Minigrids in Kenya

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Outline

- Introduction
- Methodology
- Preliminary findings
  - Political economy & Governance
  - Economic sustainability
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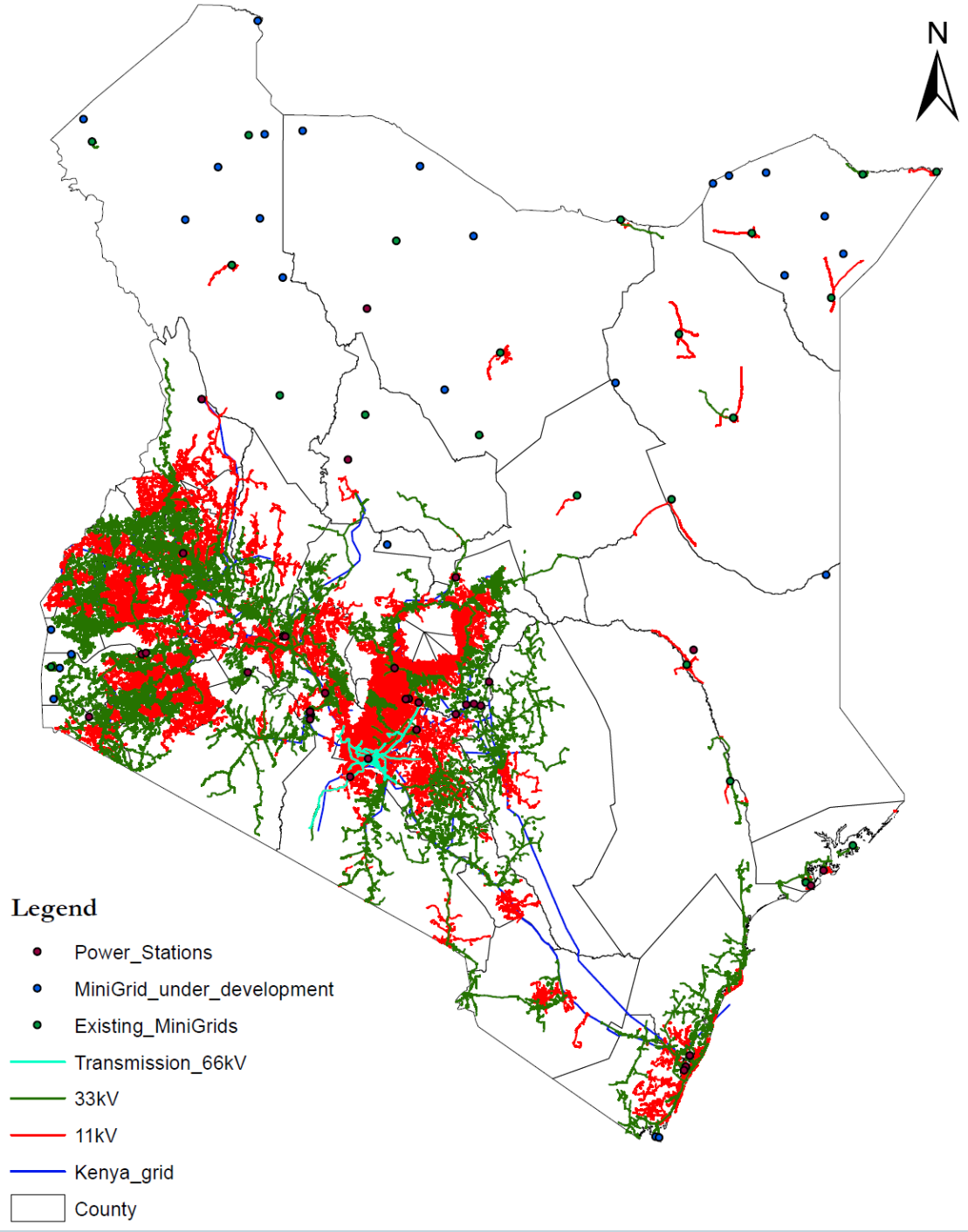
- Conclusion

Research questions

- Which business models have succeeded to deliver financially and technically sustainable mini-grids in SSA?
- Who and what have been the key beneficiaries of mini-grids in the case study countries, and in what way?
- What governance, regulatory and policy frameworks for decentralised systems of electricity provision exist in each case study country? How successful have they been and how do they differ?

