Geospatial data can help investors prioritize energy access investments to build more resilient communities

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Energy access in the time of COVID-19

While COVID-19 has shown the extent to which the world's population is profoundly interwoven, it has also revealed how vulnerable we are to global changes as a society. In Sub-Saharan Africa (SSA), communities are facing this pandemic without access to electricity. On average, one in four healthcare facilities in the region does not have access to electricity[1], and only 28% of health facilities have reliable electricity[1,2]. Furthermore, the COVID-19 crisis has underscored inequalities in access to electrified health-care services, especially in remote areas. Access to reliable electricity serves as a driver of socio-economic development. For instance, a household with reliable electricity could have running water and lighting; communities could have a more secure food-supply chain (i.e., integrating irrigation and cold storage); and healthcare facilities could provide better services by acquiring and optimally utilizing electrical medical equipment and accessing basic facility requirements (i.e., ventilators, vaccine refrigerators, water, etc.).

Can decentralized renewable energy play a role?

Considering that the electricity access rate for rural populations in SSA is 25%[3], it has become even more crucial that communities in remote areas obtain access to reliable electricity. This ensures access to basic services for well-being and enables socio-economic development as described above. One viable option—complementary to the grid—is through decentralized renewable energy (DRE) solutions, including mini-grids and stand-alone systems. DREs can be customized to specific energy needs and are adaptable to unplanned settlements and infrastructure conditions in remote rural areas, where over 80% of the population without energy access is concentrated[3]. The task seems monumental considering the scale of the population that does not have access to modern energy and is now further threatened by an increase in the access gap due to COVID-19 impacts and lack of financing for energy access projects. Only ~0.9% ($0.29 BN) of global finance for energy access flows to off-grid and mini-grid solutions[4]. This is far from the USD 6.6 to 11 billion required between 2020 and 2030 to achieve SDG7. Moving forward, DREs should play a more significant role in several scenarios, particularly when the population is distant from the centralized grid, as these decentralized energy sources are the least-cost option and a versatile solution to providing energy to remote, rural communities while achieving SDG7.

Importance of geospatial assessment in identifying opportunities and prioritizing energy access investments for resiliency

In many cases, data on remote communities and access to essential services such as the electrification status of health facilities is scarce or scattered. Thus, geospatial analysis is an important tool for decision makers as it helps identify opportunities and guide the prioritization of funds and investments aimed at building resilient communities that are better prepared to manage potential health, climate, and environmental risks.

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[1] WHO, 2015. *Access to Modern Energy Services for Health Facilities in Resource-Constrained Settings*

[2] Health centers that did not experience an outage of more than two hours, one week prior to the survey which reported these statistics.

[3] IEA, IRENA, UNSD, World Bank, WHO. 2021. *Tracking SDG 7: The Energy Progress Report.* World Bank, Washington DC.

[4] Sustainable Energy for All (SEforALL) and the Climate Policy Initiative (CPI) 2021. *Energizing Finance: Understanding the Landscape 2021.*

In Uganda, the World Resources Institute, in collaboration with the Ministry of Health and the Energy Sector GIS Working Group, is drawing on geospatial analysis in the Energy Access Explorer platform to better understand where remote populations are located, and where building more resilient communities would be a priority[5]. Furthermore, EAE allows us to customize our criteria to locate specific attributes of interest, such as population in poverty, proximity to health facilities, or areas with higher energy resource potential, where DREs could be a viable option. Our initial analyses have yielded insights on where the unserved and underserved healthcare facilities may be and on ways to introduce more targeted investment which can support the development of more resilient communities.

1. **Many people living in remote communities with high poverty rate are unserved or underserved from electricity and have limited access to health services**. Over 6.6 million people in Uganda live in areas with high poverty rates and are distant from both centralized grid and DRE options (Figure. 1). Furthermore, within this area over 730 thousand people also live away from any health facility[6], and distant from urban zones[7] (Figure. 2). This means that in these communities, certain population groups such as the elderly would need to travel great distances to receive health services from these mapped facilities. Maps show filtered areas according to the criteria mentioned above, with brighter colors representing the share of the population with a higher need for assistance (Figures. 1 & 2).

