project is a supported by the IKEA Foundation, and in partnership with Chatham House, Energy4Impact, and the Norwegian Refugee Council (Sandwell et al., 2020). The RE4R project is different from previous initiatives that aim to improve energy access for displaced communities in many ways: (i) use of renewable energy sources, (ii) empowerment of refugees so that they would be able to support themselves economically, and (iii) inclusion of refugees and host communities in projects. The project focuses on providing renewable energy for refugees and host communities in Kigeme, Nyabiheke, and Gihembe refugee camps in Rwanda and urban refugees in Irbid in Jordan (Sandwell et al., 2020). As displacement settings are often located in rural or isolated areas in Rwanda, projects by RE4R focus on off-grid renewable technologies (Sandwell et al., 2020). IKEA Foundation sponsors UNHCR Rwanda and RE4R project for food, water and sanitation, shelter, and energy needs in the camp. WFP, in a joint strategy with UNHCR, initiated a cash-based assistance program for the Kigeme refugee camp. Camp residents receive a base monthly allowance of RWF 7,600 (USD 8.84) and can earn up to RWF 24,000 (USD 27.91) through cash-for-work programs within the camp (Sandwell et al., 2020). This allowance is used by camp residents to purchase solar lanterns and solar home systems supplied by private companies operating in the camp.

4.3.3 Information

Information is the knowledge that is available to the actors in positions on policies, technology, and cost and benefits pertaining to energy access in the camp, dictated by information rules. Information on energy provision in camps is severely lacking but this has been gaining attention and with projects like HEED and RE4R, a database on electricity consumption of households, community facilities, and businesses was created. As partners in managing the camp, UNHCR and MINEMA share information on daily operations and strategic capacity building (Anonymous 3, personal communication, September 25, 2020). Traditionally, these organizations use top-down communication methods. However, with projects like HEED and RE4R in the camp, information sharing between camp residents and camp management has increased. Within the HEED project, several community engagement workshops were arranged to understand community needs and willingness to pay for energy services (HEED, 2020). The decision to install a micro-grid to two nurseries and a playground was made in consultation with the refugee community (HEED, 2020). Throughout the project, the grid was communicated as a shared resource, and representatives from REC were trained about the micro-grid and control systems (HEED, 2020). The database created by the HEED project is available on their website upon request for access and can be used by researchers and other humanitarian organizations to inform their decision making. The website provides hourly consumption and production data collected through the GSM connection in the solar micro-grid system. In addition, the participants in the HEED surveys were asked for consent after being informed about the purpose of the study (HEED, 2020). The survey numerators selected from UNHCR workers and camp residents were trained on how to collect data while respecting the privacy of camp residents (Sandwell et al., 2020). It is seen that the actors in the system create and share information collectively in order to achieve

the goal of providing refugee communities with clean and sustainable energy.

4.3.4 Control

Control is the control over actions meaning how actors can take actions: whether it is an individual initiative, collective action, or co-creation, influenced by aggregation rules. UNHCR has to obey laws and regulations of the country of operation while protecting people. For energy provision in the camp, UNHCR makes decisions in coordination with camp manager officers from MINEMA. The national law banning use of firewood in 2019 challenged UNHCR to shift towards clean cooking solutions (UNHCR, 2020). Within a year, 48.5% of the population started using liquid petroleum gas (LPG) whereas others received cash-based assistance so that they purchased biomass (in pellets or briquettes) which were made from sawdust (UNHCR, 2020). There were two main problems with this change. The first was the limited number of clean cooking solutions providers and resistance from camp community to switch to a new cooking fuel (UNHCR, 2020). Second, UNHCR had to quickly adapt to this policy change and find ad-hoc solutions (P. Sandwell, personal communication, September 16, 2020). Since the national policy bans the use of firewood, the goal for 2020-2021 is to ensure rolling out of alternative cooking solutions in all camps (UNHCR, 2020). Private sector actors have to obey the national and regional law as well, in addition to prioritizing the safety of people in camps before profits. Funding partners like IKEA Foundation and WFP can choose how much money they will grant to UNHCR and camp residents, respectively. REC, as representing body of refugees, have information and say in the decisions regarding energy provision. The committees can guide UNHCR on identification of vulnerable people within the camp so that their energy needs are prioritized. Practical Action recommends action points and solutions based on the research conducted in the camp. It is observed that the actors with most control over their actions are MINEMA and UNHCR, which is expected considering their managing position.