Introduction

- Kenya *has* a vision of ensuring 100% access to electricity through the Kenya National Electrification Strategy (KNES) by 2026.
- Currently at 81%, at 3,321 MW generation capacity, 86% renewable.
- Minigrids and SHS prioritized by the KNES.
  - Kenya Off-grid Solar Access Project (KOSAP) – World Bank funded, RBF facility, 150 million USD
  - Projection of 34,000 new connections via 121 new solar mini-grids in 14 marginalized counties
  - Targets housing clusters that are too remote or too small for national grid connection.
  - Aims to electrify remote institutions with minigrids



Counties and Sites visited

Turkana County (4 mini-grids)

- Long'ech
- Nadwat
- Lolupe
- Kalobeyei Settlement

Busia County (2)

- Sidonge
- Dirakho

Siaya County (2)

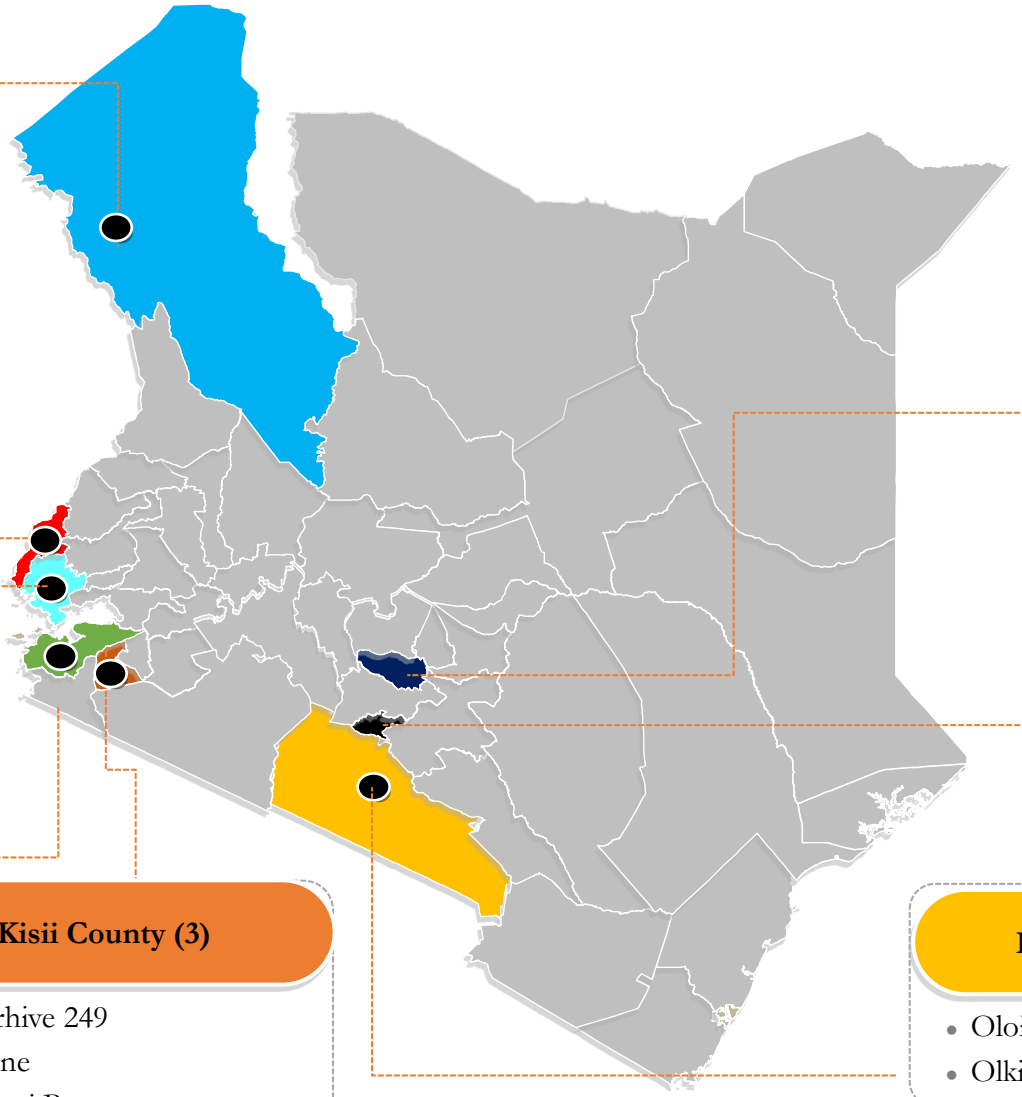
- Ndeda Island

Homa Bay County (2)

- Mfangano Island
- Ringiti Island

Kisii County (3)

- Powerhive 249
- Baranne
- Gionseri B



Murang'a County (1)

- Magiro HydroPower

Nairobi

Kajiado County (2)