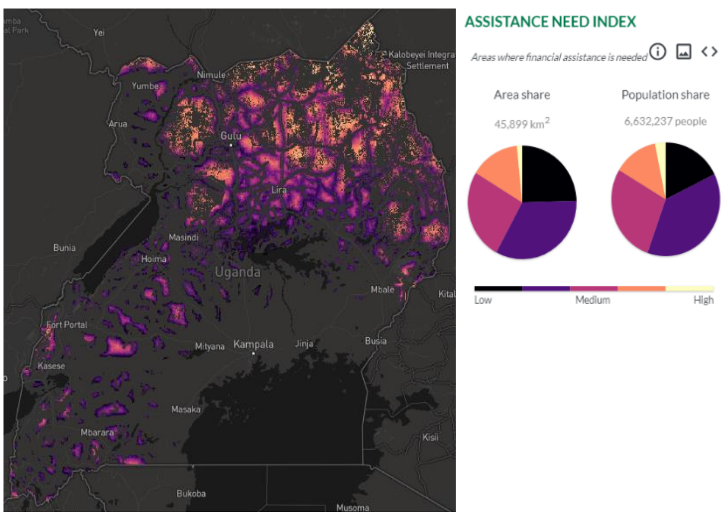


Figure 1. Remote communities unserved or underserved from electricity and with high poverty rate. [Assistance Need Index outputs based on the following filters: Poverty rate above 80%, Distant from the grid and mini grids (above 2km)].

[5] Energy Access Explorer tool provides an *Assistance Need Index* analysis to identify areas where market assistance is needed the most. It is an aggregated and weighted measure of user customized analyses under demographics, social and productive uses, power infrastructure, as well as access to finance indicating high energy demand, low economic activity, and low access to infrastructure and resources.

[6] A distance radius of 5 km

[7] A time distance above 120 minutes

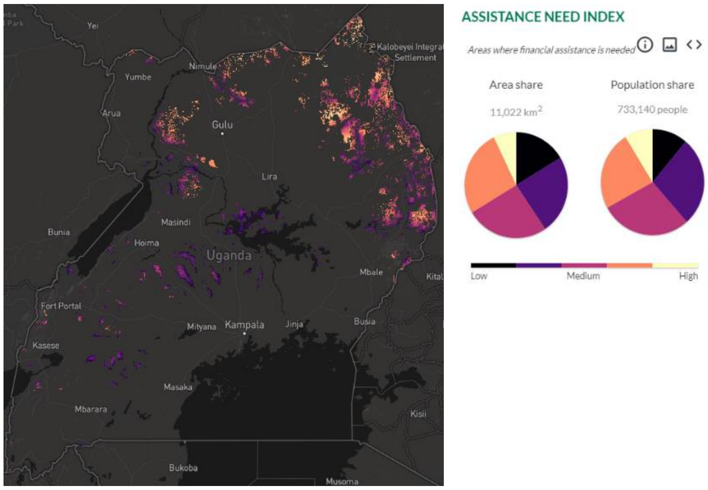


Figure 2. Remote communities unserved or underserved from electricity, with high poverty rate and limited access to health services. [Assistance Need Index outputs based on the following data and filters: Poverty rate above 80%, Distant from the grid and mini grids (above 2km), Poor accessibility to urban areas (above 120 minutes), Distant from health facilities (above 5km)].

