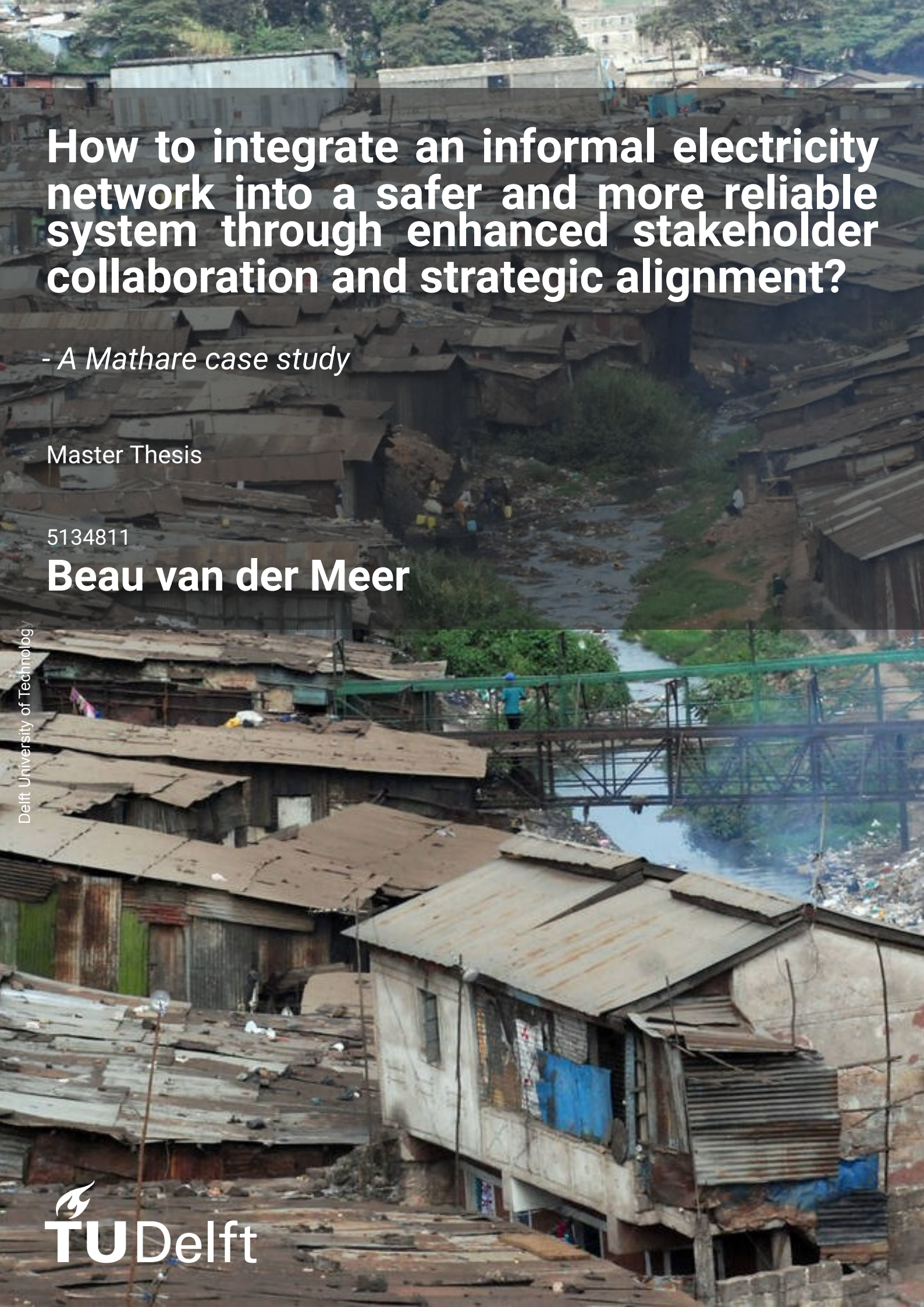

How to integrate an informal electricity network into a safer and more reliable system through enhanced stakeholder collaboration and strategic alignment?

- A Mathare case study

Master Thesis

5134811

Beau van der Meer

Delft University of Technology

TU Delft

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Master Thesis

by

Beau van der Meer

Student Name	Student Number
Beau van der Meer	5134811

First Coordinator:	Dr. L.M. Kamp
Second Coordinator:	Prof.dr. C. P. van Beers
Advisor:	Dr. Nthabi Mohlakoana
Project Duration:	January, 2025 - July, 2025
Faculty:	Technology and Policy Management, Delft

TU Delft

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Beau van der Meer
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Abstract

Access to electricity in informal settlements such as Mathare, Nairobi, remains a critical challenge that extends beyond infrastructure limitations to include governance and stakeholder coordination issues. This study investigates how enhanced stakeholder collaboration and strategic alignment can support the integration of Mathare's informal electricity network into a safer, more reliable, and legally regulated system. Motivated by the urgency of improving energy access in marginalised urban areas, the research focuses on aligning the interests of diverse actors, including community members, CBOs, informal electricity suppliers, Kenya Power, and government agencies, which often operate in silos or conflicts.

A mixed methods approach was used, including 38 semi-structured interviews, focus group discussions, and direct observations, facilitated by collaboration with local CBOs. Thematic analysis was used to identify key barriers to stakeholder alignment and opportunities for participatory governance.

The findings reveal significant misalignments in stakeholder goals and a general absence of trust and dialogue among actors. Two integration approaches were analysed: Community-Based Energy Cooperatives (CBEC) and government-led "Last Mile" expansion, the CBEC approach emerging as the most contextually viable option due to its emphasis on local ownership, accountability, and flexible governance.

The study concludes with a comprehensive roadmap and actionable policy recommendations aimed at Kenya Power. These include cooperative formation, tariff negotiations, technical training, and infrastructure implementation. By fostering collaborative governance structures and recognising the legitimacy of informal systems, the proposed roadmap contributes to building a safer and more reliable energy future in Mathare and similar urban settlements across Africa.

Executive Summary

The Challenge: Electricity Access in Mathare

As the primary executive responsible for electricity distribution in Kenya, Kenya Power Lightning Company (KPLC) is directly addressed in this summary, which provides strategic insights and recommendations for improving service delivery in informal settlements like Mathare. Mathare is one of Nairobi's largest informal settlements and illustrates the ongoing energy access challenges facing many urban poor communities in Kenya. Despite being densely populated and highly active, Mathare lacks adequate access to safe, affordable, and reliable electricity. Most of the residents depend on informal electricity networks, illegally connected, technically unsafe, and often unreliable due to prohibitive connection fees, land tenure insecurity, and institutional neglect. These networks are essential for daily living for residents, but pose serious public safety risks, such as electrocution and fire hazards. At the same time, Kenya Power suffers substantial technical and commercial losses in these areas, as well as reputational challenges due to recurring community tensions. The central challenge, therefore, lies in integrating these informal systems into a formal, regulated, and inclusive energy framework that balances community needs with institutional objectives.

Research Objective and Questions

The core objective of this study is to develop a feasible, inclusive, and stakeholder-driven roadmap for the formalisation of electricity access in Mathare. The study focuses on identifying strategies that align the interests of local communities, informal providers, and formal institutions, particularly Kenya Power. The study is guided by the central research question:

> *How can an informal electricity network be integrated into a safer and more reliable system through enhanced stakeholder collaboration and strategic alignment?*

To explore this, the following sub-questions are addressed:

- *How do key stakeholder interests and relationships influence electricity access in Mathare?*
- *What approaches are there to make informal electricity networks safer and more reliable?*
- *Which approach is most suitable for Mathare, and how can it be implemented?*

These questions help assess the social, technical, and institutional dynamics that shape electricity access and the potential for sustainable integration of informal networks into formal infrastructure.

Methodology

The study used a mixed-methods approach, including 38 interviews with residents, informal providers, KPLC representatives, local CBOs, and public officials. A multi-stakeholder focus group and field observations supported validation and contextual depth. The involvement of three trained community researchers ensured cultural sensitivity. Thematic analysis revealed patterns in stakeholder relationships, governance gaps, and infrastructure risks, forming the recommended intervention.

Key Findings

Widespread distrust of KPLC, rooted in past disconnections and high tariffs, has led many residents to rely on informal providers who, while adaptive and accessible, operate without safety standards or regulatory oversight. Regulatory barriers, such as land tenure and identity documentation, further exclude most residents from formal access.

Top-down programs like the Last Mile Connectivity initiative have failed to address the unique realities of informal settlements. In contrast, community-led, bottom-up strategies show greater promise. Among the approaches studied, the Community-Based Energy Cooperative (CBEC) approach emerged as the most viable for aligning community practices with formal grid requirements and institutional goals.

Strategic Recommendation: CBEC Approach Led by KPLC

To achieve safer and more reliable electricity in Mathare, KPLC should lead the implementation of the **Community-Based Energy Cooperative (CBEC)** approach. This approach formalises existing informal systems by building on trusted community actors and integrating them into the legal grid infrastructure. The CBEC acts as a community-governed intermediary between residents and KPLC, fostering trust, technical compliance, and local ownership. The CBEC approach presents a strategic opportunity for KPLC to reduce non-technical losses, expand its legitimate customer base, and fulfill its mandate for equitable energy access.

Key components of the CBEC approach include:

- **Community Partnership:** KPLC collaborates with local Community-Based Organisations (CBOs) and trusted community leaders to establish CBECs with formal licensing and legal standing.
- **Professionalising Informal Providers:** Existing informal providers are identified and trained to become certified Community Energy Agents (CEAs), responsible for metering, billing, and basic maintenance under KPLC oversight.
- **Flexible Tariff Models:** CBECs adopt context-sensitive tariffs (e.g., pay-as-you-go), matched to irregular income flows in informal settlements.
- **Transparent Governance:** Local advisory boards and grievance mechanisms ensure inclusive decision-making and long-term trust.
- **Policy Advocacy:** KPLC advocates for enabling regulatory changes such as collective metering and simplified connection requirements for informal structures.

Why This Matters for KPLC

The CBEC approach is more than a technical solution; it is a strategic tool for KPLC to:

- Reduce electricity theft, illegal connections, and enforcement burdens.
- Re-establish legitimacy and trust among communities historically excluded from formal service.
- Expand the paying customer base while improving safety and grid stability.
- Lead a national precedent in inclusive urban electrification aligned with SDG 7.

The Path Forward: Implementation Roadmap for KPLC

A four-stage roadmap is proposed to support KPLC in implementing the CBEC approach in Mathare:

1. **Stage 1 – Stakeholder Mobilisation and Legal Setup:** Initiate dialogue with community leaders, informal suppliers and CBOs; co-design governance models; secure legal and institutional frameworks for CBEC operation.
2. **Stage 2 – Tariff Co-Design and Partnership Structuring:** Develop viable business models and tariff structures in consultation with residents; define KPLC's service commitments and oversight role.
3. **Stage 3 – Training and Formalization of CEAs:** Provide technical and safety training to selected informal providers; certify them as CEAs; equip them with tools and digital systems for service delivery.
4. **Stage 4 – Technical Integration and Service Launch:** Upgrade grid infrastructure, install smart metering, and commence phased electricity rollout through the CBEC; monitor progress and scale based on lessons learned.