- Oloika
- Olkiramatian

Characteristics

Mini grid name	Technology	Capacity (KW)	Status	Ownership	Connections
Oloika	Solar	13.5	Semi operational	Community	46
Olkiramatian	Solar	6.2	Fully operational	Private	70
Ndeda	Solar & Wind	Solar-9 Wind-6	Fully operational	Private	400
Ringiti	Solar	20.45	Fully operational	Private	290
Mfangano	Diesel & Solar	Diesel-520 Solar-10	Fully operational	Public	5,000+
Powerhive 249	Solar	60	Fully operational	Private	169
Gionseri B	Solar	60	Fully operational	Private	374
Baranne	Solar	50	Decommissioned	Private	80
Sidonge	Solar	7.3	Fully operational	Private	220
Dirakho	Solar	30	Fully operational	Private	524
Longech	Solar	45	Semi operational	Private	218
Lolupe	Solar	22	Fully operational	Private	136
Nadwat	Solar	44	Semi operational	Private	180
Kalobeyei Settlement	Solar	60, expanded to 541	Semi operational	Private	504 expected to rise to 2,500+
Magiro (Kahinduini)	Hydro	70	Fully Operational	Private	1,500

Hybrid (solar and wind) minigrid in Ndeda Island

Solar mini grid at Gionseri B, Kisii County

Longech mini grid, Turkana County

Magiro hydro mini grid, Murang’a County

Shores of Lake Victoria at Ringiti Island

Mini grid powering Ringiti Island

25 interviews conducted at the sites

18 KIIs with policy actors, minigrid developers, DFIs.

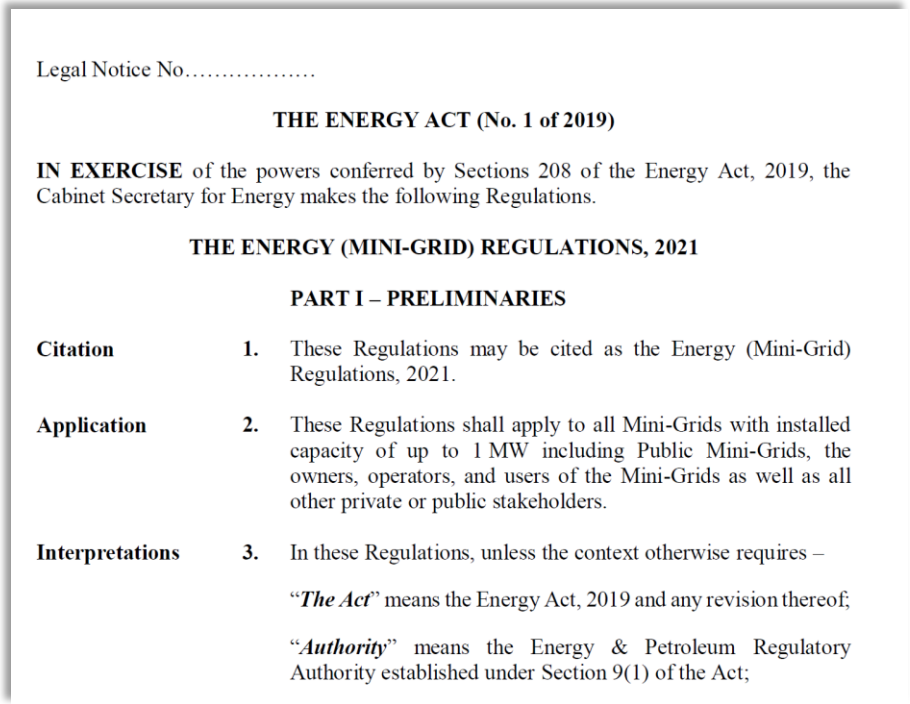
	HH-Connected	HH unconnected	PUE	Institutions	FGD	Community leaders	Operator	County Energy Dept.
Oloika	10	5	5	2		1	1	1
Olkiramatian	10	5	5	2			1	
Ndeda	10	5	5	2		1	1	1
Ringiti	10	5	5	2			1	1
Mfangano			2	1	1		1	
Powerhive 249	10	5	3	0			1	1
Gionseri	10	5	3	0			1	
Baranne					1		1	
Sidonge	10	0	5	0		1		1
Dirakho	10	0	5	1		1	1	
Longech	10	5	5	2			1	1
Lolupe					1		1	
Nadwat	10	5	5	0				
Kalobeyei Settlement	10	5	5	3				
Magiro					1		1	1

Political economy & governance

Minigrid sector in Kenya

Political economy & governance

- Enabling environment
  - Policies that have enabled the development of the mini grids sector include:
    - Kenya National Electrification Strategy (KNES) 2018
      - Aimed to achieve universal electrification by 2026
    - The Energy (Mini-grid) Regulations 2021
      - recently been adopted in Kenya.
    - Energy Act 2019
      - charges EPRA with the regulation mandate; REREC with the mandate for rural electrification



Legal Notice No.....