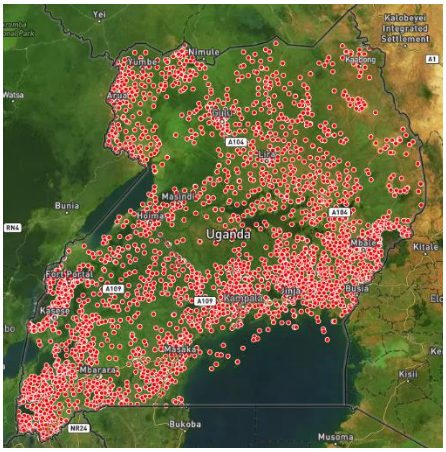
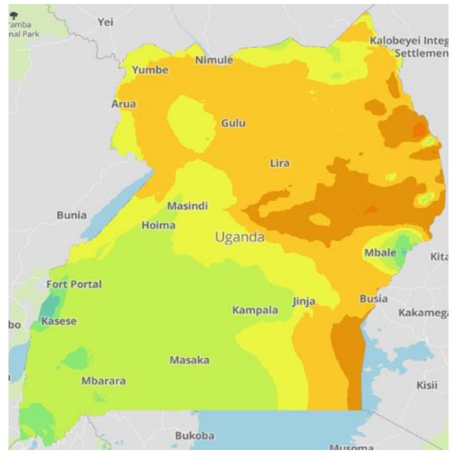
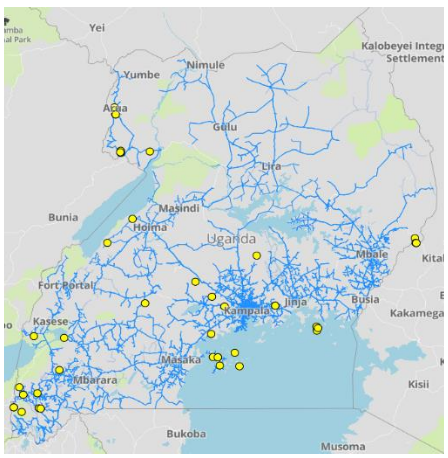
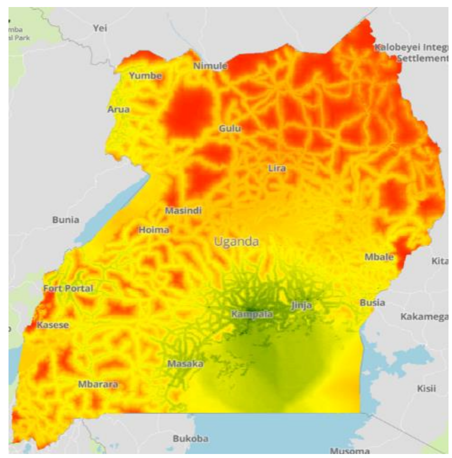
2. **Operational Healthcare facilities in areas unserved or underserved from electricity have a high potential for solar PV.** Analysis shows that in areas with high poverty rates and where we find operational healthcare facilities that are unserved or underserved from electricity, there is also 'very high global horizontal irradiation.'[8] Currently in Uganda, healthcare facilities serving approximately 4.3 million people, are distant from both main grid and existing mini grids. This means that many of these facilities are likely unserved or underserved from electricity and have a higher need for assistance in order to provide optimal health services. Under the right conditions, most facilities without electricity access in these areas are eligible to have their own source of power through a DRE option such as stand-alone PV systems, small-scale hydropower, or wind. Currently, the Health Component of the Uganda Energy for Rural Transformation (ERT) program[9] has this precise aim—to continue electrifying health facilities using solar PV systems plus battery storage systems for lighting, vaccine/blood refrigeration, as well as operation of essential medical equipment (Figure. 3). For example, electricity in unserved health facilities would allow effective distribution and storage of COVID-19 vaccines. The maps show proximity areas around the health facilities and filters according to the criteria mentioned above, with brighter colors representing the share of the health facilities with a higher need for assistance (Figures. 5 & 6).

Figure 3. Image of healthcare facility part of the ERT program seen in the EAE with detailed facility, service, and electrification information

[8] *Global Horizontal Irradiation (GHI) above 1,800 kWh/m²*

[9] Planned and executed by the Ministry of Health of Uganda under the Ministry of Energy Mining and Development's Energy for Rural Transformation programs I, II, and III.