Conclusion

This study presents the CBEC approach as a practical and scalable pathway for KPLC to address the complex realities of informal electricity in Mathare. It aligns community incentives with corporate goals and regulatory demands. KPLC has both the authority and the opportunity to lead this transformation, redefining how electricity access is delivered in informal settlements in Kenya. With targeted investment and strategic partnership, the CBEC could become the cornerstone of inclusive and resilient energy systems in urban Kenya.

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List of Acronyms

CBEC	Community-Based Energy Cooperatives ii–iv, vii, 30–33, 36–53
CBO	Community-Based Organisation vii, 14, 26, 38, 47, 49
CBOs	Community-Based Organisations ii, vii, 1–4, 10, 11, 13, 14, 17, 21, 23, 25–27, 32, 37, 39, 41, 43–47, 52
CEAs	Community Energy Agents vii, 31, 34, 39–41, 44, 45, 47, 52
eCAP	The eCooking Capacity Building and Market Development programme vii, 24
EPRA	Energy and Petroleum Regulatory Authority vii, 8, 38, 39, 41, 45, 47, 52
ESTs	Energy Service Technicians vii, 32
FGD	Focus Group Discussion vii, 14–18, 32
FGDs	Focus Group Discussions vii, 14, 15, 32, 36
HREC	Human Research Ethics Committee vii, 18
INEP	Integrated National Energy Planning Framework vii, 7, 8, 20
KES	Kenyan Shilling vii, 7, 28, 29, 39
KOSAP	Kenya Off-Grid Solar Access Project vii, 6
KPLC	Kenya Power and Lighting Company iii, iv, vii, 17, 34
LMCP	Last Mile Connectivity Program vii, 6
M&E	Monitoring and Evaluation vii, 41
NGO	Non-Governmental Organisation vii
NGOs	Non-Governmental Organisations vii, 2, 9, 39, 47, 48
SDG	Sustainable Development Goal iv, vii
SWOT	Strengths, Weaknesses, Opportunities, and Threats vii, 32

1 Introduction

1.1. Background and Context

Kenya has achieved a 76% electrification rate as of 2023, driven by initiatives such as the Last Mile Connectivity Program to expand electricity access to rural and informal settlements (Global Infrastructure Hub, 2019; Ministry of Energy and Petroleum, 2024). Despite this progress, informal settlements still face major electricity access challenges due to governance issues, infrastructure gaps, and economic constraints (UNHCR, 2024).

Illegal electricity connections are widespread in these areas, as high costs and bureaucratic hurdles make legal connections inaccessible (Kamau & Onyango, 2019; Kenya Power and Lighting Company, 2020). Many residents rely on informal suppliers, often controlled by local cartels, to meet their energy needs (Bercegol & Monstadt, 2018). While providing a temporary solution, these unauthorised connections increase power outages, fire hazards, and electrocution risks (ENERGIA, 2021b). In Mathare, frequent accidents caused by exposed live wires have been reported, especially during the rainy season (Odhiambo, 2021). Kenya Power estimates that illegal connections account for around 20% in revenue losses, further straining the electricity sector (EPRA, 2021).

Informal settlements operate within a mix of formal and informal governance, involving community members, informal energy providers, energy companies (Kenya Power), and government agencies (ENERGIA, 2021b). Misalignment between these actors leads to inefficient distribution, high costs, and unsafe connections. Governance structures at national, county, and local levels lack coordination, creating policy gaps that hinder effective electricity access (Ministry of Energy and Petroleum, 2021). Addressing these challenges requires collaboration between formal and informal actors to develop safe, affordable, and sustainable electricity solutions.

1.2. Problem Statement

Electricity access in Kenya's informal settlements is not solely a technical challenge but also a governance and coordination issue (Ono & Kidokoro, 2020). The lack of alignment between key stakeholders, including community members, informal energy providers, Kenya Power, government agencies, and CBOs, creates inefficiencies in electricity distribution, pricing, and service reliability (ENERGIA, 2021a; Okello, 2023). Each stakeholder group has different interests, often leading to conflicts and inefficiencies.

Community members require affordable, reliable, and safe electricity connections but often rely on informal providers due to the inaccessibility of formal grid connections (Nuvoni Centre for Innovation Research, 2023a). Informal energy providers, which operate unauthorised electricity distribution networks, fill a service gap left by Kenya Power but frequently charge inflated prices while offering unreliable and hazardous services (Onsongo et al., 2023). Kenya Power, as the sole national electricity provider, faces significant challenges in expanding services to informal settlements due to issues such as illegal connections, infrastructure costs, and policy constraints (Nuvoni Centre for Innovation Research, 2023c). Government authorities at both national and county levels regulate electricity provision but often struggle with enforcement, funding, and integrating informal settlements into official electrification plans (Ministry of Energy and Petroleum, 2021).CBOs play an important mediating role by advocating

for local energy needs, supporting engagement efforts, and fostering connections between communities and policymakers (Onsongo et al., 2023).

One of the key structural barriers to integration is that informal settlements are often not recognised by the government in formal energy planning processes due to their lack of legal land tenure. Without land rights, these areas are deemed unauthorised or illegal, making them ineligible for formal infrastructure investment and electrification programs (Kombe, 2005; UN-Habitat, 2020). This administrative exclusion results in a systemic gap where residents are effectively left outside public service planning frameworks, perpetuating dependence on informal and unsafe electricity networks (Todes, 2010a). Land tenure security is thus deeply intertwined with energy justice and access; without it, national utilities like Kenya Power are unable or unwilling to formalise connections in these high-density urban areas (Omwoma, 2013).

The misalignment of incentives and lack of coordination among stakeholders have led to persistent inefficiencies in electricity supply within informal settlements (Clarke & Kivuva, 2018). These inefficiencies are characterised by unreliable electricity access, frequent outages, and elevated electricity costs. Notably, safety hazards, including electrocution incidents and fires, are prevalent due to unauthorised and unsafe electrical connections, especially in densely populated areas such as Mathare (Bercegol & Monstadt, 2018). Kenya Power has also reported that illegal connections contribute to approximately 20% revenue losses, exacerbating the financial challenges within the energy sector (EPRA, 2021).

The governance of electricity access in informal settlements is marked by fragmented decision-making, with multiple actors operating independently and often without effective coordination (Nuvoni Centre for Innovation Research, 2023a). The Energy Planning Workshop for Informal Settlements emphasised the importance of collaborative planning, formalising informal energy providers, and engaging local communities in electricity policy formulation (Onsongo et al., 2023). Such initiatives highlight the critical need for a structured governance framework that enhances participation from all relevant stakeholders.

As part of this study, Nuvoni Research, an interdisciplinary institute focused on energy access and urban resilience, facilitated a multi-stakeholder workshop aimed at identifying barriers to effective energy planning in informal settlements. The workshop brought together representatives from CBOs in Mathare, national government officials, informal energy suppliers, representatives from Kenya Power, and NGOs. Its primary objective was to foster dialogue and promote collaborative problem-solving, leading to the identification of systemic and practical barriers to coordinated energy planning. The insights generated have provided a foundational basis for the development of more inclusive and integrated energy planning strategies.

Addressing these challenges requires a concerted effort among government agencies, Kenya Power, community-based organisations, and informal energy providers. Such a coordinated approach is essential to establishing a sustainable and equitable electricity system that effectively serves the needs of residents in informal settlements.

1.3. Research Gap

Despite significant progress in rural electrification and formal grid expansion, there remains a notable lack of understanding regarding how urban informal settlements can be effectively integrated into formal electricity systems. Existing studies predominantly focus on technical and infrastructural challenges, often overlooking the roles of stakeholder collaboration, participatory governance, and the socio-economic complexities unique to these environments (Clancy, 2016; Jones, 2019; Mimmi, 2014).

Moreover, there is a scarcity of comparative studies that examine both successful and unsuccessful integration efforts across different contexts. This limits the development of adaptable and inclusive models for formalising electricity access. Much of the current research focuses on national and county-level energy policies, without adequately addressing the operational realities and governance barriers present in informal settlements like Mathare.

The key gaps in the literature include:

- A lack of research on how diverse stakeholders, such as community members, informal providers, Kenya Power, and government agencies, can collaborate to enable safe, affordable, and legal electricity access.
- Insufficient attention to the role of stakeholder alignment in the success or failure of electrification initiatives in informal settlements.

- Limited investigation into mechanisms for integrating informal electricity providers into formal systems through participatory governance.
- A need for comparative analyses that identify key drivers of success or failure in formalisation efforts across various geographic and institutional settings.

This study seeks to fill these gaps by focusing on the case of Mathare, Nairobi. It explores how improved stakeholder collaboration can support the integration of informal electricity networks into a more reliable and safe formal system. In doing so, it aims to generate insights that inform both policy and practice in similar urban informal contexts.

A more detailed substantiation of these gaps is provided in Chapter 2, where relevant literature is critically reviewed.

1.4. Research Focus and Objectives

This research aims to develop a comprehensive roadmap and provide actionable recommendations for Kenya Power to integrate Mathare's electricity network into a safer and more reliable system. The focus on Mathare is motivated by its status as one of Nairobi's most densely populated informal settlements, where electricity access is characterised by high safety risks, unreliable supply, and informal networks. Addressing these challenges is not only a local priority but also a critical case study for similar urban settlements across Africa.

The goal is to reduce safety hazards and enhance accessibility and affordability for residents. These objectives are grounded in the need to ensure energy access for marginalised communities, which aligns with global sustainability goals (United Nations, 2015b). By analysing the roles, relationships, and challenges faced by various stakeholders, the study seeks to offer practical solutions for creating a safer, more reliable, and more legally regulated electricity network in Mathare.

The research will assess how stakeholder alignment and collaboration can improve the shift to a more reliable and safer electricity system. This focus on stakeholder alignment is based on the recognition that multi-actor coordination is essential for effective governance in complex urban environments (Ansell & Gash, 2008a). This analysis will identify barriers, power dynamics, and cooperation challenges among key stakeholders and propose strategies for improved engagement. Achieving these objectives requires a structured governance framework that promotes inclusive participation from all stakeholders, including government agencies, Kenya Power, CBOs, and informal energy providers.

The study focuses on assessing the role of informal electricity distribution networks and their interactions with formal providers. It will explore how Kenya Power and government agencies can collaborate to integrate informal settlements like Mathare into an improved electricity network, which is safer and more reliable. This is motivated by evidence showing that improving informal networks by making them more regulated can enhance safety and service reliability (Clancy & Skutsch, 2016). Additionally, the study will investigate pathways to incentivise informal suppliers and networks to transition towards legal, regulated electricity provision. Strengthening community participation and engagement is essential to ensure that electricity access initiatives are both affordable and accessible (Makunde et al., 2022).

