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Promoting E-Cooking and Access To Electricity To Underserved Areas- Case Study- Oloika Solar PV Mini-Grid, Kenya

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Introduction

- Electricity is one of the key enabler in the world that catapult country's socio-economic development.
- Commonly referred as lifeblood because is an integral part of the modern living.
- The modern living consists of numerous electrical devices- which require electricity
- Strategies to accelerate electricity access;
  - ✓ expansion of grid network and
  - ✓ establishment of off grid mini-grids

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INTRODUCTION CONT..

Statistical data on Kenyans network

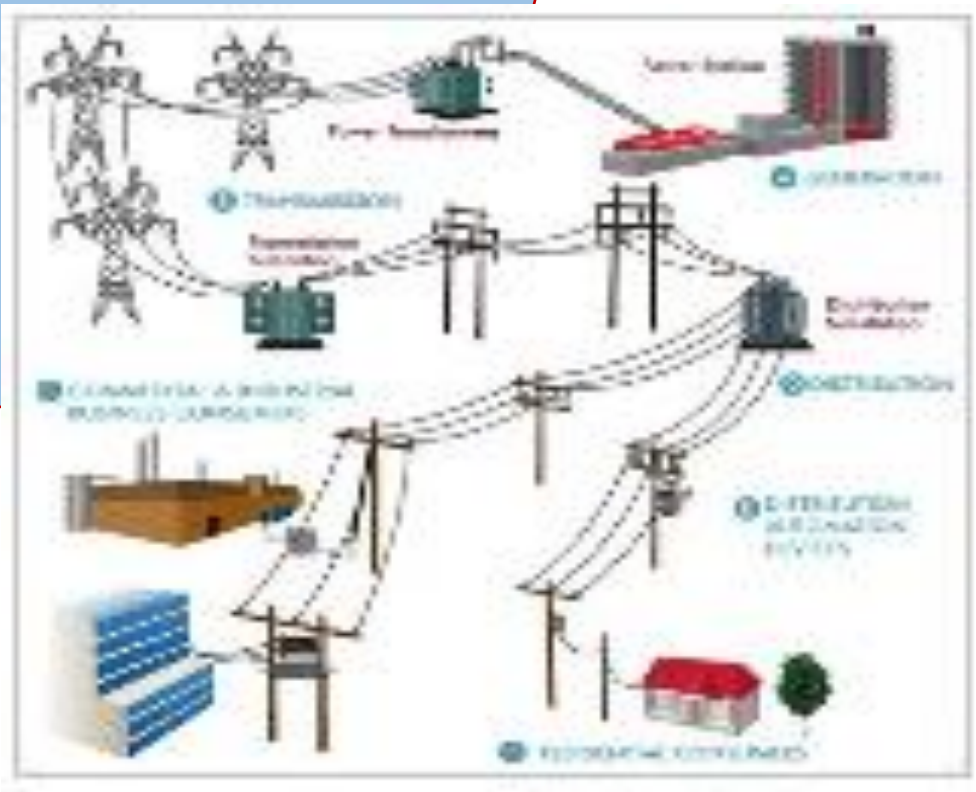
Transmission lines= 9,000+ km

Projected transmission lines circuit length = 3,200 + (2042)

Medium voltage lines = 83,000+ km

LV network= 300,000 + km

Secondary substations = 81,000+



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INTRODUCTION CONT..

Status of off grid mini-grids in Kenya

- Total installed capacity of mini-grids is 4.5 MW (30 mini grids).
- The five (5) towns with highest installed mini –grid, that constitute 46.02 % of installed capacity of mini-grids are namely; **Wajir, Mandera, Marsabit, Moyale and Habaswein.**
- This paper evaluates the performance of the Oloika solar PV plant, a standalone mini-grid located in Magadi Ward, Kajiado West Constituency, Kajiado County.
- Establishing the impact of adopting e-cooking in a mini-grid set up.
- Clean e-cooking is at infancy stage hence there is need to devise smart strategies to hasten transition from traditional cooking; fire woods, charcoal and LPG.
- The conventional cooking methods cause health related challenges, land degradations, greenhouse emission and deforestation.

