How fair is the transition towards sustainable development in rural electrification?: A case study in Kanturo community, Ghana.

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Introduction, Motivation and Objectives

Energy itself is not a basic human need, but it is fundamental for the fulfillment of other needs and basic human rights [1,2]. Modern energy services are essential for human-well being and to a country's economy development as they enable access to essential resources [1,3,4]. In 2021, the number of unelectrified people reduced from 1.1 billion in 2010 to 675 million, in a growing population scenario during the last decades. Despite this significant progress, around 750 million people still lack access to electricity, with only one-in-five of these people gaining access to electricity in this period living in Africa [5]. Without the implementation of any new policies, it is expected that 660 million people will still have no access to electricity by 2030, 8 out of 10 of them will be from rural communities in Sub-Saharan Africa [6].

This project presents a case study showcasing the potential of mini-grid as alternative strategy for sustainable rural electrification and sustainable development. The main objectives is:

- Identify gaps that may be delaying or limiting mini-grid deployment, therefore, the inclusion of rural communities in the worldwide goal to become climate-neutral by 2050 and reach the Sustainable Development Goal 7.1 (SDG7.1).

Electrification and Sustainable Development

This project presents a case study showcasing the potential of mini-grid as alternative strategy for sustainable rural electrification by providing:

- Sustainable, affordable, reliable and modern electricity
- Access to basic human services (clean water, sanitation, lighting, transportation, others)
- Better economic opportunities

Challenges and Potential of Rural Electrification: Kanturo case study

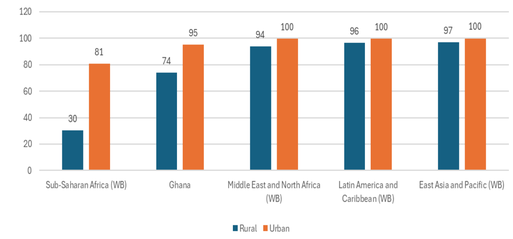
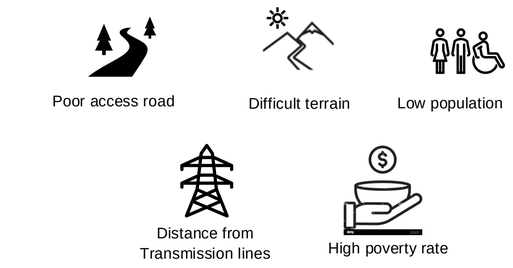


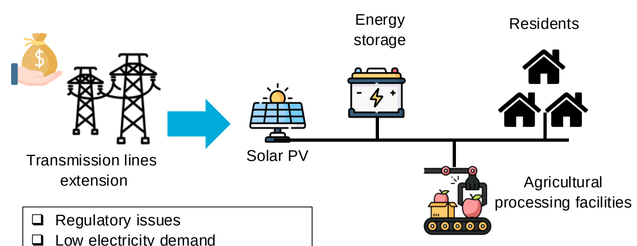
Figure 1. Global inequality in rural and urban electrification, [6].

Figure 2. Kanturo community's facilities: (a) School, (b) poultry farm, (c) water storage, (d) household. Source: Authors' own work.

Challenges for rural electrification



How can mini-grids support rural electrification and sustainable development?



- Regulatory issues
- Low electricity demand
- Over optimistic demand projections

Methodology

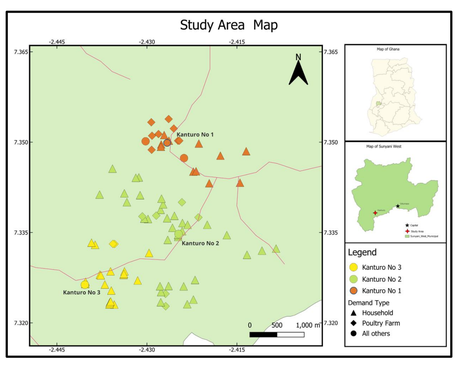


Fig. 3. (a) Map of study area

Study Approach

Questionnaire design	Community engagement	Data collection
Aim to characterize a typical rural Ghanaian community, gathering data on current and future energy demand and social acceptance of mini-grid projects. Link to the questionnaire	Initial discussions were held on May 24, 2024, with local stakeholders to explain the study's objectives and gain their support.  **Source:** Authors' own work.	Primary data were collected in person from the various community zones (Kanturo 1, 2, and 3) through interviews with different demand types. The survey was conducted from June 2-9, 2024.  **Source:** Authors' own work.

Tab. 1. Sampling for survey in Kanturo community.