Understanding the existing dynamics and relationships among stakeholders is crucial for developing a successful roadmap. The approach of understanding all stakeholders is emphasised by governance theory, which emphasises that effective policy implementation requires a clear understanding of stakeholder roles and interactions (McCarthy, 2018a). The study will draw insights from workshops, interviews, and secondary data to identify barriers and misalignments in stakeholder participation. The Nuvoni Workshop will serve as a critical source of information for evaluating stakeholder perspectives and participation challenges. Electricity usage patterns from the Nuvoni database will be analysed to understand the energy demand within informal settlements and to identify opportunities for collaboration between stakeholders to improve electricity access, governance, and safety.

The main research question guiding this study is:

> *How can an informal electricity network be integrated into a safer and more reliable system through enhanced stakeholder collaboration and strategic alignment?*

To further explore this research question, the study is structured around the following subquestions:

- How do key stakeholder interests and relationships influence electricity access in Mathare?

- What approaches are there to make informal electricity networks safer and more reliable?
- Which single approach can be implemented to create a safer and more reliable electricity system in Mathare, and how can it be implemented?

These questions are designed to ensure a systematic exploration of the problem, starting from stakeholder analysis to identifying practical solutions. The findings from the Barriers Workshop, which is discussed in Section 1.2 Problem Statement, will contribute to identifying key obstacles and proposing practical solutions. Ultimately, this research will provide Kenya Power with clear, actionable advice on how to formalise Mathare's electricity network while enhancing safety and accessibility, which can be found in Executive Summary.

By addressing these questions, the research aims to generate actionable insights into effective stakeholder collaboration and strategic alignment, ensuring that efforts to improve electricity access in Mathare are safer and more reliable.

1.5. Research Contributions

This research is built on earlier studies conducted by the Nuvoni Research Institute, which explored various aspects of electricity access in informal settlements. By focusing on stakeholder alignment in Mathare, this study extended and refined these insights, providing a more structured and theoretically grounded approach to improving collaboration among community members, informal suppliers, Kenya Power, CBOs, and government agencies. This focus was motivated by the recognition that stakeholder alignment is critical for addressing governance challenges in complex socio-technical systems (Ansell & Gash, 2008a; Fischer, 2012a).

The findings of this research provided practical solutions grounded in theoretical models. This dual focus on theory and practice bridged the gap between academic knowledge and policy implementation (Creswell et al., 2011). The outcomes would be relevant beyond Mathare, as many informal settlements in Africa face similar governance and infrastructure challenges. The generalizability of this study was further supported by its emphasis on stakeholder alignment: a concept applicable across diverse urban contexts (Clancy & Skutsch, 2016).

Furthermore, this research aligned with the objectives of the Management of Technology (MOT) program at TU Delft by integrating both technical and socio-managerial aspects of electricity access. The study examined stakeholder coordination, governance structures, and social incentives that influence electricity distribution in informal settlements. This multidisciplinary approach reflected the core vision of the MOT program, which seeks to bridge technology and management to create impactful, sustainable solutions (McCarthy, 2018a).

By examining how to improve the informal network of Mathare, this research offered:

- An understanding of the relationships and power dynamics between community members, CBOs, informal suppliers, Kenya Power, and government agencies. This understanding was crucial for designing interventions that are socially acceptable and contextually appropriate.
- Recommendations for policy and regulatory changes that support the integration of Mathare into a safer and more reliable electricity network, ensuring that access is both legal and safe.
- Approaches to transition informal electricity networks into legally recognised service providers.
- Approaches for fostering collaboration between formal and informal actors in electricity distribution, supported by the principles of collaborative governance and Arnstein's Ladder (Ansell & Gash, 2008a; Arnstein, 1969).

These insights contributed to a roadmap for improving electricity access in Mathare. The findings were relevant for policymakers, electricity providers, development agencies, and local organisations, ensuring that stakeholder alignment is prioritised as a strategic response to the electricity challenges facing informal settlements.

2

Literature Review

This chapter provides a comprehensive review of the academic and policy literature relevant to electricity access in informal settlements, with a particular focus on stakeholder participation, governance dynamics, and informal energy systems. The purpose is to establish both conceptual and empirical foundations for this study, which investigates how informal electricity networks in Mathare can be integrated into a formal, safer, and more reliable system through enhanced stakeholder collaboration.

Section 2.1 introduces the global and urban challenges of electricity access in informal settlements, highlighting the infrastructural, institutional, and socio-economic barriers that hinder formal integration. Section 2.2 narrows the focus to the Kenyan context, analysing recent national electrification progress and identifying the persistent access gaps that affect urban informal areas such as Mathare.

Section 2.3 explores the structure and function of informal electricity systems, discussing both their adaptive role in filling service gaps and the substantial risks they pose in terms of safety, affordability, and reliability. Section 2.4 examines the regulatory and governance challenges that contribute to the persistence of informal networks, including institutional fragmentation, legal exclusions, and weak enforcement mechanisms.

Section 2.5 delves into the literature on stakeholder participation in energy planning, outlining both the barriers to inclusive engagement and strategies for building trust, legitimacy, and co-production among actors. Section 2.6 introduces the conceptual models that underpin this study, Arnstein's Ladder of Participation and Collaborative Governance Theory, both of which inform the analysis of stakeholder alignment as a strategic and conceptual goal.

Finally, Section 2.7 identifies the key gaps in the existing literature and articulates this study's contribution to academic and policy discussions on inclusive electrification, participatory governance, and urban infrastructure transformation.

Together, these sections establish a robust analytical and conceptual foundation for understanding the multifaceted challenges and opportunities associated with formalising and improving electricity access in Mathare and similar informal settlements.

2.1. Energy Access in Informal Settlements

Energy access is widely recognised as a fundamental enabler of sustainable development, affecting multiple dimensions of human well-being, including health, education, income generation, and gender equality (Modi et al., 2005). Electricity, in particular, facilitates the functioning of essential services, supports small businesses, enhances communication and information access, and reduces reliance on polluting and inefficient energy sources such as kerosene and charcoal (Blimpo & Cosgrove-Davies, 2019; Sovacool, 2012b).

Globally, an estimated 1.1 billion people still lack access to electricity, the majority of whom reside in Sub-Saharan Africa and South Asia (International Energy Agency, 2019). A significant proportion of this underserved population lives in urban informal settlements or densely populated areas that lack formal planning, secure land tenure, and basic services. Despite their centrality in urban growth, these areas are often excluded from national infrastructure plans due to their "illegal" status in planning frameworks (Kombe, 2005; UN-Habitat, 2022).

Informal settlements present unique challenges for electrification due to a combination of spatial, institutional, and socio-economic factors. Spatially, they are often characterised by high-density housing, narrow alleys, and inadequate road networks, which complicate the installation and maintenance of grid infrastructure. Institutionally, many lack formal recognition by governments, rendering them ineligible for public investment in infrastructure and utility services. Socio-economically, residents typically face high levels of poverty and informality in employment, which makes them less attractive to commercial service providers (Kooijman et al., 2023; Todes, 2010b).

Energy access in informal settlements is not merely a matter of technical provision or financial affordability; it is also a question of governance and energy justice. The existence of dual systems where informal electricity networks operate alongside or even replace formal grid infrastructure reflects complex socio-economic and political dynamics (Turner & Browning, 2019; Williams, 2020). Informal providers, who often step in to fill the service gaps left by formal utilities, offer a level of accessibility that may be critical for low-income residents. However, their operations are characterised by unregulated practices, which lead to safety hazards, poor-quality wiring, overloading, and a heightened risk of fire incidents.

Energy justice is a normative goal that advocates for fairness, equity, and inclusion in energy systems. It serves as an analytical lens to assess whether energy access and governance practices align with principles of distributive, procedural, and recognition justice (Heffron & McCauley, 2015; Jenkins et al., 2016).

Applying this goal in the context of informal settlements reveals the systemic misalignment between formal energy policies and the lived realities of residents. Centralised energy planning approaches, typically designed with urban or well-established residential areas in mind, do not account for the socio-spatial complexity of informal areas (Andrews & Silva, 2017; Fischer, 2012b). This misalignment perpetuates exclusion, as low-income communities remain dependent on unsafe informal networks.

Sustainable Development Goal 7, which aims for universal access to affordable, reliable, and sustainable energy, cannot be achieved without addressing these governance dimensions. Effective energy access strategies for informal settlements must therefore prioritise adaptive governance models that integrate participatory decision-making, community-led initiatives, and context-specific infrastructure solutions (Bhattacharyya, 2019; United Nations, 2015a).

2.2. Electricity Access in Kenya: Progress and Gaps

Kenya has emerged as a regional leader in electricity access, driven by substantial public investments, institutional reforms, and donor-supported initiatives. As of 2023, the national electricity access rate stands at 76%, a significant leap from 27% in 2013 (Ministry of Energy and Petroleum, 2024). This expansion is largely attributed to strategic programs such as the Last Mile Connectivity Program (LMCP), which aims to provide subsidised grid connections to low-income households by leveraging existing distribution transformers (Global Infrastructure Hub, 2019; Ministry of Energy and Petroleum, 2021).

The Kenyan government has also prioritised electrification as part of its Vision 2030 agenda, recognising the role of energy in achieving economic development, job creation, and social inclusion (Government of Kenya, 2007). These efforts have been complemented by donor-backed projects such as the KOSAP, which seeks to reach remote communities through decentralised renewable energy systems (World Bank, 2022).

Despite these impressive national-level achievements, a persistent and troubling access gap remains in urban informal settlements such as Mathare. These areas are home to a large proportion of Kenya's urban poor but are often excluded from electrification plans due to their informal legal status, lack of infrastructure, and the complexities of tenure and planning regulations (Mimmi, 2014; Oketch & Mwangi, 2019). Consequently, while electrification rates appear high at a national scale, they conceal significant spatial and socio-economic disparities (Urpelainen & Yadav, 2020).

The main barriers to formal electricity access in informal settlements can be categorised as infrastructural, regulatory, and financial (Lemaire & Kerr, 2016). From an infrastructural perspective, high population density, narrow passageways, and informal housing structures make it difficult to install and maintain conventional grid infrastructure (McCarthy, 2018b). Regulatory barriers stem from the lack of formal land titles, which disqualifies many residents from applying for legal connections. Kenya Power, the country's primary utility, requires documentation such as title deeds or tenancy agreements to establish a formal connection, effectively excluding vast swaths of urban populations (Rodriguez & Patel,

2021).

On the financial side, upfront connection fees remain prohibitively high. For many residents, the cost of a legal connection, including wiring and meter installation, can exceed KES 25,000, equivalent to several months of household income (Odhiambo & Kamau, 2022). Furthermore, the prepaid token system employed by Kenya Power does not accommodate the irregular income patterns of informal settlement residents, leading to frequent disconnections and dissatisfaction with the formal service (Baugh, 2015).