4.3.5 Net costs and benefits

Net costs an benefits and how these costs and benefits are shared within the actor group are determined by payoff rules. These costs and benefits are system component costs, installation costs, operation and maintenance costs, payback time. WFP and IKEA Foundation, and other donor agencies indirectly and directly bear the costs. For example, UNHCR received a 30.8 million grant from IKEA Foundation, the agency's largest private sector partner to improve lighting (Rosenberg-Jansen, 2018). Refugees pay for services through the cash allowance provided by WFP and UNHCR Rwanda. Practical Action and private companies assess energy needs and initiate projects through the IKEA Foundation's support. Which actors benefit from the improvement of energy services in the Kigeme refugee camp depends on which energy locales are considered in the provision activities. The already limited budgets for humanitarian response activities could be transferred from energy to other sectors with the deployment of diesel generators. MINEMA and UNHCR would reach their goals of promoting economic inclusion and self-reliance of refugees. Households would directly benefit if their cooking, lighting, and phone charging needs are met. The indirect benefit would be through powering community facilities like health centers and schools which UNHCR operates. The business enterprises would benefit from energy access during the day, in accordance with their operating hours.

4.4 Interactions

The analysis of the action situation highlights the patterns of interactions shaped by the structures within the action situation and actions taken by actors in the policy sphere. The interactions between the actors involved in the decision-making processes for energy provision in the Kigeme refugee camp are illustrated in Figure 4.

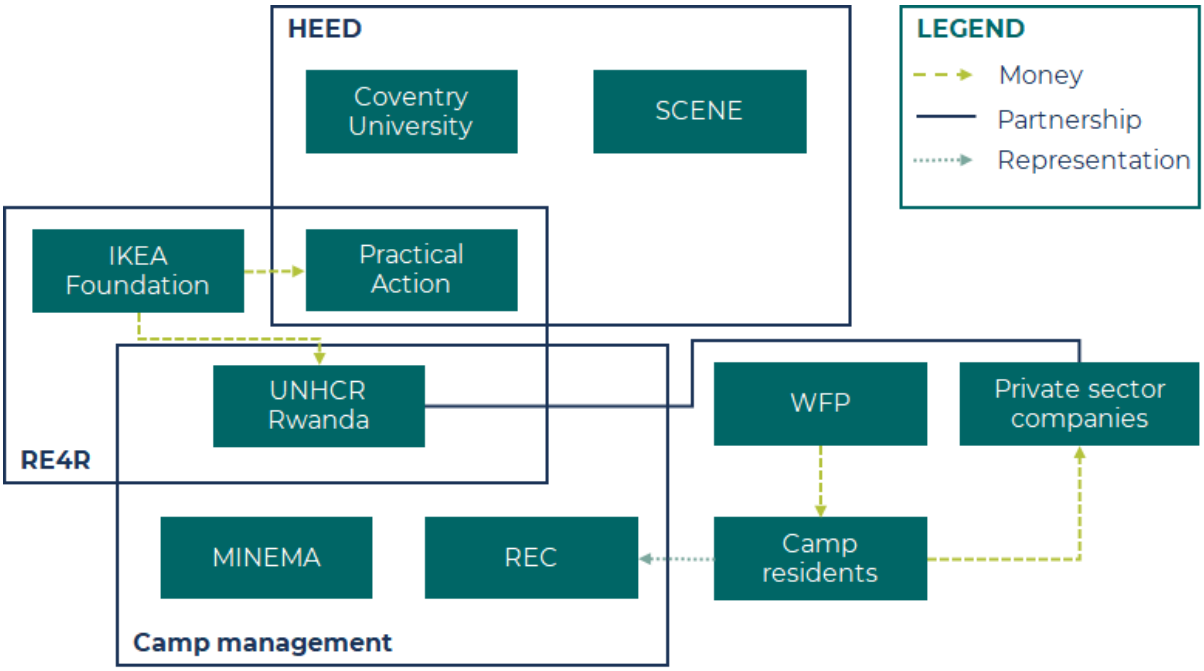

Figure 4: The interactions between the actors involved in energy provision activities in the Kigeme refugee camp.