THE ENERGY ACT (No. 1 of 2019)

IN EXERCISE of the powers conferred by Sections 208 of the Energy Act, 2019, the Cabinet Secretary for Energy makes the following Regulations.

THE ENERGY (MINI-GRID) REGULATIONS, 2021

PART I – PRELIMINARIES

Citation **1.** These Regulations may be cited as the Energy (Mini-Grid) Regulations, 2021.

Application **2.** These Regulations shall apply to all Mini-Grids with installed capacity of up to 1 MW including Public Mini-Grids, the owners, operators, and users of the Mini-Grids as well as all other private or public stakeholders.

Interpretations **3.** In these Regulations, unless the context otherwise requires –

"***The Act***" means the Energy Act, 2019 and any revision thereof;

"***Authority***" means the Energy & Petroleum Regulatory Authority established under Section 9(1) of the Act;

Political economy & governance

- Issues:
  - Buffer zones (concession areas) within 15km of existing medium voltage infrastructure earmarked for KPLC and REREC
    - Excludes remote communities from electrification since grid arrival in some areas is uncertain
  - Licensing and financial risk
    - Regulatory requirement to partially construct a plant reaching 30% of targeted customers before licence is issued.
  - Lack of transparency in regulation
    - e.g. in tariff setting, approval of permits. Delays in tariff approval
  - Co-ordination issues between MoEP, EPRA and local authorities
    - Lack of capacity at some counties; revenue-sharing disputes; push for decentralisation or governance
    - To be resolved through County energy planning under the INEP
  - Local politics around minigrid deployment:
    - Threaten the operation of mini grids creating financial and project risks
    - Has led to decommissioning of some sites

The economics of minigrids in Kenya

Minigrid sector in Kenya

Financing

- Reliance on external financing: grants, DFI-funded government subsidies (e.g. through WB, GMG Facility, NEFCO, CAMCO), private equity
  - At the early stage, grants are crucial. In the long run: loans with long maturities
  - Debt financing is too expensive, difficult to secure due to
    - Demand risk (uncertainty in cashflows), RoI profile
  - There's a push from EPRA for a higher ratio of debt to equity (like 80:20) to lower the tariffs for mini grids
  - Hybrid financing models are prevalent
- De-risking mini-grid projects is core to financing
  - Patient capital (e.g. grants) is needed to de-risk mini grid projects.
  - Local currency financing: this would reduce the forex movement which is currently passed on to end users
  - Stabilising the governance framework

Affordability of electricity

- Financing models affect the tariffs charged to clients.
- Cost of connection and tariff structure: cost-reflective?
  - Vary from among developers and projects. Different regimes: Flat rate and Tier system
  - Significantly lower tariffs in hydro mini grids. Subsidies in special contexts e.g. displaced settlements
- Cost recovery: Billing and payment
  - Innovation: smart metering, pre-paid systems, mobile payment systems
- Underutilisation of mini grids keeps costs high. Approaches to stimulate demand include:
  - Anchor clients & stimulating productive uses
  - Appliance and equipment financing e.g. eCooking, e-mobility
  - Leasing infrastructure

Leasing infrastructure: Cold storage containers leased to farmers in Muranga country by Hydrobox-Magiro Power