As a result of these barriers, informal electricity networks have proliferated. These systems are operated by local actors who tap into Kenya Power's infrastructure illegally and redistribute electricity to households at flat rates. While more accessible and affordable in the short term, these informal networks are plagued by frequent power outages, voltage instability, and severe safety hazards, including electrical fires and electrocution risks (Gibson, 2019; Williams, 2020). Kenya Power estimates that illegal connections contribute to annual revenue losses of approximately 20%, undermining the utility's financial sustainability and investment capacity (EPRA, 2021).

The persistence of informal networks highlights the governance and coordination challenges in urban electricity provision. National electrification plans such as the Integrated National Energy Planning Framework (INEP) tend to prioritise rural electrification and industrial zones, while urban informal settlements remain institutionally invisible (Ministry of Energy and Petroleum, 2021). County governments, which are expected to play a key role in local energy planning under the devolved governance system, often lack the technical capacity, financial resources, and legal mandate to develop tailored solutions for these areas (Kaberia et al., 2023).

In summary, Kenya's progress in electricity access masks critical equity concerns. Informal settlements continue to be excluded from formal systems due to structural, legal, and institutional barriers. Addressing these disparities will require targeted interventions that go beyond infrastructure provision to include regulatory reform, financial innovation, and inclusive stakeholder engagement. Only through such a multidimensional approach can electrification efforts align with the principles of energy justice and urban equity.

2.3. Informal Electricity Systems

Informal electricity networks have become a defining feature of urban informal settlements in many developing countries, including Kenya. These systems emerge as community-based, unregulated alternatives to the formal electricity grid, often operated by local actors who tap into existing infrastructure and redistribute electricity through improvised wiring systems (Turner & Browning, 2019; Williams, 2020). While technically illegal, these networks provide essential energy services to populations excluded from the formal system, illustrating the adaptive strategies residents employ to meet their energy needs (Baye, 2025).

The widespread reliance on informal electricity systems is primarily a response to barriers within the formal sector. These include high connection costs, burdensome administrative requirements, and long delays in service provision by utilities such as Kenya Power (Baugh, 2015; Mimmi, 2014). For many residents of settlements like Mathare, accessing electricity through informal channels is often the only viable option due to a lack of formal documentation or financial resources.

Functionally, informal electricity systems serve as lifelines. They enable lighting, charging of mobile phones, refrigeration of food and medicine, and operation of small businesses, thereby contributing to livelihood activities and household well-being (Zaman et al., 2021). Some informal providers even maintain basic systems for customer service, including flat-rate payments and informal maintenance agreements (Gibson, 2019; Rodriguez & Patel, 2021). In this way, informal suppliers have carved out a niche within the broader urban energy landscape, filling gaps left by under-resourced formal institutions.

However, the operation of informal systems comes with substantial risks. Technically, these networks are characterised by unsafe wiring, overloaded transformers, lack of grounding, and widespread non-compliance with electrical safety standards (Gibson, 2019; Williams, 2020). The result is a high incidence of electrical shocks, fires, and equipment damage. In high-density areas like Mathare, exposed wires are commonly found hanging from buildings or running across walkways, posing significant dangers, especially to children and the elderly (Oketch & Mwangi, 2019).

Reliability is another key concern. Informal networks are prone to frequent outages due to poor-quality infrastructure and limited repair capacity. Residents report voltage fluctuations, power surges,

and inconsistent supply, especially during peak hours or rainy seasons (Mimmi, 2014). These reliability issues directly impact daily life and economic productivity, as appliances and lighting are essential for small-scale enterprises such as salons, food vendors, and phone charging stations.

Moreover, the governance of informal networks raises important ethical and legal questions. In some cases, electricity provision is controlled by local cartels or criminal groups that use coercion to maintain control and extract high payments from residents (Energy and Petroleum Regulatory Authority, 2022; Turner & Browning, 2019). This leads to exploitative practices, including arbitrary price increases and punitive disconnections. Despite their role in service provision, these actors operate in a legal grey area, often beyond the reach of regulation or accountability.

From the perspective of the formal electricity utility, these systems contribute to significant commercial losses. Kenya Power estimates that illegal connections account for up to 20% of its total annual revenue losses (EPRA, 2021). These losses reduce the utility's financial capacity to invest in infrastructure upgrades and expand service to underserved areas, creating a vicious cycle where informal settlements remain unconnected.

Despite the risks and inefficiencies associated with informal electricity systems, their existence points to critical governance failures and systemic exclusion in urban energy policy. Simply cracking down on illegal connections without offering viable formal alternatives risks further marginalising vulnerable populations. A growing body of literature emphasises the need for innovative governance models that acknowledge the role of informal providers while working toward safer, more inclusive, and regulated systems (Chakrabarti & Sen, 2016; Fischer, 2012b).

2.4. Governance and Regulatory Challenges

The challenge of extending electricity access to informal settlements is not merely technical or financial, it is fundamentally a question of governance. In many developing countries, including Kenya, governance frameworks surrounding energy planning tend to marginalise informal urban areas due to their legal ambiguity and political invisibility (Kombe, 2005; Todes, 2010b). Informal settlements often fall outside the jurisdiction of formal planning regimes, and their lack of legal land tenure prevents them from being included in public infrastructure projects such as electricity distribution (Kooijman et al., 2023; UN-Habitat, 2022).

In Kenya, electricity distribution is managed primarily by Kenya Power, an Energy company with monopoly status over the transmission and distribution of electricity. While Kenya Power has significantly expanded grid access nationwide, it faces serious regulatory and infrastructural constraints when operating in informal settlements (Ministry of Energy and Petroleum, 2024; Rodriguez & Patel, 2021). The utility's requirement for formal property documentation, such as title deeds or registered tenancy agreements, automatically excludes many informal residents from the eligibility criteria for legal grid connections (McCarthy, 2018b).

At the policy level, national energy planning frameworks such as the INEP are primarily oriented toward rural electrification and grid expansion for formally planned urban developments (Ministry of Energy and Petroleum, 2021). These frameworks offer limited flexibility or recognition for settlements classified as "illegal," thus institutionalising exclusion. Meanwhile, county governments, which were empowered under Kenya's 2010 Constitution through devolution, are often under-resourced and lack both the legal authority and technical capacity to address energy issues in informal areas effectively (Kaberia et al., 2023).

Fragmented governance structures significantly hinder effective coordination in urban energy planning. National and county-level agencies frequently operate in isolation, with limited communication and collaboration. This soloed approach results in overlapping responsibilities, inconsistent policies, and ambiguous mandates, making it difficult to implement coherent and inclusive electrification strategies in informal settlements (Booth, 2014; Duot et al., 2024). Regulatory authorities such as EPRA focus primarily on tariffs, safety compliance, and energy markets, but provide little guidance on the integration of informal settlements into legal frameworks (Energy and Petroleum Regulatory Authority, 2022). Moreover, there is no legal framework recognising informal energy providers, which leaves them outside any official oversight or pathways for formalisation.

These regulatory gaps contribute to a vacuum in which informal providers flourish. While they offer practical solutions to residents excluded from the formal system, their operations are largely unregulated and, at times, exploitative (Turner & Browning, 2019). Kenya Power, on the other hand, expe-

riences substantial technical and commercial losses due to electricity theft, further discouraging the utility from investing in areas perceived as high-risk (EPRA, 2021). This reinforces a cycle of neglect and informal reliance.

Security and enforcement also pose challenges. Attempts to dismantle illegal connections often spark resistance or are quickly reversed through re-connections (Winther et al., 2017). In the absence of community engagement or viable alternatives, punitive enforcement measures alone are ineffective and risk exacerbating distrust between residents and formal institutions (Andrews & Silva, 2017; Baugh, 2015).

From a governance perspective, informal settlements like Mathare represent “zones of ambiguity” where the lines between state and non-state actors blur. Community leaders, informal providers, and NGOs often fill roles traditionally occupied by the state, such as service delivery and dispute resolution (Fischer, 2012b). These actors operate in the absence of official mandates, which gives rise to a hybrid governance structure, which is flexible but also fragile and prone to conflict.

To address these challenges, scholars and practitioners increasingly advocate for more inclusive, participatory governance models that recognise the legitimacy of informal settlements and support their gradual integration into formal systems (Emerson et al., 2012). Such approaches emphasise coordination across governance levels, recognition of informal providers, and adaptation of legal frameworks to account for social realities on the ground. Without these reforms, informal settlements will continue to be systematically excluded from equitable energy access.

2.5. Stakeholder Participation in Electricity Access

Stakeholder participation is increasingly recognised as a critical component of effective infrastructure governance, especially in contexts characterised by social inequality, legal informality, and institutional fragmentation (Andrews & Silva, 2017; Fischer, 2012b). In the case of access to electricity for informal settlements, the inclusion of various stakeholders, residents, NGOs, informal providers, government agencies, and informal suppliers, can significantly improve the design, implementation, and legitimacy of electrification initiatives (Makunde et al., 2022).

Traditional top-down models of energy planning often overlook the lived experiences and priorities of marginalised communities (Prakash & Singh, 2019; Sovacool & Dworkin, 2015). This has led to numerous implementation failures, ranging from low adoption rates to active resistance from communities excluded from the planning process (Hickey & Mohan, 2004; Kooijman et al., 2023). In contrast, participatory governance enables more accurate identification of needs, fosters local ownership, and improves service sustainability by building trust between stakeholders (Fischer, 2012b).

In Kenya, the gap between formal electricity providers, such as Kenya Power and informal urban communities like Mathare reflects a breakdown in effective stakeholder coordination and engagement. Residents often distrust formal institutions due to past experiences with corruption, neglect, and unaffordable services. Conversely, utilities and government agencies view informal providers as illegitimate and uncooperative actors (Baugh, 2015; Oketch & Mwangi, 2019). These mutual perceptions hinder collaborative problem-solving and perpetuate exclusionary policies.

2.5.1. Barriers to Effective Participation

Multiple factors constrain stakeholder participation in electricity access initiatives. A key issue is the entrenched power imbalance within energy governance systems, which often marginalises community voices and reinforces top-down decision-making structures (Sovacool et al., 2015). Formal actors such as utilities and government ministries often dominate decision-making spaces, marginalising community voices (Arnstein, 1969; Lee & Byrne, 2019). Also, the informal nature of many settlements creates legal ambiguities that prevent formal recognition of community-based actors and their contributions (Mitlin, 2011).

Furthermore, the lack of institutional capacity is a challenge, particularly at the county level. Local authorities are often under-resourced and lack the mandate to mediate between informal networks and formal utilities (Kaberia et al., 2023). Finally, there is a deficit of trust among stakeholders. Past experiences of exclusion or exploitation have made many residents sceptical of government-led interventions, while formal actors often associate informal settlements with lawlessness and revenue loss (Kooijman et al., 2023; Turner & Browning, 2019).

2.5.2. Strategies for Inclusive Stakeholder Engagement

Despite these barriers, there is growing evidence that stakeholder participation can be improved through targeted strategies. First, inclusive planning processes that involve community representatives in all stages, from problem identification to solution design, can enhance project legitimacy and responsiveness (Chakrabarti & Sen, 2016). Participatory budgeting, co-design workshops, and stakeholder forums are practical tools that have shown promise in other urban contexts.