As the figure shows, UNHCR is the most connected actor to others and it is observed that UNHCR is dominating the action situation. The agency decides how a project is implemented and defines structures for governance. This situation might negatively impact energy initiatives as "there is a severe lack of expertise within the energy officers in UNHCR Rwanda" (Anonymous 2, personal communication, September 23, 2020). One of the interviewees mentioned that the problem was not the lack of funding but rather the lack of a clear plan on how to spend the money (Anonymous 2, personal communication, September 23, 2020). "UNHCR didn't have a plan on how to spend the money. They didn't have people with engineering and technical background at the time and instead of hiring experts with long-term contracts, they hired people with 2-6 months contracts, which is a very short period of time for any energy project" (Anonymous 2, personal communication, September 23, 2020). In addition, "the funding from IKEA Foundation could be used to connect all households to the main grid and the refugees could pay the electricity bill. They are already paying disproportionate amount of money for candles and kerosene in comparison to the service they get in turn. But it was a political no-go because this could have mean that camp community had a better quality of life than Rwandan citizens even though that's certainly can't be the case" (Anonymous 2, personal communication, September 23, 2020). This situation challenged the regular pattern of funding for refugee protection activities. Donor countries and organizations like IKEA Foundation started directly investing in

organizations with technical expertise in electrification such as Practical Action (Anonymous 2, personal communication, September 23, 2020).

Another pattern of interaction observed is the lack of defined ownership for the energy systems operated in the camp. For example the diesel generator used as back-up to power UNHCR offices is owned by UNHCR and procured by their procurement office (Anonymous 3, personal communication, September 25, 2020). However, the informal obligation to operate and maintain the system is given to Alight without any official contract (Anonymous 3, personal communication, September 25, 2020). In addition, there is no clear way that maps out how a refugee can connect to the system if they want to (Anonymous 3, personal communication, September 25, 2020). In terms of ownership, it is observed that there is a conflict between rules-in-use. Refugees can own and operate immovable assets as defined in the CRRF and Strategic Plan for Refugee Inclusion (MINEMA, 2019b). However, whether or not they can own an asset like a micro- or mini-grid is determined by UNHCR as gatekeeper organization (Anonymous 2, personal communication, September 23, 2020). Here, there were two different reasons why the ownership of the micro-grid is not handed over to refugees yet. One of the experts mentioned that even though the community was keen on the implementation of the idea it got pushed back from UNHCR. UNHCR preferred a community cooperative to own the system but the community refused this idea because they argued that the "people who own the system would have too much physical and political power" (Anonymous 2, personal communication, September 23, 2020). In addition, UNHCR argued that the whole camp cannot be owners of the system that's why the ownership of the system stayed with the MeshPower (Anonymous 2, personal communication, September 23, 2020). However, there were meetings to decide on how to hand the system over was halted because the camp has been in lockdown for the last three months due to COVID-19 (Anonymous 3, personal communication, September 25, 2020).

4.5 Outcomes

The outcomes of the decision-making process regarding energy provision in the Kigeme refugee camp are evaluated using eight criteria: efficiency, equity, legitimacy, participation, accountability, fiscal equivalence, consistency with moral values, and resilience and sustainability based on empirical data from the case study.

4.5.1 Efficiency and equity

Efficiency of the outcomes of energy provision activities is measured by their cost-effectiveness. It has been shown that providing diesel generators by shipping or air travel in a country with high solar irradiation increases the costs without providing reliable and sustainable electricity. Even though the up-front costs of large-scale renewable energy solutions are too high for underfunded UNHCR, private sector engagement shows to be promising. The equity of energy access is an important topic to discuss since not all households can bear the costs of electricity services, especially if they do not have employment or allowance from their relatives abroad (Sandwell et al., 2020). However, the limited access to solar home system suppliers and their high costs make them not easily accessible and affordable for most households (Sandwell et al., 2020). The data shows that almost 75% of the target is reached for rolling-out the solar home systems

(NORCAP and BCG, 2020). Innovative funding is needed otherwise mini-grids pose high risk for both humanitarian organizations and private sector in the short term (P. Sandwell, personal communication, September 16, 2020).