INTRODUCTION CONT..

- The Oloika mini-grid is approximately 30 km from the national grid with low economical activities, hence an uneconomical to extend the grid to supply power to the sparsely populated homesteads.
- The mini-grid was jointly funded by energy for development (e4D) of UK and Rural Electrification and Renewable Energy Corporation (REREC) of Kenya.
- e4D did civil works and REREC constructed low voltage distribution.
- The construction of mini grid commenced in 2015 with an initial installed capacity of 13.5 kWp, 2x 5 kW inverters and 38.4 kWh battery storage.
- However, loads connected overshoot the installed capacity.

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INTRODUCTION CONT..

- There were frequent power cut experienced particularly at peak time.
- In 2022, an additional 16.5 kW solar panels, 45 kWh lithium –ion batteries.
- An upgrade of low voltage network from single phase to three phase distribution network.
- These modifications culminated to a resilience system adequate to support nascent e-cooking initiative.

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Problem & Theories

Upgrading of solar plant from 13.5 kWp to 30 kWp

Single phase dist. network

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Research Methods

- ✓ Mixed-methods approach were adopted to enable accomplish a comprehensive evaluation on the effects of clean e-cooking deployment within a mini-grid context.
- ✓ First we determined the number of potential households, assess the available power generation, battery banks condition and the status of network infrastructure.
- ✓ The baseline data enabled assessing the penetration and impact of e-cooking and mini grid network upgrade designs.
- ✓ The data collected from quantitative, qualitative and observation surveys were subsequently analyzed using statistical tools and data visualization technique.
- ✓ The multi-dimensional approaches provided a holistic view of the mini-grid's performance and its role in fostering sustainable energy access

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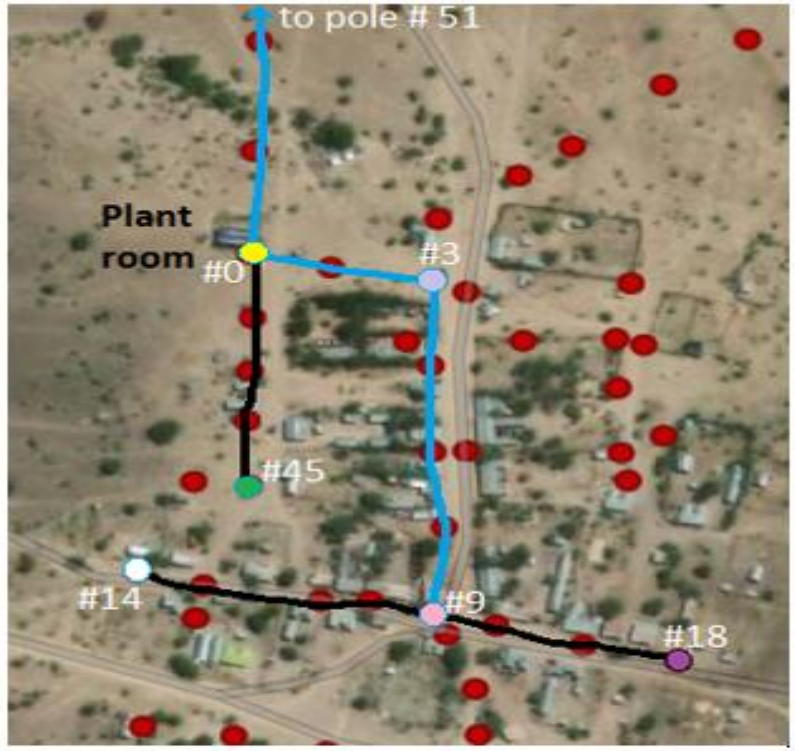
Results & Discussion

There were seventy five (75) active power end users connected with electricity.
Ten (10) of the connected end users were noted to have e-cookers which were issued by a local cooperative through a pre-financing scheme to simulate demand and test the resilience of the mini grid.