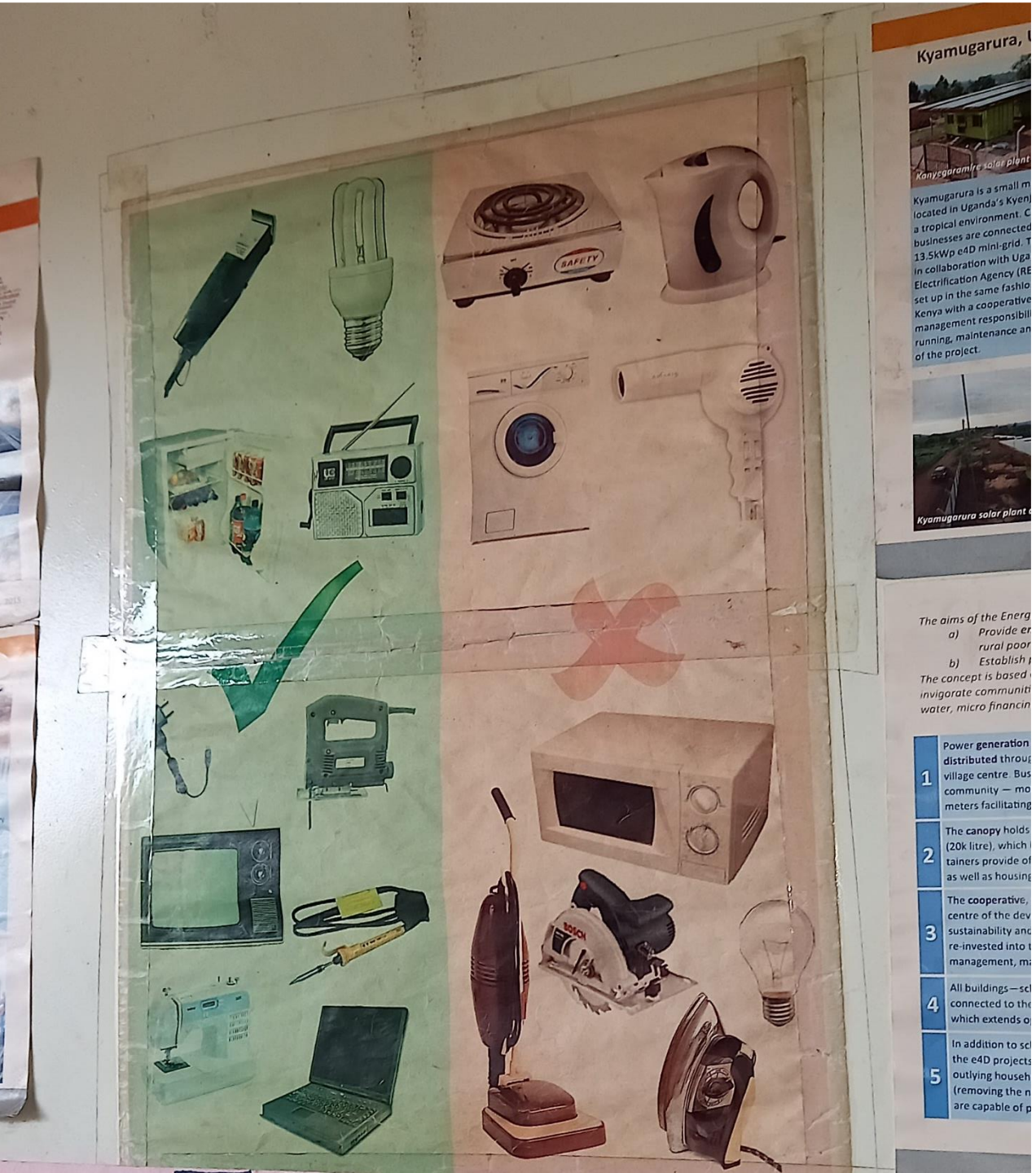
Retrofitted e-bikes by Opibus charged using minigrid electricity