4.5.2 Legitimacy and participation

Legitimacy and participation are measures of the extent to which actors think of the decision-making processes in terms of co-creation. However, the inclusion of communities in decision-making and planning activities ensures that their energy needs are understood by the humanitarian organizations (Rosenberg-Jansen, 2018). It is argued that refugees have the most accurate knowledge about themselves so engaging communities and private sector who might meet their needs is required to deliver the best solution. The Kigeme refugee camp, through the HEED and RE4R projects, sets an example for collecting data on energy provision in refugee camps. The camp residents were involved in the projects from start to finish as they collected the data and participated in decisions regarding the choice of facilities to connect to the micro-grid. The common values and homogeneity in the camp population positively impacted the co-design sessions and workshops. The fact that the information is readily shared with interested parties is a positive action since more knowledge sharing is needed within the humanitarian energy sector (P. Sandwell, personal communication, September 16, 2020).

4.5.3 Accountability and fiscal equivalence

Accountability is a measure of the cost of sharing information with the users of the resource, the level of actors' capability to evaluate each other's actions, and the extent of how actors access monitoring and sanctioning systems. In the Kigeme refugee camp, the data on electricity consumption patterns is collected by using monitoring systems and training refugees in using these monitoring systems. The monitoring sensors increase the cost of the overall system yet they are crucial in observing how the consumption changes over time. This way, the community can negotiate and share the electricity provided via solar PV system as a common-pool resource (Nixon and Gaura, 2019). Fiscal equivalence is a measure of the contribution of beneficiaries on the production of the good or service in comparison to the benefits they receive. For market-based solutions, the camp residents pay the full cost of the production of electricity services. However, the service quality they get in return can be labeled as barely sufficient, or insufficient when the limited utilization options of these services are considered. In the case of solar micro-grids, the residents do not pay for the system but monitor and adapt their consumption based on the data ([Anonymous 3, personal communication, September 25, 2020).

4.5.4 Consistency with moral values, resilience and sustainability

Consistency with moral values is a measure of how the decision process is in line with the participating organizations' core values. The current levels of energy provision in the camp fall short in respecting these values of protection, resilience, and self-reliance. As the coordination between MINEMA, UNHCR, funding partners, and private companies increases, it is expected that the goals such as self-reliance and security will be reached (Sandwell et al., 2020). Energy is an enabler for education, income-generating activities, and safety for women and children.

The sustainability of any energy project depends on how much the camp residents are involved in the decision-making processes.

5 Discussion

5.1 Reflection on research

This research contributes to academic research by applying the IAD framework for analyzing energy governance in a refugee camp. First, this research investigates how the IAD framework can be applied to a complex socio-technical system. Traditionally, the IAD framework is applied to socio-ecological systems in which natural resources such as irrigation systems, forests and fishery areas are governed by a small group of community with shared values. The conceptualization of electricity provided by mini-grids as common-pool resources by Acosta et al. (2018); Agrawal (2001); Frame et al. (2011); Gollwitzer et al. (2015,0); Lestari et al. (2018); Wolsink (2012,0) opened up the commons literature to energy infrastructures that were treated as socio-technical systems (Scholten and Künneke, 2016). This study builds on the previous works by applying the IAD framework to a mini-grid in a displacement setting, which has quite different characteristics than a community energy systems implemented in high- and low-income countries. The case study of the Kigeme refugee camp showed that authorities from global to local level, stakeholders with public, private, voluntary, and community-based organizational structures, different functions such as the production, provision, coordination, funding, and monitoring of the energy systems are intertwined. The institutional analysis for a socio-technical system in a refugee camp setting helped to dismantle overlapping roles and responsibilities and identify options to provide energy access for refugees.