Figure 4. Data layers included in healthcare facilities underserved from electricity analysis

	
Healthcare Facilities	Global Horizontal Irradiation (GHI)
	
Distribution lines and Minigrids	Population percentage in poverty

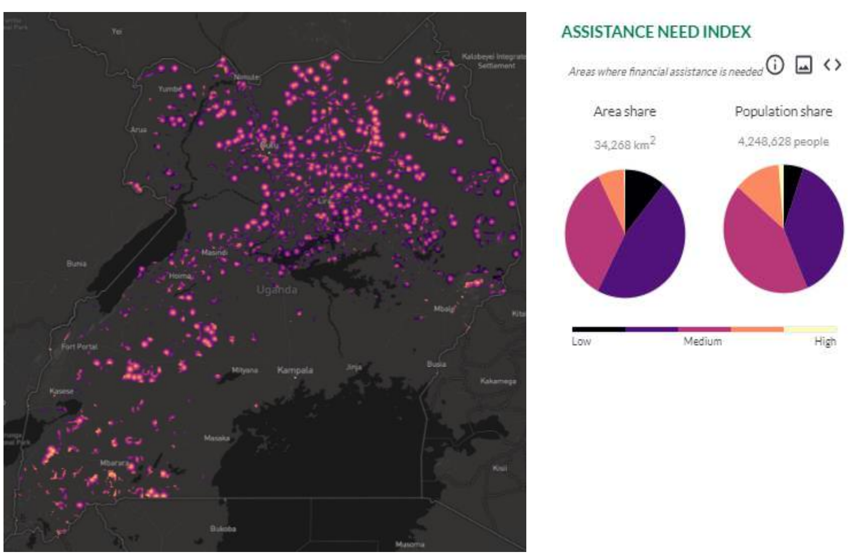


Figure 5. Healthcare facilities underserved from electricity [Assistance Need Index outputs based on the following layers and filters: Proximity to health facilities (within 5km), High solar potential (GHI above 1,800 kWh/m^2), Poverty rate above 80%, Distant from the main grid and mini grids (above 2km)].

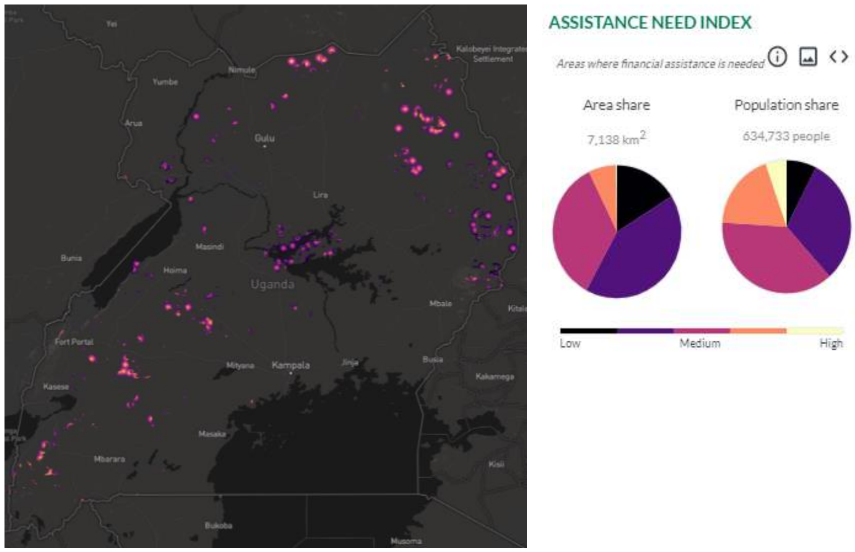


Figure 6. Healthcare facilities underserved from electricity in remote communities [Assistance Need Index outputs based on the following layers and filters: Proximity to health facilities (within 5km), High solar potential (GHI above 1,800 kWh/m^2), Poverty rate above 80%, Distant from the main grid, mini grids, and financial services (above 2km) accessibility to urban areas, (above 120 minutes)].

3. **Operational healthcare facilities in areas unserved or underserved from electricity within refugee settlements have high solar PV potential.** Uganda has a total of 1.4 million refugees[10], 48% of whom are in northwest Uganda (as seen on the map below). Many of the settlements and the services provided within these areas are distant from the grid, meaning that healthcare facilities are likely underserved. All the healthcare facilities analyzed within the refugee settlements are in areas categorized as 'very high global horizontal irradiation.' Similarly, under the right conditions, these facilities too are eligible to generate electricity through a solar PV system. Again, the figure below shows proximity areas around healthcare facilities in refugee settlements that are distant from the main and decentralized grid (Figure 7).