Second, transparency in communication regarding costs, timelines, and responsibilities builds trust and reduces misinformation. In Mathare, for example, previous pilot projects that openly shared connection costs and allowed community input on pricing mechanisms were met with higher participation rates (Nuvoni Centre for Innovation Research, 2023b).

Third, collaboration with trusted intermediaries such as CBOs can bridge gaps between formal institutions and informal networks. CBOs often possess local legitimacy, cultural fluency, and technical knowledge that enable them to facilitate dialogue and mediate disputes (Fischer, 2012b; Jones, 2019).

Fourth, legal and regulatory frameworks should be adapted to accommodate community-level actors. This includes providing pathways for informal providers to become licensed or integrated into formal networks through cooperative models or public-private partnerships (Chakrabarti & Sen, 2016; Emerson et al., 2012).

Finally, long-term capacity-building initiatives that train both residents and local government officials in technical, regulatory, and participatory planning processes can foster more sustainable and equitable outcomes. These approaches are aligned with the goals of energy justice, which emphasise fairness in both the distribution of energy services and the processes through which those services are planned and delivered (Sovacool, 2016).

In summary, enhancing stakeholder participation is not only a governance imperative but a practical necessity for achieving sustainable, safe, and affordable electricity access in informal settlements. Building meaningful collaboration between formal and informal actors requires deliberate, inclusive, and adaptive approaches that reflect the socio-political complexities of urban energy access.

2.6. Theoretical Approaches: Stakeholder Alignment

This study draws upon two complementary theoretical approaches to conceptualise and analyse stakeholder dynamics in the context of electricity access in informal settlements: Arnstein's Ladder of Participation and Collaborative Governance Theory. Together, these approaches provide an analytical lens through which power asymmetries, institutional structures, and collaborative mechanisms can be examined in the process of formalising informal electricity networks.

2.6.1. Arnstein's Ladder of Participation

Sherry Arnstein's seminal model, the Ladder of Citizen Participation, categorizes levels of stakeholder involvement into eight rungs, ranging from non-participation (manipulation, therapy) to tokenism (informing, consultation, placation), and ultimately to degrees of citizen power (partnership, delegated power, citizen control) (Arnstein, 1969). The ladder is widely used to assess how much real influence communities have over decisions that affect their lives.

In the context of Mathare's electricity access, the lower rungs of Arnstein's ladder reflect the predominant mode of engagement, where residents are often informed or consulted late in the planning process, if at all, with little opportunity to shape policy or infrastructure design (Kooijman et al., 2023). This tokenistic approach results in community resistance, low trust in authorities, and limited adoption of formal services.

Elevating participation to higher levels, such as partnership or delegated power, would involve institutionalising roles for community-based organisations, informal suppliers, and residents in decision-making processes. This could take the form of participatory budgeting, co-management committees, or community energy cooperatives, which offer meaningful pathways for marginalised groups to influence electrification strategies (Andrews & Silva, 2017; Baugh, 2015).

2.6.2. Collaborative Governance Theory

Collaborative Governance Theory, as developed by Ansell and Gash, offers a second approach focused on the mechanisms through which multiple actors: government agencies, private firms, community organisations, and citizens work together to achieve shared public goals (Ansell & Gash, 2008a). This

theory is particularly relevant for complex cross-sectoral challenges such as access to electricity in informal settlements, where no single actor has sufficient authority, legitimacy, or resources to resolve the issue alone.

The core premise of collaborative governance is that effective coordination requires trust-building, inclusive participation, shared accountability, and iterative deliberation (Emerson et al., 2012). In Mathare, these principles can be applied to understand how Kenya Power, informal suppliers, CBOs, government agencies, and residents might engage in structured dialogues and joint planning exercises aimed at formalising service delivery while maintaining local relevance.

For collaboration to succeed, several conditions must be met. These include a shared understanding of the problem, a convening actor or neutral facilitator, transparency of goals, and commitment to long-term engagement. Institutions like the Nuvoni Research Lab or local CBOs may play a bridging role in facilitating this governance model by linking formal institutions with grassroots networks.

2.6.3. Stakeholder Alignment as a Strategic Objective

Together, these approaches support the central conceptual focus of this study: stakeholder alignment. Alignment is understood as an iterative process in which actors with diverse and sometimes conflicting interests gradually develop a shared agenda through negotiation, trust-building, and institutional adaptation (Fischer, 2012b). This process is particularly important in the context of informal settlements, where existing governance structures are fragmented and often contested.

By applying Arnstein's and Ansell and Gash's theories, this research seeks to identify opportunities to elevate participation, design inclusive coordination mechanisms, and support a transition from informal to formal electricity networks that is socially just, technically feasible, and institutionally sustainable.

The approaches discussed here not only provide a theoretical foundation for the empirical analysis in Chapter 5 but also inform the policy recommendations presented later in the thesis. They underscore the need to move beyond technical solutions and toward governance innovations that recognise informal realities and foster co-produced urban infrastructure systems.

2.7. Literature Knowledge Gaps

The existing literature on electricity access in informal settlements extensively addresses the technical, financial, and regulatory challenges associated with service delivery (Blimpo & Cosgrove-Davies, 2019; Kooijman et al., 2023; Sovacool, 2012b). However, significant gaps remain, particularly in understanding the complex relationships between stakeholders and their influence on electricity access outcomes. This study seeks to address these gaps, focusing on the specific context of Mathare, a densely populated informal settlement in Nairobi.

First, while existing research often categorises informal electricity networks as illegal or problematic, it rarely explores their functional role within communities. These networks are not merely sources of risk or loss but are embedded within local governance structures, providing essential services to residents who lack formal access (Turner & Browning, 2019; Williams, 2020). The tendency to view these networks solely as problems overlooks their adaptive value in contexts where formal systems are absent, unreliable, or unaffordable. This study aims to reposition informal electricity providers not only as obstacles but also as potential collaborators in the transition toward safer and more reliable electricity systems.

Second, the literature tends to focus on stakeholder analysis from a static perspective, mapping stakeholders without examining the evolving nature of their relationships and interactions. In rapidly changing urban environments like Mathare, where power dynamics are fluid, understanding these interactions is crucial. There is limited understanding of how trust is built or eroded among stakeholders, how power asymmetries are managed, and how conflicting interests can be negotiated (Fischer, 2012b; Lee & Byrne, 2019). This study will address this gap by exploring the relational dynamics among stakeholders and identifying mechanisms that can foster collaboration.

Third, while theoretical approaches such as Arnstein's Ladder of Participation and Collaborative Governance Theory offer insights into stakeholder engagement, their application to urban energy access in informal settlements remains limited. Existing studies often focus on rural electrification or decentralised renewable energy solutions, which may not address the unique challenges of densely populated, politically sensitive urban areas (Chakrabarti & Sen, 2016; Hickey & Mohan, 2004). This research seeks to adapt these theories to the specific context of Mathare, examining how principles of

participation and collaborative governance can be operationalised in an environment characterised by informal networks, conflicting interests, and limited regulatory oversight.

Fourth, although the concept of stakeholder alignment is recognised as critical for effective governance, there is a lack of studies examining how alignment is achieved or maintained in complex urban settings. Stakeholder alignment is often discussed in the abstract, without clear guidance on how conflicting interests can be harmonised or how trust can be built among actors with different agendas. This research contributes to filling this gap by identifying practical strategies for aligning stakeholder interests, supported by real-world evidence from Mathare.

Fifth, while many studies emphasise the importance of regulatory reform to improve electricity access, they often overlook the social and cultural dimensions of electricity provision. Understanding local perceptions of electricity, the informal norms governing energy access, and the socio-economic factors influencing energy use are essential for designing policies that are both effective and socially acceptable. This study adopts a multi-actor, context-sensitive approach to ensure that the proposed approaches are grounded in the lived experiences of Mathare residents.

In summary, this study aims to provide a nuanced, multi-actor analysis of electricity access in Mathare, addressing gaps in understanding stakeholder dynamics, informal network functionality, and the practical application of theoretical approaches. By doing so, it seeks to generate actionable insights for improving electricity governance in urban informal settlements.

3

Methodology

This chapter outlines the research design, data collection methods, and analytical strategies used to investigate how stakeholder alignment can support the improvement of electricity networks in informal settlements. The approaches discussed in Proposed Approaches are tailored to the complex sociotechnical context of Mathare, Nairobi, and emphasise local involvement.

Section 3.1 introduces the overall research design, which follows a mixed-methods approach to capture qualitative and contextual data. Section 3.2 describes the data collection process, including semi-structured interviews, focus group discussions, and direct observations. Section 3.3 explains the sampling strategy, detailing how participants were selected across stakeholder groups. Section 3.4 outlines the process of data analysis, including coding, thematic analysis, and comparative techniques. Sections 3.5 and 3.6 address the study's validity, reliability, and ethical considerations, ensuring rigour and transparency throughout the research process.

Together, these sections provide a detailed account of how data was systematically gathered, processed, and interpreted to produce robust and actionable insights.

3.1. Research Design

This study used a mixed-methods research design that incorporated qualitative and quantitative approaches with a focus on the qualitative part. A mixed methods approach is well suited for complex socio-technical contexts, allowing for triangulation and a more complete understanding of the research problem (Brannen, 1992). Mixed-methods have been widely used in social sciences to combine the strengths of qualitative insights and quantitative precision (Creswell et al., 2011). The integration of these methods in this study enabled the collection of diverse perspectives, enhancing the validity of the findings (Tashakkori, 2003).

Several of the specific methodological tools used in this study, such as stakeholder mapping and the SWOT analysis, are applied and discussed in more detail in Section 4.1.6 and Section 4.3. These sections dive deeper into how the findings were based.

The research adopted a cross-sectional design, which involves data collection at a single point in time. Cross-sectional designs are effective for assessing relationships among variables without the need for long-term tracking (Kesmodel, 2018). This approach is particularly appropriate for the context of Mathare, where the dynamic nature of stakeholder interactions in electricity access could be captured effectively within a defined period.

Three primary data collection methods were employed:

1. Semi-Structured Interviews: These were used to obtain in-depth insights from a diverse group of stakeholders, including community members, informal electricity providers, CBOs, Kenya Power, and government officials. Semi-structured interviews are a flexible qualitative method that allows for probing and clarifying participant responses (Kvale, 2007). Interviews were conducted at the Ghetto Foundation, a community-based organisation that provided a neutral environment for open dialogue.
2. Direct Observations: To capture real-time interactions and behaviours related to electricity access, direct observations were conducted. This method is useful for understanding context-specific

practices and interactions that may not be fully captured through interviews alone (Angrosino, 2007).

3. Focus Group Discussions: A focus group discussion was conducted to explore collective perspectives and validate findings. The FGD was also used to get feedback on the approaches, which were designed after the Interviews; they can be found in Proposed Approaches. The Focus groups are particularly useful for capturing group dynamics and reaching an understanding of shared concerns among stakeholders (Morgan, 1997).