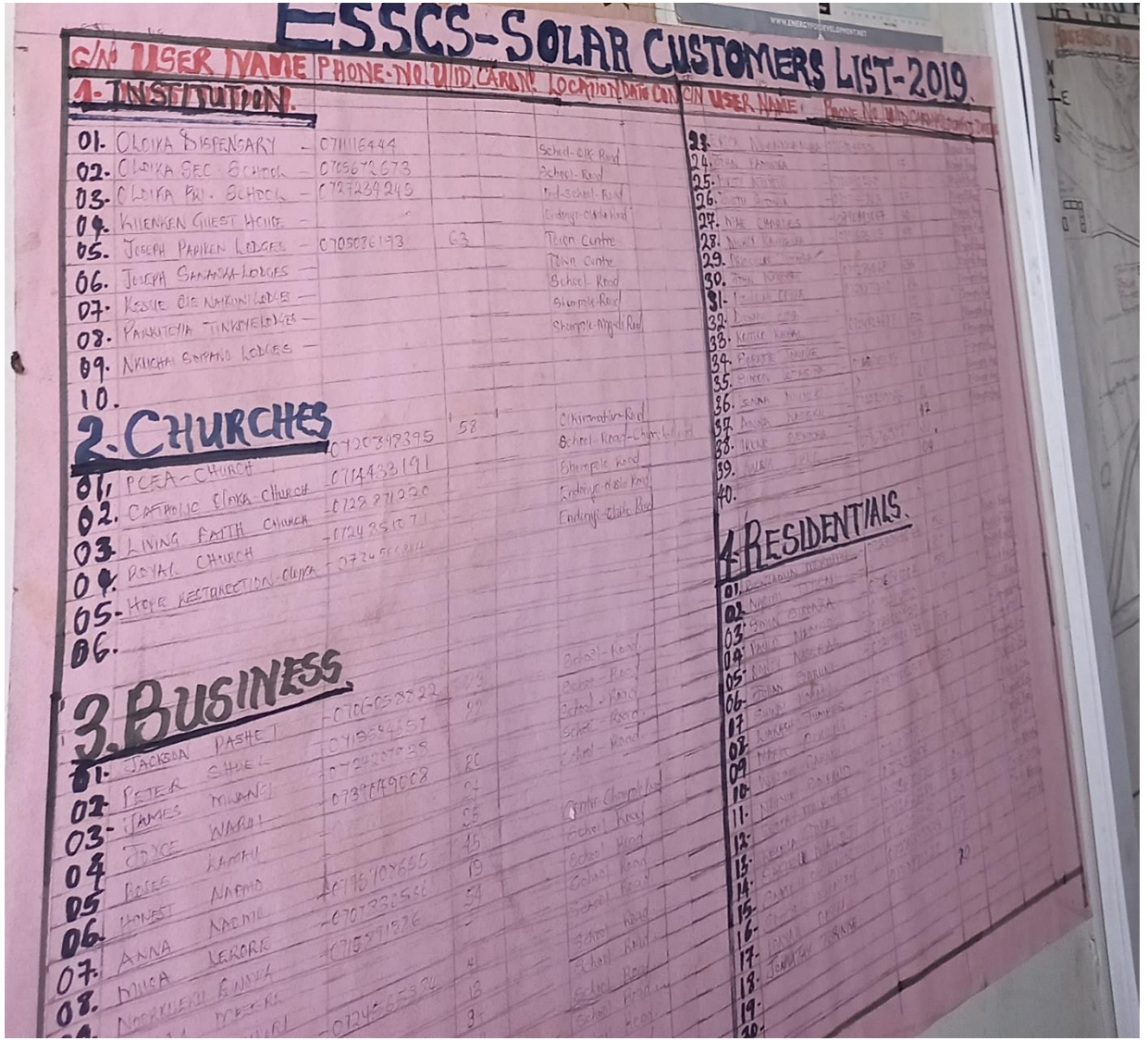
Technical sustainability

Minigrid sector in Kenya

Demand management

- Technologies used in Kenya
  - Solar, small-hydro, wind, hybrid (solar & wind, diesel & solar, hydro & diesel)
- Generation capacity ranges from 7.3 kW to over 520 kW. Connections: 50 to over 2000 customers
- Challenges in demand management, particularly for smaller and community grids, including:
  - Operating beyond capacity with excessive connections
  - Delayed connections for paid-up customers due to equipment shortages and operational logistics
  - Demand management solutions:
    - Upgrading systems to boost generation capacity
    - Integrating hybrid technologies (e.g., solar and wind)
    - Streamlining connection and repair processes for clients





Oloika solar minigrid, 13.5KW, 46 connections
(Community owned/operated)