Key
Existing conductors for 3-phase configuration
Additional conductors needed to make the circuit 3-Phase

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Results & Discussion

The specific objectives

To evaluate the effectiveness of the upgraded Oloika mini-grid in enabling e-cooking and improving electricity access.

To identify enablers and barriers to electric cooking adoption within the mini-grid community.

Propose recommendations to foster e-cooking into mini-grid rollout in similar contexts.

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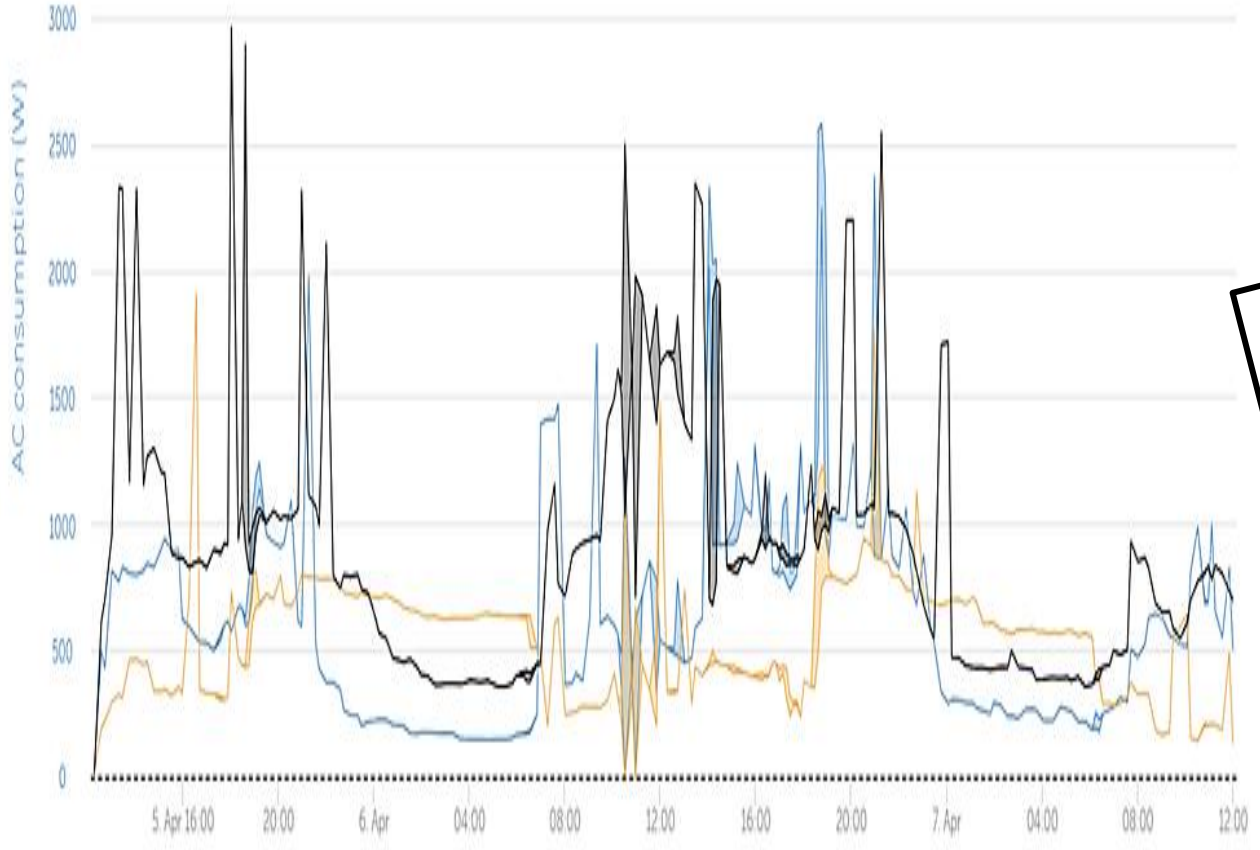
Effectiveness of the upgraded Oloika mini-grid in enabling e-cooking and improving electricity access