These methods were chosen because they have been successfully applied in other studies of community participation, stakeholder engagement and governance in informal settlements (Fischer, 2012a; Sovacool, 2012a; Vizinho & Penha-Lopes, 2016). Using this design, the study ensured a robust and contextually grounded analysis of stakeholder alignment in electricity access within Mathare.

3.2. Data Collection

The data collection process involved a multifaceted approach aimed at capturing both institutional perspectives and community experiences within Mathare. To ensure culturally appropriate and contextually relevant data collection, multiple methods were employed, including interviews, focus group discussions, and direct observations (Angrosino, 2007; Morgan, 1997; Patton, 2015).

The interviews were conducted at the Ghetto Foundation, a CBO located in Mathare that provided a conducive environment for engaging with various stakeholders. A total of 38 semi-structured interviews were conducted with a diverse range of participants, including residents of Mathare (both with informal and formal electricity connections), CBOs, informal electricity providers, representatives from Kenya Power, and local and national government officials. The purpose of these interviews was to explore how different actors engaged in electricity access, the challenges they faced, and potential opportunities for improved collaboration (Bryman, 2016; Kvale, 2007).

To facilitate the interview process, three community researchers were recruited and trained through a full-day workshop. During this workshop, I provided detailed instructions on the research objectives, interview techniques, ethical considerations, building rapport with participants, and maintaining neutrality throughout the process. This training aimed to enhance the reliability and consistency of data collection.

The community researchers were equipped with voice recorders to ensure accurate data capture. I was present during the interviews to provide support, answer participant questions, and ensure adherence to the research protocol. This presence also allowed me to monitor the interview process and address any concerns raised by participants in real time. Additionally, having the researcher onsite ensured that any queries from participants could be addressed immediately, promoting trust and transparency.

The contributions and influence of community researchers on data interpretation are revisited in Subsection 6.6.4, particularly in relation to stakeholder trust and narrative credibility.

All recorded interviews were manually transcribed, ensuring an accurate and comprehensive account of participant responses. For interviews and FGDs that involved Swahili, a bilingual translator from Nuvoni was hired to translate these segments into English. This approach was adopted to accommodate the participants' linguistic preferences and enhance their comfort in expressing their views. Notably, most participants were comfortable using English, as it is the primary language of instruction in schools across Kenya. To maintain data integrity and prevent loss of meaning, the translation process emphasised cultural context and semantic accuracy. The translator worked closely with the research team, and ambiguous phrases were cross-checked to ensure that the English transcriptions faithfully reflected participants' original statements.

In addition to the interviews, a FGD was conducted to test the framework designed to integrate the informal electricity network into the formal grid. The focus group discussion included 10 participants representing various stakeholder groups: residents, community leaders, informal suppliers, CBOs, Kenya Power officials, and government officials. This diverse representation ensured that multiple perspectives were considered, providing a comprehensive understanding of the challenges and opportunities associated with formalising electricity access in Mathare (Morgan, 1997). The feedback from this session informed the SWOT analysis, which is elaborated in Section 4.3.

Direct observations were also employed to document stakeholder interactions during meetings, community discussions, and electricity distribution activities. These observations aimed to understand

the practical realities of informal electricity networks, including pricing negotiations, service reliability, and the organisational structure of informal suppliers (Angrosino, 2007; Patton, 2015). The insights gained from these observations were integrated with interview and focus group data to ensure a more robust analysis.

3.3. Sampling

This study employed a multi-stage sampling strategy to ensure comprehensive representation across Mathare's diverse socio-spatial landscape. Initially, stratified area sampling was utilised by dividing Mathare into its 13 distinct villages. This approach ensured that each village, representing unique community characteristics, was proportionally included in the study (Creswell et al., 2011; Flick, 2018).

Within each village, cluster sampling was implemented to select specific households for interviews. Given the absence of a comprehensive household list, cluster sampling facilitated the practical selection of groups based on geographic proximity, optimising resource allocation and logistical feasibility (Flick, 2018).

To capture a broad spectrum of community experiences, two English-speaking households per village were randomly selected. Random selection within clusters enhances the representativeness of the sample and mitigates selection bias (Patton, 2015). The emphasis on English-speaking participants was informed by the prevalence of English as the primary language of instruction in Kenyan schools, which facilitated effective communication during interviews.

Engagement with community members and informal electricity providers was facilitated by a local guide from the Ghetto Foundation. Utilising community-based guides is a recognised strategy in qualitative research to build trust, navigate social dynamics, and ensure cultural sensitivity during data collection (Flick, 2018).

The final sample size was determined by the principle of data saturation, wherein data collection continued until no new themes or insights emerged. This was mostly used during the interviews and FGDs. This approach ensures the depth and comprehensiveness of qualitative findings (Guest et al., 2006).

For the inclusion of Kenya Power representatives and government officials, convenience sampling was employed due to their limited availability. While this non-probability sampling method may introduce certain biases, it is appropriate for accessing participants with specific expertise who are otherwise difficult to reach (Flick, 2018; Patton, 2015).

A FGD was conducted in the post-interview phase to validate and refine the approaches developed from interview data. A purposively selected group of 10 participants, representing five key stakeholder categories, engaged in a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis of the proposed approaches. Purposive sampling in this context ensured the inclusion of participants with relevant knowledge and perspectives (Morgan, 1997; Patton, 2015).

3.4. Data Analysis

The study employed a qualitative analysis approach to ensure a comprehensive understanding of stakeholder alignment. Qualitative analysis is well-suited for exploring complex social phenomena, allowing for the identification of patterns, themes, and relationships within the data (Flick, 2018; Patton, 2015). The primary data sources included interviews, FGDs, and observations involving various stakeholder groups in Mathare. A combination of transcription methods, thematic analysis, and comparative analysis was utilised to extract meaningful insights from the data (Braun & Clarke, 2006; Miles et al., 2014).

3.4.1. Thematic Analysis

This research adopted an inductive thematic analysis (Braun & Clarke, 2006) as the primary qualitative analysis method, given its suitability for exploring complex stakeholder dynamics in an open-ended manner. This choice is driven by the exploratory nature of the research questions, which seek to uncover patterns in stakeholder perceptions and interactions without imposing preconceived categories. Thematic analysis offers a systematic yet flexible approach for identifying emergent themes, making it ideal for a case study in Mathare's informal electricity context, where existing theory provides guidance but not complete answers.

In applying this method, this research followed a rigorous, multi-step procedure to ensure credibility and depth. All interviews and FGDs were first transcribed and carefully verified for accuracy (including

cross-checks of translated segments) to establish a reliable data foundation. Next, an open-coding process was undertaken in which the data were inductively coded line-by-line, allowing salient concepts and stakeholder viewpoints to surface organically. These first-order codes were then examined for patterns and grouped into candidate themes based on their frequency and the consistency of participant viewpoints, following qualitative analysis best practices (Miles et al., 2014).

Throughout this process, this research remained reflexive, iteratively comparing themes across different stakeholder groups to capture both convergent and divergent perspectives on electrification. Crucially, the decision to use thematic analysis is reinforced by its proven reliability in similar socio-technical research contexts, as it enables the integration of stakeholder narratives with theoretical constructs.

To bolster the trustworthiness of the findings, this research incorporated verification steps such as posing a few factual questions during interviews (to check respondent sincerity) and triangulating emergent themes with observations and secondary information (Patton, 2015). This approach ensured that the resulting themes are empirically grounded, internally coherent and theoretically informed.

3.4.2. Criteria for Theme Identification

Themes were identified based on two primary criteria, consistent with established qualitative analysis practices (Braun & Clarke, 2006; Miles et al., 2014):

- **Frequency:** Recurring topics or concerns mentioned by multiple participants were noted and prioritised for further analysis. Frequency is a key indicator of the prominence of themes within qualitative data (Patton, 2015).
- **Consensus:** Agreement among stakeholders on particular issues was considered indicative of widespread perceptions or challenges. Consensus helps to validate the importance of themes, reflecting shared viewpoints among participants (Flick, 2018).

Although primarily qualitative, the study also considered the frequency of themes as a means of enhancing the reliability of the analysis. By integrating both consensus and frequency, the study ensured a more robust interpretation of the data.

3.4.3. Summary of Interviews Conducted

A total of 38 interviews were conducted across seven stakeholder groups to gather diverse insights on electricity access in Mathare. Table 3.1 presents a summary of the interviews and corresponding codes.

Group	Description	Interview Codes
A	Residents with Informal Electricity Connections	A1 - A12
B	Residents with Legal Electricity Connections	B1 - B10
C	Households Without Electricity	C1 - C6
D	Informal Electricity Providers	D1 - D4
E	Community Leaders	E1 - E4
F	Government Officials (National and County Level)	F1, F2
G	Kenya Power Officials	G1

Table 3.1: Summary of Interviews Conducted with Stakeholders

3.4.4. Summary of Focus Group Discussion Participants

A total of 10 participants took part in the FGD, which was held after the completion of the interviews. The participants were purposively selected to ensure balanced representation from key stakeholder groups involved in electricity access and governance in Mathare. The FGD was structured to facilitate a SWOT analysis of the two proposed frameworks, allowing each group to express their perspectives on feasibility, risks, and implementation strategies. Table 3.2 provides an overview of the participants and their group affiliations.

Group	Description	Number of Participants
A	Community Residents	2
D	Informal Electricity Providers	2
E	Community leaders	1
F	Kenya Power Officials	2
G	Government Officials (National and County Level)	3

Table 3.2: Summary of Focus Group Discussion Participants

3.4.5. Data Integration and Presentation

The findings from interviews, FGD and observations were integrated through a process of thematic analysis and narrative summarisation. Themes were identified based on the criteria of frequency and consensus, with particular attention given to areas of conflict and cooperation among stakeholders.

Additionally, qualitative data was compared across stakeholder groups to highlight divergent and convergent viewpoints. This comparative analysis enabled the identification of key barriers, facilitators, and opportunities for improved stakeholder alignment in the context of formalising electricity access in Mathare. The methodological structure and results of the SWOT analysis conducted during the focus group are further elaborated in Section 4.3.

Roadmap Development Method

The development of the roadmap was based on a multi-stage process combining empirical insights and theoretical guidance. First, qualitative data from stakeholder interviews were used to identify the specific needs and interests of each stakeholder group. This allowed for a grounded understanding of the social, institutional, and technical conditions that any solution must respond to.

Next, the initial structure of the proposed approach was tested and refined through a FGD. During this session, participants provided feedback on the feasibility, clarity, and relevance of the proposed actions. Their input was instrumental in adjusting the approach to better reflect local realities and stakeholder expectations.

Finally, the refined approach was further shaped into a structured roadmap by drawing on academic literature on collaborative governance and energy planning in Literature Review. These sources provided guidance on how to phase implementation over time and how to align the roles of formal and informal actors. The resulting roadmap is therefore both empirically grounded and theoretically informed, designed to be actionable and adaptable to the complexities of informal urban contexts like Mathare. The resulting roadmap is discussed in detail in Chapter 5, where its structure and application are further explained as part of the advice for KPLC.