The literature suggests integrating multiple levels of analysis into the framework to get a better understanding of how constitutional, collective-choice, and operational rules affect action situation, the multiple levels of analysis is integrated into the IAD framework (Ostrom, 2005). This integration could be done by analyzing one action situation with three different levels of rules (Polski and Ostrom, 1999). The fact that there is not an actor responsible for energy governance in the national level blurs the lines between constitutional and collective-choice rules-in-use. Therefore, these two levels are merged as one in which international agreements signed by states specify who participates in decision-making processes and policies are created to ensure displaced populations have access to energy. An additional modification was made in the operationalization of the framework. The potential outcomes was regarded as a repetition of the outcomes and therefore discarded from the analysis, so as scope rules that define them. The research is built on the works of Lestari et al. (2018), Agrawal (2001), and Gollwitzer et al. (2018). Lestari et al. (2018) combine the IAD framework with sustainability indicators for off-grid energy technologies. Agrawal (2001) evaluates the works of Wade (1989), Ostrom (1990), and Baland and Platteau (1996) to come up with a list of enabling conditions that would ensure sustainability of common-pool resources. By building on this work, Gollwitzer et al. (2018) argues which of these conditions are applicable to mini-grids in rural areas. This research contributes to the use of IAD framework and common-pool resource literature by taking the efforts of Gollwitzer (2014) and Lestari et al. (2018) to a next step by examining the conditions from

the perspective of community-based approaches in refugee camps.

5.2 Recommendations for decision-makers

This section provides a list of recommendations for decision-makers based on theoretical and empirical findings of this research.

- Humanitarian system is hard to change because of long-established structures, limited funds, and challenging working conditions (Grafham, 2019). Yet, the newly developing humanitarian energy sector can see these challenges as propellers for improving the existing governance structures for providing energy in displacement settings.
- Pure solar mini-grids might not be feasible because of their high costs and initial sizing problems. Instead, a hybrid mini-grid with solar PV and diesel can be installed. In time, the solar PV system can be scaled up and diesel can be phased out.
- For the systems with installed solar energy solutions, diesel generators can still be used as back-up options especially for critical loads such as healthcare facilities and when there is not regular sunshine.
- Long-term planning and funding play an important role to realize change. These can be ensured by strengthened relationships with funding partners and private sector actors. To improve the sustainability of energy services, more coordination will be needed between refugees, local governments, humanitarian organizations, and private sector actors -which opens up the possibility for public-private partnerships.
- Inclusive and participatory data collection activities should be carried out so that the sizing of the system would fit the energy consumption patterns of refugee communities.
- Investing in capacity building is crucial because the lack of expertise within humanitarian organizations results in ineffective management of energy projects and limited funds.
- The national and local laws and regulations should be evaluated to realize change within a given regulatory framework. When possible, humanitarian and development organizations should operate in line with governments' rural electrification strategies. The solar mini-grids can be implemented in host communities near refugee camps which helps governments to achieve their electrification targets and contributes to the integration of refugees with local community. Eventually, the energy system should help to facilitate the sustainable development of displaced communities.

6 Conclusion

This research aimed to explore to what extent community-based approaches can be used for governing solar mini-grids in refugee camps by answering the question *To what extent can community-based governance approaches for solar mini-grids provide energy access in refugee camps?*. The research shows that there are several drivers as well as barriers to using community-based governance approaches for solar mini-grids in refugee camps. The lack of regulatory

framework on defining ownership of the system through different business models challenges successful implementation of community solar mini-grid projects. It is seen that giving the ownership of the system to refugee communities or a cooperative of camp residents is an ambitious goal due to political and institutional reasons. However, a sense of ownership can be created by using participatory activities during planning, design, implementation, and operation and maintenance of the system. Such an approach would both increase the resilience of refugees and improve the sustainability of system.

This thesis contributed to the newly accelerating body of humanitarian energy literature by utilizing an institutional analysis framework to analyze the complex network of actors involved in decision-making process for energy provision in the Kigeme refugee camp. In addition, an assessment framework is created that lists technological, institutional, economic, and social factors that need to be taken into account by decision-makers so that the community-based solar mini-grids would be successful. Future research can focus on multi-country analysis to better understand similarities and differences of energy provision in different camps. The IAD framework can be applied to other camps and the outcomes of the policy-making processes can be used to check whether the local context affect the outcomes and update the assessment framework accordingly. A field study can be conducted in camps to better understand the energy use of camp residents and evaluate the applicability of solar mini-grids with community participation. Finally, after analyzing the institutional arrangements and exploring to what extent community solar mini-grids are applicable in camp settings, next step is researching the design of such systems. The principles of community-based approaches for camp management can be consolidated with the framework for comprehensive energy infrastructure design.

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