Adequacy & Reliability

Adequacy

Types of appliances supported by the grids: in some cases restricted

Not able to support multiple appliances

Day & Night **time supply**

Stable mini grids **are able to meet the energy demand** during the day & night

Unstable mini grids cut supply **as early as 4pm.**

Clients have to source for back-ups

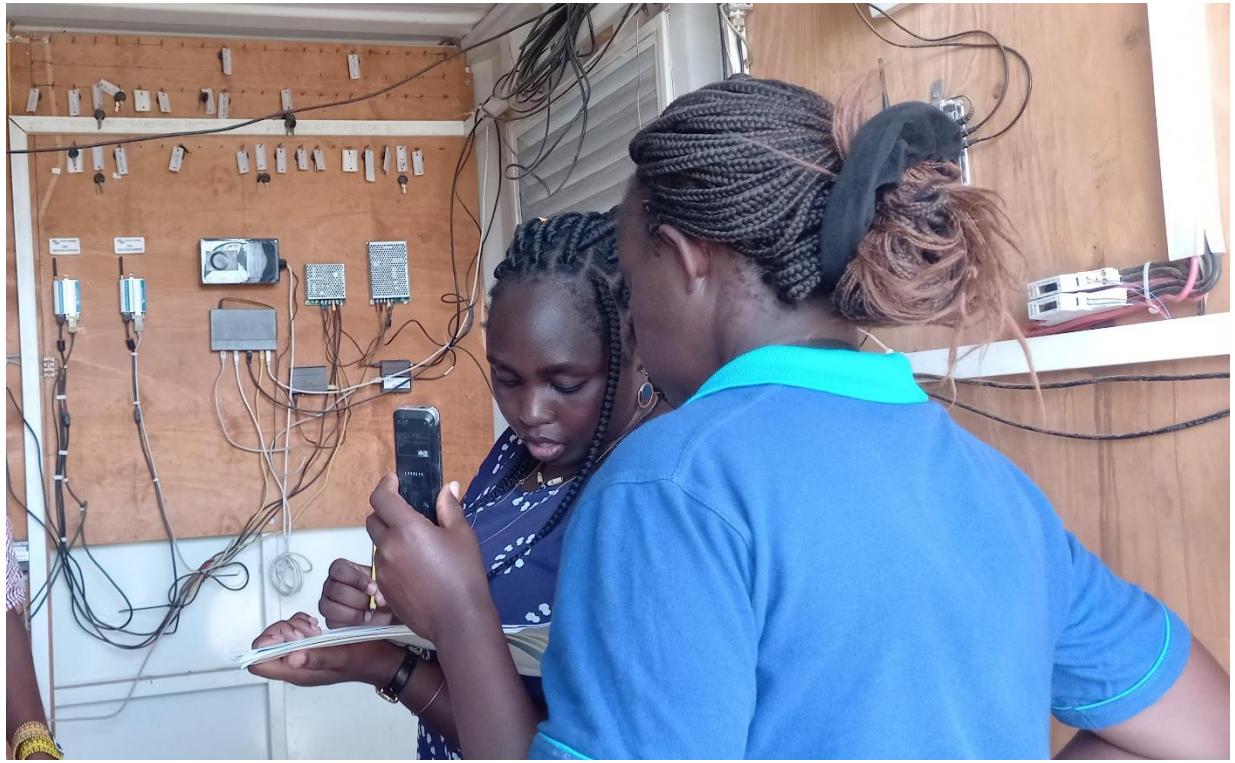
Outages

For stable mini grids, outages are not common / frequent

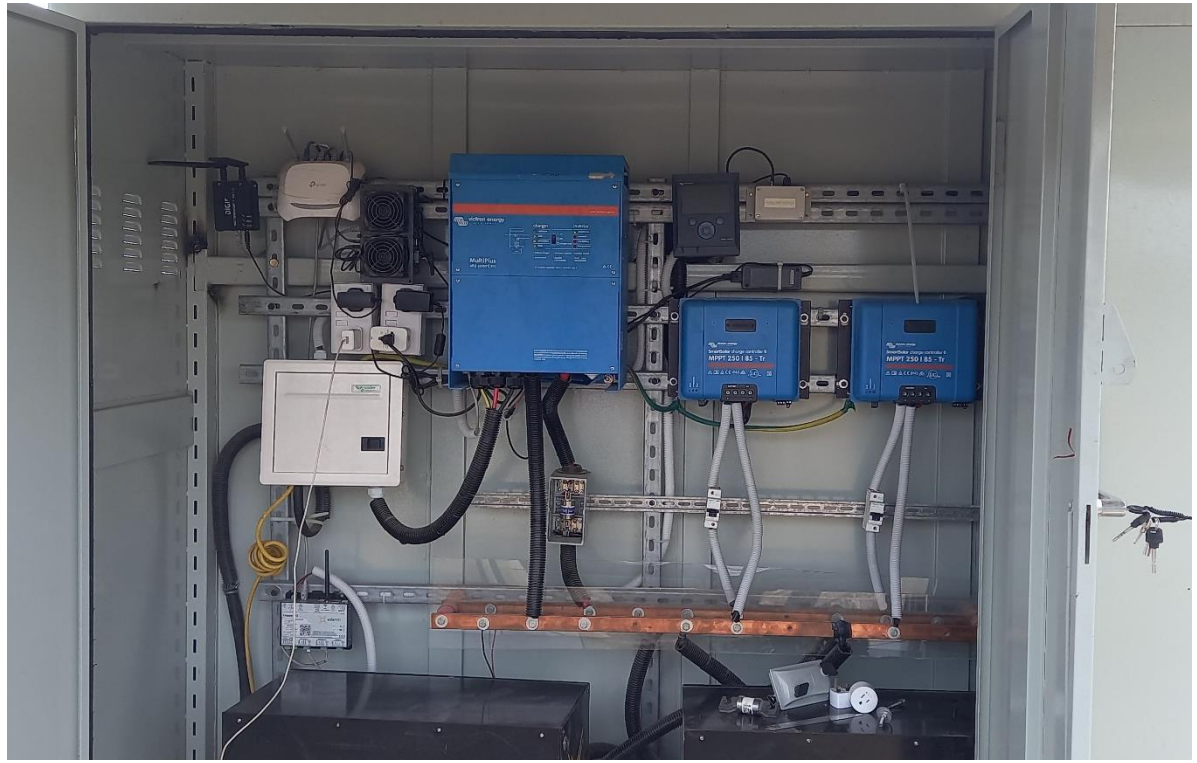
Community minigrids and locally owned: daily outages, between less than an hour to 12 hours in cases of unstable grids