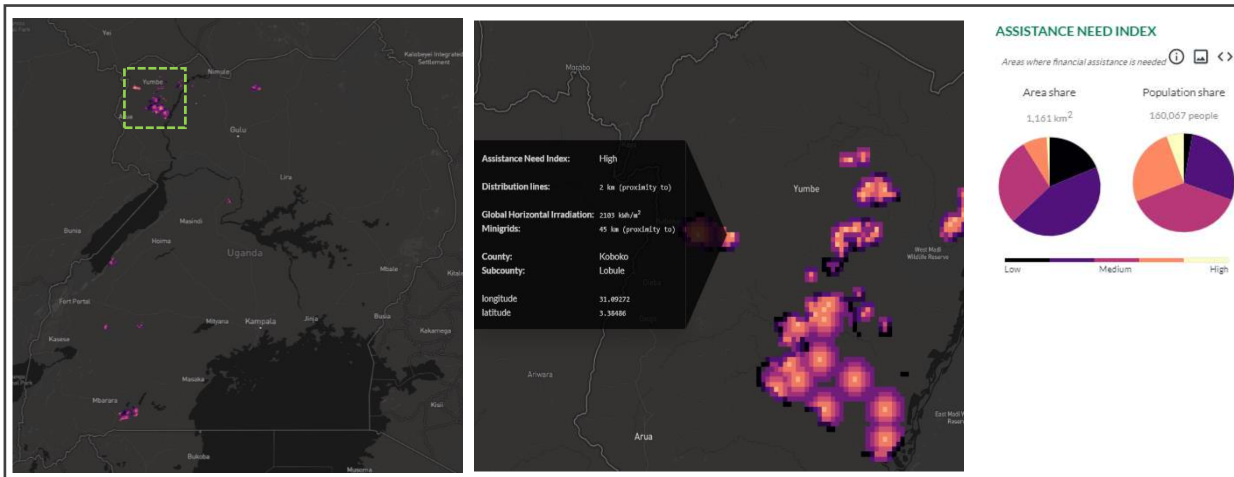


Figure 7. Healthcare facilities in and near Remote Refugee Camps. [Assistance Need Index outputs based on the following filters: Within Refugee Settlements, Proximity to health facilities (within 5km), High solar potential (GHI above 1,800 kWh/m^2), Distant from the grid and mini grids (above 2km)].

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[10] Office of the Prime Minister, UNHCR, Government of Uganda (Refugees Operational Data Portal UNHCR Uganda)

From the initial analysis, we can observe that there are still several remote communities with high poverty rates that are distant from health facilities. Furthermore, the nearest health facilities to these remote communities and other adjacent villages are either unserved or underserved regarding electricity. In addition to poor access to electricity, several of these areas also have a scarce presence of local financial services – including local banks or Savings and Credit Cooperatives, which in turn makes it more difficult for health facilities applying for funds to electrify their buildings, as well as upgrade their equipment (Figure.6). This creates a challenging scenario for health facilities to provide the required services, even more so during a pandemic. However, with more granular geospatial information and on-the-ground data, government agencies, financial institutions, donors, impact investors, and development organizations can identify and prioritize areas or facilities in order to have greater impact by administering funds, resources and assistance to those who need it the most.

The EAE can provide insight for Ministries of Health, such as that in Uganda, as they assess the best options for providing energy to healthcare facilities. The tool can provide important data-driven planning and decision-making analysis at the start of a project through its phases. This reduces time-intensive data collection and analysis efforts to identify relevant healthcare facilities and their energy needs. Still, there is a long way to go, and more data will be critical to understanding the full scope of the impact to achieve reliable, modern, and sustainable energy. That said, the EAE tool provides a unique opportunity to ensure more focused investment that also builds more resilient communities.