- Higher energy demand was observed during the day, when customers using electric cookers had access to incentivized time of use tariff when there is direct use of solar irradiation.
- Further, all the phases were found to be fairly balanced

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Barriers to electric cooking adoption

- Initial cost to procure an electrical cooker
- Loss of the original teste of the food, terming it as an inferior
- Not possible to prepare some of the traditional food such as Ugali and mashed potatoes
- Intermittent power supplies
- Poor quality and rapid changing of appliance model
- Safety aspect, and
- High electricity cost

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Enablers and barriers to electric cooking adoption

Enablers

- Lower the cost of electricity by introducing a special tariff for e-cooking
- Carry out intensive trainings focusing mainly on safety, standardization of proper wiring, and repair of the appliances
- Develop an end- of- life framework for e-cooking appliances
- Establish a check –off system that can finance the upfront cost of the e-cooking appliances
- Maintaining a stable and good quality power supply
- Campaigns on community behavior change through e-cooking hubs/demonstrations

Solutions to boast e-cooking at Oloika solar PV mini grid

Sensitization of community to adopt clean e-cooking at Oloika mini grid solar power plant

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CONCLUSIONS AND RECOMMENDATIONS

- ✓ This study focused on energy access and promoting clean cooking in rural areas and underserved communities.
- ✓ The case study has demonstrated that with appropriate technical interventions, policy incentives, community engagement, and capacity-building, mini-grids can enable the productive use of energy and foster sustainable health livelihoods.
- ✓ These include poverty eradication, improvement of both health and education, and overall well-being of the society.
- ✓ While many barriers to e-cooking adoption remain a profound challenge; ranging from high upfront costs, limited financing options, policy bottlenecks and low awareness, this study shows that a combination of technical, policy, financial, and educational measures can collectively hasten adoption.

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CONCLUSIONS AND RECOMMENDATIONS CONT..

- ✓ From this study, we recommends training and sensitization of power end users in proper usage of the equipment, maintenance and safety, develop disposal and recycling mechanisms for appliances
- ✓ Replicating this approach in other mini-grid settings can contribute immensely toward universal energy access and clean energy transition.
- ✓ Power utilities, policymakers, government agencies, private project developers, financial institutions, and community stakeholders should collaborate to create a favorable ecosystem for scaling up mini-grid electrification alongside clean cooking.
- ✓ This will enable underserved communities to realize the accrued benefits that are allied with clean energy, (as aforementioned), strengthening resiliency of mini grid, reduce greenhouse gas emissions, and improving quality of life for future generations.

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References

[1] Al Kez, D. et al. (2024) 'Energy Poverty Assessment: Indicators and implications for developing and developed countries', Energy Conversion and Management, 307, p. 118324. doi:10.1016/j.enconman.2024.118324.

[2] Banerjee, R., Mishra, V. and Maruta, A.A. (2021) 'Energy Poverty, health and education outcomes: Evidence from the developing world', Energy Economics, 101, p. 105447. doi:10.1016/j.eneco.2021.105447.

[3] Energy and Petroleum Regulatory Authority (EPRA). (2022). *Draft mini-grid regulations*. EPRA, Kenya. [https://epra.go.ke]

[4] Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). (2020). *Productive uses of energy: An opportunity for mini-grid development in Sub-Saharan Africa*. GIZ. [https://www.giz.de]

[5] International Energy Agency (IEA). (2021). *World Energy Outlook 2021*. IEA. [https://www.iea.org]

[6] International Renewable Energy Agency (IRENA). (2021). *Innovation Outlook: Smart Grids*. IRENA. [https://www.irena.org]

[7] Kenya Power and Lighting Company (KPLC). (2024). *Project eCooking: Deployment of energy-efficient cookers*. KPLC. [https://www.kplc.co.ke]

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Thank You

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