3.5. Validity and Reliability

To ensure the credibility and trustworthiness of the findings, a multi-layered strategy was employed to strengthen both validity and reliability throughout the research process (Gibbs, 2007; Lincoln & Guba, 1985; Patton, 2015).

Interview protocols were carefully designed and pre-tested in collaboration with local community researchers. These pilot tests assessed the clarity, cultural appropriateness, and relevance of each question (Creswell et al., 2011). Feedback from the pilot interviews was used to refine the wording and sequence of questions to improve respondent comprehension and engagement (Flick, 2018).

To reinforce internal validity, the study employed triangulation by incorporating data from diverse sources, including community residents (with and without formal electricity access), informal electricity providers, CBOs, Kenya Power representatives, and government officials (Patton, 2015). Triangulation enhances the credibility of qualitative research by allowing for cross-verification of information from multiple sources (Denzin, 1978).

Reliability was enhanced through standardised data collection procedures. Community researchers received formal training in interview techniques, ethical considerations, and maintaining neutrality (Bryman, 2016). Additionally, interviews were recorded and transcribed verbatim, with segments conducted in Swahili translated into English by a professional translator to ensure consistency across languages (Gibbs, 2007).

Participants were also invited to review their transcripts and provide feedback to confirm the accuracy of the recorded data. This process of respondent validation, also known as member checking, helped to reduce the risk of misinterpretation and increased the reliability of qualitative findings (Lincoln & Guba, 1985).

The FGD further contributed to both the validity and reliability of the study. Conducted after the individual interviews, the focus group brought together representatives from five key stakeholder groups. It was structured to facilitate a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis of the proposed approaches (Morgan, 1997). This participatory method enabled the researcher to validate preliminary findings, test the feasibility of the proposed solutions, and explore stakeholder reactions in a collective setting. The group dynamics offered valuable insights into consensus areas and points of contention, further enhancing the depth and accuracy of the analysis (Gibbs, 2007).

Together, these measures ensured a rigorous and transparent research process, strengthening confidence in the study's outcomes and their applicability in real-world stakeholder engagement and policy development.

Further reflections on the researcher's role and positionality in interpreting stakeholder narratives are offered in Section 7.3.

3.6. Ethical Considerations

Ethical approval was sought before the commencement of the study, following the HREC procedure at TU Delft. Participants were fully informed about the research purpose, and informed consent was obtained before data collection. The study adhered to ethical guidelines outlined by HREC, ensuring compliance with principles of voluntary participation, risk minimisation, and transparency (HREC TU Delft, 2025).

Confidentiality and anonymity were strictly maintained, and all collected data were securely stored to protect participant identities. Given that this research involved sensitive topics related to illegal activities, maintaining anonymity was of utmost importance to protect participants from potential legal repercussions or social stigma. Special attention was given to ethical considerations when engaging with vulnerable communities in Mathare.

In collaboration with Nuvoni Research Lab and local community leaders, the study ensured that participant well-being was prioritised and that findings contributed to practical solutions for improving electricity access. The research process was continuously reviewed to uphold ethical standards throughout the study, with particular focus on ensuring that participants felt safe and secure when providing information related to informal electricity networks.

4

Analysis

This chapter presents the key findings of the study and is structured to address the three subquestions that underpin the central research inquiry. Drawing on data collected through interviews, focus group discussions, and stakeholder observations in Mathare, the analysis is grounded in the frameworks of stakeholder alignment and participatory governance introduced in earlier chapters.

To systematically analyse the multi-actor environment of Mathare's electricity access, the study employed established stakeholder mapping tools. A stakeholder matrix and a power-interest grid are used to visualise stakeholder roles and power dynamics. These tools were chosen because they offer a structured way to interpret the qualitative data on stakeholder relationships, moving beyond narrative description to a more analytical visualisation of influence and interest. In Methodology, the study recognised that mapping stakeholders would be crucial for addressing the first sub-question ("How do key stakeholder interests and relationships influence electricity access in Mathare?"). Therefore, methods like the power-interest grid (a two-dimensional chart plotting stakeholders by their level of power/influence and interest in the electrification initiative) were adopted from stakeholder management literature to categorise actors and predict their likely behaviour or influence (Freeman, 1984). Similarly, a stakeholder matrix was constructed to capture pairwise relationships, highlighting where stakeholders' motivations align, conflict, or remain neutral (Baugh, 2015). This matrix format allowed the study to visually summarise areas of collaboration versus tension, underlining which stakeholder interactions would need the most attention in any improvement effort.

By incorporating these tools, the analysis gains clarity and academic rigour: abstract relational data is translated into interpretable figures and tables, making power imbalances and alliance opportunities evident. The use of a stakeholder map (Figure 4.2) further situates each actor within the broader network, illustrating, for example, the central role of Kenya Power versus the informal providers. Employing the stakeholder matrix and power-interest grid enhances the credibility of the findings by demonstrating that stakeholder dynamics were assessed with systematic, theory-backed methods rather than ad-hoc observation.

Section 4.2 responds to the first subquestion: *How do key stakeholder interests and relationships influence electricity access in Mathare?*. This section maps out the main actors involved in electricity provision (see Subsections 4.2.6–4.2.7), explores their motivations, identifies conflicts and areas of cooperation (Table 4.1, Table 4.2) and analyzes power dynamics using tools such as the stakeholder matrix, the power-interest grid (Figure 4.1), and the stakeholder map (Figure 4.2).

Section 4.2 addresses the second subquestion: *What formalisation frameworks and mechanisms can effectively transition informal electricity suppliers into a regulated, safer, and more reliable system?* It presents the findings related to current access pathways, informal supplier operations, pricing structures, and safety challenges (see Subsections 4.2.6–4.2.7). Based on these insights, two improved approaches are introduced, each tailored to the institutional, social and infrastructural realities of Mathare. These approaches are: The Community-Based Energy Cooperatives (CBEC) in Subsection 4.2.8, and the Government-Sponsored "Last Mile" Electrification Expansion in Subsection 4.2.9.

Section 4.3 answers the third subquestion: *Which single approach can be implemented to create a safer and more reliable electricity system in Mathare, and how can it be implemented?* This section provides a comparative analysis of the proposed approaches through a SWOT evaluation conducted

with stakeholders (see Figures 4.3 and 4.4). The analysis highlights the perceived strengths, risks, and implementation trade-offs of each approach, offering insight into feasible and inclusive strategies for systemic integration.

Together, these sections provide an evidence-based foundation for the roadmap and policy recommendations presented in Chapter 5 and 7.

This chapter builds directly on the theoretical approaches introduced in Section 2.6, particularly Arnstein's Ladder of Participation and Collaborative Governance Theory. These approaches guide the interpretation of stakeholder roles, relationships, and decision-making dynamics throughout the analysis. Arnstein's Ladder provides a lens to assess the level of influence and engagement offered to Mathare residents and informal actors, while Collaborative Governance helps examine how inclusive, trust-based processes can be designed for more effective coordination between stakeholders. These concepts inform both the structure of the stakeholder analysis and the evaluation of potential formalisation strategies.

4.1. Stakeholder Analysis

Electricity access in Kenya's informal settlements is influenced by multiple stakeholders, each playing a distinct role in service provision, regulation, and community engagement. The degree of alignment and cooperation among these actors significantly impacts the efficiency, affordability, and sustainability of electricity access. In addition to traditional stakeholders, emerging players such as development partners, professional bodies, and informal community groups are also shaping the electricity landscape in informal settlements. This chapter identifies and analyses the key stakeholders involved in electricity distribution within these areas, their roles, and the challenges they face in achieving coordinated solutions.

4.1.1. Key Stakeholders

Residents of Mathare

Residents of informal settlements are the primary beneficiaries of electricity access. Their energy needs include household consumption, small businesses, and community services such as schools and health centres. Due to financial constraints and bureaucratic hurdles, many households rely on informal electricity providers rather than the national grid. Additionally, community members engage in adaptive strategies such as energy stacking using multiple energy sources simultaneously to navigate unreliable access (Nuvoni Centre for Innovation Research, 2024).

Informal Electricity Providers

Informal energy providers, often referred to as cartels or local distributors, control a significant portion of electricity distribution within informal settlements. They operate outside formal regulatory frameworks, offering connections that, while accessible, are often unsafe. These providers fill a crucial service gap left by formal utilities but pose major governance and safety challenges. Efforts to integrate them into the formal electricity market remain contentious, as many providers resist formalisation due to potential revenue losses.

Kenya Power

Kenya Power is the sole national electricity provider, responsible for grid expansion and infrastructure maintenance. The company faces significant challenges in integrating informal settlements into the formal grid due to illegal connections, infrastructure limitations, and policy constraints. Revenue losses from electricity theft further complicate its ability to invest in new connections. However, Kenya Power has engaged in pilot programs to legalise connections in certain settlements, with mixed results (EPRA, 2021).

Government

Government stakeholders operate at multiple levels:

- **National Government:** Responsible for formulating policies, regulations, and overall energy strategies, such as the INEP (Ministry of Energy and Petroleum, 2021).
- **County Governments:** Tasked with implementing policies at the local level, collecting data on energy needs, and ensuring community participation in planning efforts.

- **Local Administration:** Includes chiefs, elders, and local police, who often mediate disputes between formal and informal electricity providers.

Despite these roles, misalignment between national and county governments often leads to fragmented decision-making and inefficient resource allocation (Onsongo et al., 2023).

Community-Based Organisations (CBOs)
CBOs serve as intermediaries between residents, government agencies, and energy providers. They advocate for the energy needs of informal settlements, facilitate stakeholder engagement, and support capacity-building initiatives. However, their influence is often limited by inadequate funding and a lack of formal recognition. Recent collaborations with development partners have attempted to bridge this gap.

4.1.2. Stakeholder Interests and Conflicts

This section identifies the key motivations and conflicts among electricity stakeholders in Mathare, based entirely on data gathered from 40 semi-structured interviews conducted during fieldwork. Stakeholders include residents, informal electricity providers, Kenya Power officials, community-based organisations (CBOs), and government actors.

The following table was generated through a qualitative coding process, in which recurring themes (e.g., affordability, safety, regulatory fear, legitimacy) were identified during the interviews. Motivations and conflicts were coded inductively and the most frequently mentioned issues, those cited in at least three interviews, are reflected in the table. Each point is supported by direct accounts from participants.