Prolonged cloud cover affecting mainly solar systems

Drought affecting hydro mini grids due to low water levels in rivers



Community owned minigrid control room



Multinational minigrid developer control room

Operation & maintenance

Smart metering enables remote monitoring, which addresses many O&M issues

Lack of local capacity to do repairs and maintenance due to untrained personnel

Supply-chain issues: Spare parts mostly shipped from overseas

Poles need replacement due to termites, soil acidity & rotting

Battery storage a significant issue: affordability, sizing, replacement, upgrades

Cleaning of panels: Dust and soiling of solar panels

Social inclusion in minigrid projects

Minigrid sector in Kenya

Social inclusion in consumption and impact

- In principle, minigrids are designed to include marginalized communities
- Consumption and impact:
  - Domestic use:
    - access to lighting, powering small appliances and devices, entertainment and communication, powering social institutions (schools, health centres, community centres, religious centres, etc.
    - However, there are disparities in consumption and impact:
      - Reduced drudgery of housework for women? Equity of access to power among genders/age groups?
  - Productive uses:
    - Income generation and employment creation. Emergence of new businesses: barber shops, carpentry, chilling units, bars, ice-block provider and photocopying among others
    - Women owned businesses increased
    - increased business competition within the community, conflicts
    - forward and backward linkages that the arrival of the mini grid has spurred between agriculture and SMEs
    - Absolutely poor households are excluded: lack capacity to start businesses

Businessman at Ndeda Island minigrid

A video hall on Ndeda Island

Social inclusion in minigrid processes

Feasibility, site acquisition, approval

- **Community entry points**: CBOs, influential persons, community leaders
  Community land donated for minigrid site. Conflicts around compensation
- Local consultations through meetings and committees. But often, **community involvement borders on tokenism.**
- Approval processes at the local level involves local authorities and community leaders

Engineering, Procuring & construction

- There is still a major **lack of capacity and skills** around mini grid development
- **EPC done in a top-down way**. Local procurement of poles and structural equipment. Communities often involved in construction: provide manual labour.

O & M

- Several cases of **community-driven O&M:** CBOs in O&M, independent local/village committees; local cooperatives.
- **Skilled labour in most cases outsourced.** Unskilled labour- security/ groundsman/cleaning of panels and maintaining site

Issues: Capacity development, local employment creation, gender issues, local politics (elections).

- Recommendations
  - active community involvement in managing the energy intervention and crafting local forms of governance can lead to more inclusive institutional arrangements, capable to promptly adapt to local realities and respond to upcoming issues
  - Local knowledge of energy matters a hinderance to community participation. Need for capacity building
    - E.g., in evaluating technologies (solar vs wind vs biomass; Ac vs DC, microgrids vs individual systems)
  - mixed project outcomes and high levels of failures call for a systematic investigation into the nature and extent of community involvement

Summary insights: Mini-grids in Kenya

Technical

- There is still a major lack of capacity and skills around minigrid development
- Technical specifications around grid readiness of minigrids are unclear in the regulations
- Significant grid reliability and scalability problems in smaller companies and community minigrids

Economic

- Cost-reflective minigrid tarrifs remain prohibitively high for vulnerale households
- Dominance of DFI financing in the minigrid sector. Grants are crucial at early stage of development.
- Underutilisation of minigrids keep costs high. Developers seeking businesses and anchor customers
- To be profitable, developers are investing in anchor customers & productive use value chains

Social

- Political challenges: local politics create financial and project risks. E.g. delegitimization of minigrids by local politicians
- Regulation on participation is underdeveloped in most SSA countries
- Cultural factors determine who is included. Men and wealthier community members have higher participation and decision-making capabilities in minigrid projects
- Implementing an inclusive process is very costly for government and developers. It is not clear to them what the value addition of community participation is

Governance

- Minigrid regulations were enacted in 2021
- Contentious issues: Ambiguity around what happens when the grid arrives
- There is a lack of alignment between the national regulator and local authorities
- Some minigrid developers feel there is a lack of transparency in regulation, e.g. In tarrif setting, approval of permits

Conclusion

- The need for universal access to electricity provides an environment for stakeholder involvement/engagement in electrification
- Current policies provide an environment for mini grid development
- Continuous stakeholder engagement needed to understand the mini grid regulations and where possible find a solution for the contentious issues
- Innovative financing models are necessary to lower the tariffs since the communities (rural) served are in most cases already vulnerable

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The Sample

		Ownership model					
		Publicly owned	Privately owned	Public Private Partnership	Community owned	Other (e.g. faith-based org)	**TOTAL**
Technology	Hydro	0	1	0	0	0	**1**
	Solar PV		11		1		**12**
	Fuel oil						**0**
	Geothermal						**0**
	Biomass		0				**0**
	Natural gas	0					**0**
	Wind						**0**
	Hybrid	1	1				**2**
	TOTAL	**1**	**13**	**0**	**1**	**0**	**15**