Demand type	Kanturo 1	Kanturo 2	Kanturo 3	Total visited	Total population Kanturo	Residents interviewed
Household	11	34	21	66	1435	94
Church and mosque	1	2	1	4		
Health Posts and Clinics	0	1	0	1		
School and Colleges	0	1	0	1		
Poultry Farm	8	6	2	16		
Livestock Farm	2	1	0	3		
Provision stores	0	3	0	3		

Results

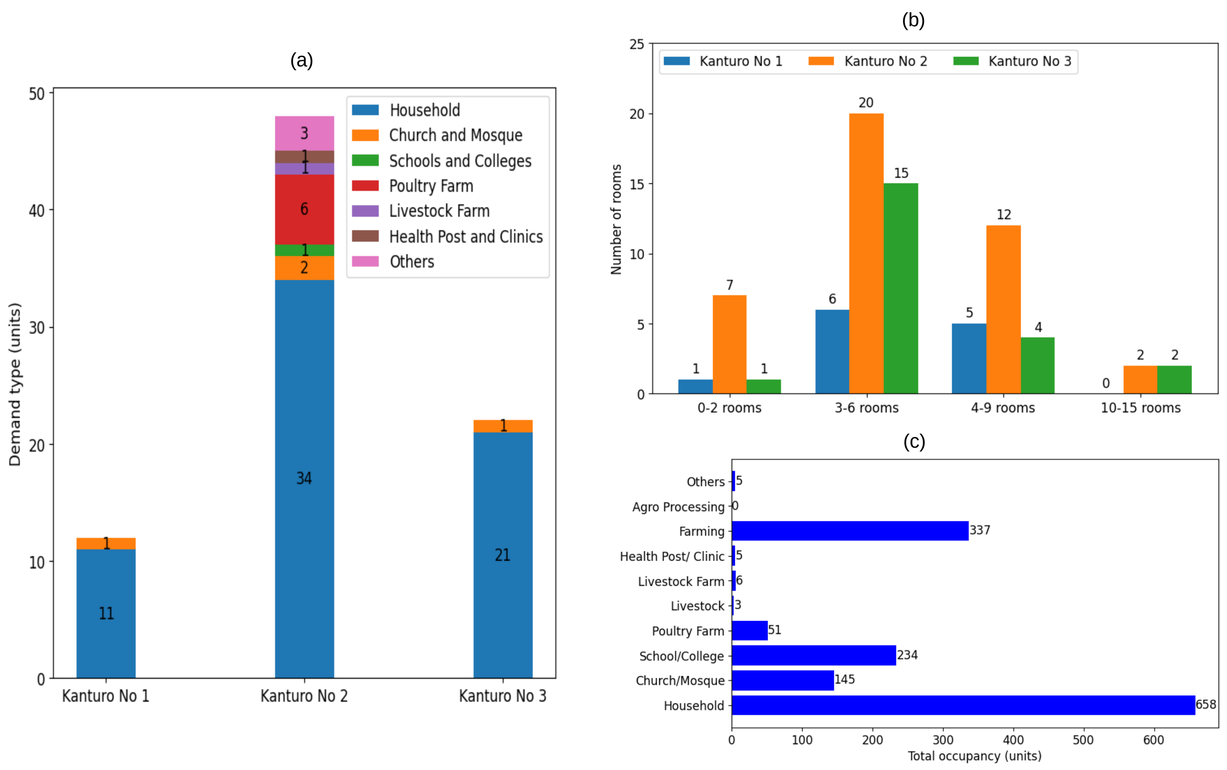


Figure 4. (a) Distribution of demand type per area, (b) number of rooms per area, and (c) occupancy per demand type.

Tab. 2. Monthly energy demand in kWh in Kanturo.

Demand type	Kanturo 1 (kWh)	Kanturo 2 (kWh)	Kanturo 3 (kWh)	Annual energy demand Kanturo (kWh)	Annual energy demand per capital Germany (kWh)
Household	39.29	145.93	90.90	5,394.96	6,004.00
Church and mosque	0.00	0.00	0.00		
Health Posts and Clinics	0.00	3.74	0.00		
School and Colleges	0	10.89	0.00		
Poultry Farm	107.22	29.28	10.04		
Livestock Farm	3.98	0.00	0.00		
Provision stores	0.00	8.31	0.00		
Total energy demand	150.49	198.15	100.94		

Fig. 5. Energy forecast of Kanturo community.

Conclusions

- Globally, there is disparity in the rural and urban electrification rate which put rural dwellers at a disadvantage. This is fuelled by some factors like the low population of the communities, difficult terrain and high poverty rate which makes grid extension not economical and makes mini-grid the viable option.
- Mini-grids deployment in rural communities is currently building the future energy power which is expected to be decentralized and distributed across urban and rural areas. Therefore, it is found to be the most suitable solution in the short term to achieve universal access to electricity and the Sustainable Development Goals (SDGs) by 2030.
- The case study´s results demonstrates the people´s willingness to have mini-grids in their community and to cover the cost of electricity usage. A new business model is required to boost mini-grid deployments, where organizations from the public, academia and private sector can work holistically to provide guidance for the community sustainable development.
- The preference for a prepaid metering system among residents highlights the importance of financial control and affordability which better aligns their power usage with their economic circumstances underscoring their limited purchasing power.

References

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