Stakeholder	Motivations	Conflicts
Residents of Mathare	Affordable, safe, and reliable electricity; Control over usage via token meters; Reduced fire and safety risks (Interviews C5, E4)	Kenya Power's formal services perceived as expensive and bureaucratic; Informal connections are risky but accessible; residents often caught between unsafe supply and unaffordable legal options (C6, E4)
Informal Electricity Providers	Revenue from supplying households; Community legitimacy; Filling the gap left by state failure (D1, D4)	Threat of arrest or disconnection; Tensions with Kenya Power; Exploitative pricing reported by residents; fear of losing livelihoods under formalisation (D2, E4)
Kenya Power	Expand formal grid; Reduce technical and commercial losses; Improve service equity (G1)	Faces theft and sabotage; Cartel interference; Land tenure issues; Disconnect between planning models and ground realities (G1, G1)
Government (National and County)	Support regulatory compliance; Develop inclusive energy policies; Advance formalisation through County Energy Plans (F2, F1)	Poor coordination between agencies; Lack of enforcement; Informal providers do not openly engage due to risk of arrest; community distrust remains high (F2, F1)
CBOs and Local Leaders	Advocate for affordability and inclusion; Facilitate dialogue; Represent community interests (E4)	Limited influence in formal planning; Excluded from key decision-making processes; Dependence on inconsistent funding and goodwill from formal actors (E4, D3)

Table 4.1: Stakeholder Motivations and Conflicts in Electricity Access in Mathare

Although stakeholder motivations reflect real needs, such as affordable power, regulatory control, or business sustainability, their implementation often results in direct conflict. Residents rely on informal providers due to cost and accessibility, despite awareness of safety risks (Interview C5). Informal

providers themselves operate in a legal grey area, often facing wire cuts or enforcement raids (Interviews D1, D4). However, many report that formalisation has not been made viable or safe.

Kenya Power and the national government have attempted to expand the grid, such as through the token rollout (Interview G1). These efforts have been undermined by local resistance, structural barriers, and inconsistent engagement with residents. Meanwhile, community organisations and leaders remain marginal to policymaking processes, even though they understand local conditions and are trusted mediators (Interview E4).

These findings were reviewed and validated by experts from the Energy Department at the Nuvoni Research Institute. Their professional assessment confirmed that the conclusions drawn from the interviews were consistent with their own field observations and policy engagement in Mathare. This expert review reinforced the credibility of the analysis and supported its relevance for applied urban energy governance.

These tensions illustrate that improving electricity access in informal settlements requires more than technical expansion. It requires stakeholder alignment, co-designed incentives, and trust-building mechanisms that bridge formal mandates and informal realities.

4.1.3. Stakeholder Matrix

The Stakeholder Matrix presented in Table 4.2 illustrates the relationships between different stakeholders involved in electricity access in Mathare. The matrix highlights areas of conflict, collaboration, and neutral relationships, providing a visual representation of where motivations align or diverge. Understanding these relationships is essential for designing effective integration strategies (Baugh, 2015). This matrix was developed based on qualitative data gathered from 38 semi-structured interviews conducted with residents, informal electricity providers, Kenya Power staff, government officials, and community leaders. Interview groups A through G were systematically coded for references to stakeholder interactions, both cooperative and conflictual. Coding was performed inductively using thematic analysis and relationships were categorized as conflict (red), partial alignment (yellow), or alignment (green) when similar relationship descriptions were reported across at least three different interviews. Only primary interview data was used to determine these relationships; secondary literature (Nuvoni Centre for Innovation Research, 2023c) was used solely to cross-check consistency with interview findings.

The colour-coding used in the table helps to quickly identify the nature of these interactions:

Green cells: Indicate alignment of motivations or interests between stakeholders, suggesting potential areas for collaboration.

Yellow cells: Indicate partial alignment or mixed motivations, where some aspects are agreeable while others conflict.

Red cells: Indicate significant conflicts between stakeholders, often resulting from opposing interests or objectives.

	Residents of Mathare	**Informal Electricity Providers**	**Kenya Power**	**Government (National and County)**
Residents of Mathare				
Informal Electricity Providers	Exploitation of residents			
Kenya Power	High connection fees	Kenya Power aims to eliminate them		
Government (National and County)	Bureaucratic hurdles	Illegal operations create conflicts	Aligned in formal expansion efforts	
CBOs	Advocacy for energy access	CBOs push for formalization, which they resist	Sometimes collaborate on legalizing access	CBOs often engage in advocacy, but limited impact

Table 4.2: Stakeholder Relationship Matrix: Conflicts, Shared Interests, and Neutral Relations

This matrix is symmetric and has been intentionally half-filled to avoid redundancy. Relationships between stakeholders are mutual, so each cell mirrors the one across the diagonal.

The stakeholder matrix highlights the complex and often conflicting relationships involved in electricity access in Mathare. Based on interview data from residents (Groups A–C), many described informal providers as exploitative, citing coercive pricing, threats of disconnection, and unsafe wiring conditions (Interviews A5, B2, C5). Others viewed Kenya Power negatively due to high costs and excessive bureaucracy (Interviews A4, B6, C6), while frustration with unresponsive or unclear government procedures was common (Interviews C4, C5, D3).

Informal electricity providers (Group) expressed that they felt criminalised by state actors and Kenya Power, despite their role in meeting daily energy needs (Interviews D1, D2, D3). They resisted formalisation due to fear of revenue loss and legal exposure (Interviews D3, E4), generating open conflict with both Kenya Power and local CBOs.

Kenya Power staff (Group G) acknowledged these challenges and recognised that informal systems interfere with metering, billing, and infrastructure protection (Interview G1). They reported working with the national government to improve legal connections, but cited land tenure and resident resistance as key barriers (Interviews G1, G2).

Government stakeholders (Group F) generally aligned with Kenya Power on regulatory goals (Interview F2), but expressed concern about fragmented implementation and community mistrust (F1, F2). Informal actors were viewed largely as illegal, with little space for negotiation.

CBOs and community leaders (Group E) were widely viewed by residents as allies, advocating for affordable and safe connections (Interviews D3, E4, F1). However, they reported being excluded from formal planning or funding frameworks (Interview F2), and sometimes clashed with informal providers when advocating for legalisation.

This matrix was constructed through thematic coding of qualitative interview data from Groups A–G. Each relationship classification, whether conflict, partial alignment, or collaboration, was validated when similar descriptions appeared in at least three different interviews between different stakeholder groups. This approach ensured empirical saturation and cross-group reliability in identifying stakeholder dynamics.

Secondary sources, such as the eCAP report (Nuvoni Centre for Innovation Research, 2024), were used exclusively for triangulation purposes to verify and contextualise patterns that emerged organically from the interview data. These materials did not determine the classifications in the matrix but served to support interpretations grounded in fieldwork.

Additionally, the preliminary findings and matrix structure were presented to and reviewed by experts from the Energy Department at the Nuvoni Research Institute. These experts confirmed that the patterns observed were consistent with their own applied research and policy engagement work in Mathare. Their validation reinforced the credibility of the findings and demonstrated strong alignment between community-level insights and expert institutional perspectives.

As such, the matrix reflects lived realities rather than formal policy positions. Addressing the conflicts identified here will require deliberate multi-actor collaboration and the creation of inclusive governance mechanisms that recognize the legitimate concerns, risks, and incentives of all stakeholders, not only those operating within formal frameworks.

4.1.4. Stakeholder Power-Interest Grid

Electricity access in informal settlements like Mathare involves a diverse set of stakeholders with varying levels of power and interest. The Power-Interest Grid categorises these actors to help determine appropriate engagement strategies during the process of formalising electricity access. This framework is adapted from Mendelow's stakeholder matrix, widely used to assess influence and involvement in infrastructure governance and public sector planning (Bradshaw & Caster, 2016; Mendelow, 1991).

4.1.5. Stakeholder Categorization

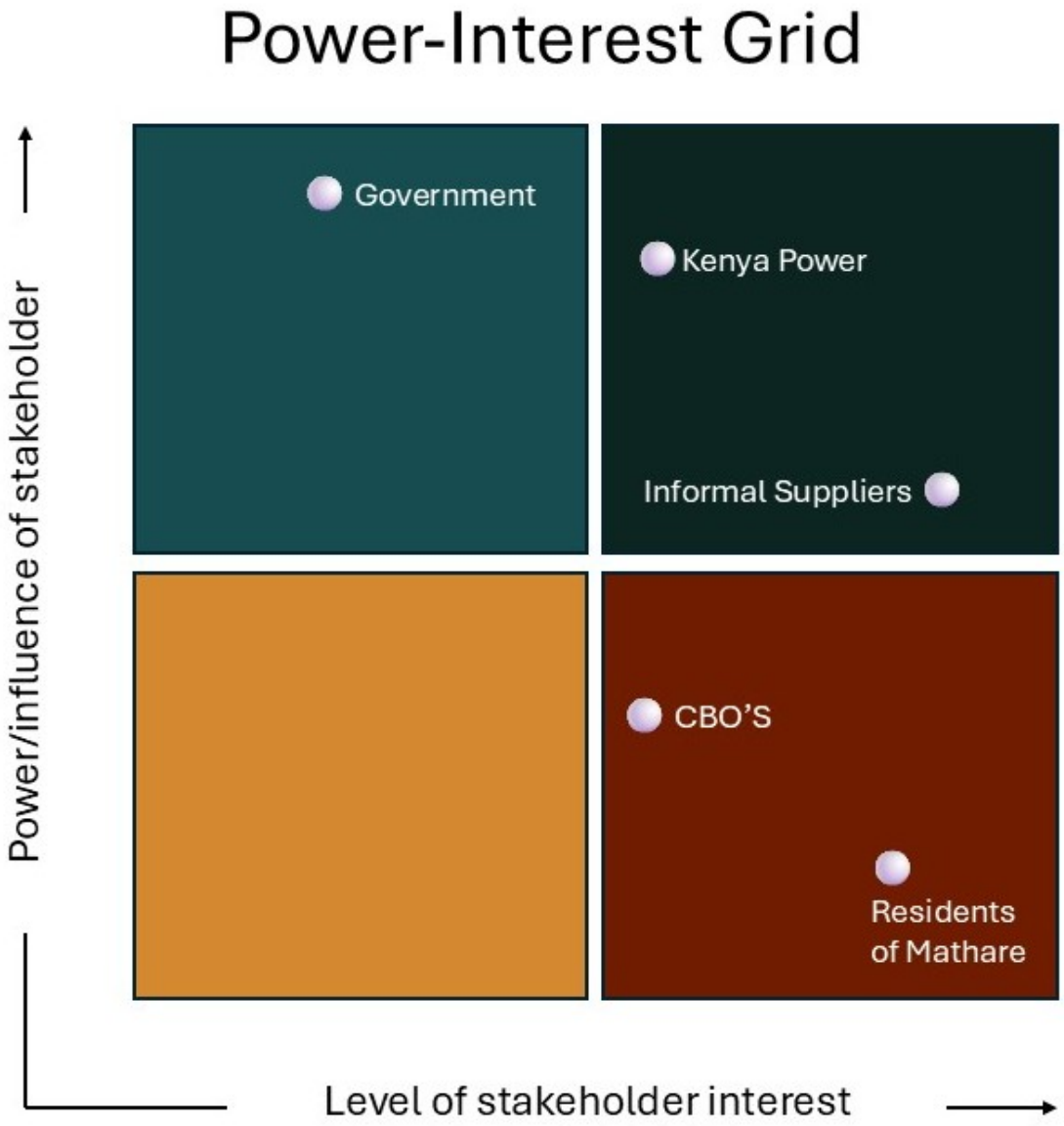

Figure 4.1: Power-Interest Grid for Stakeholders in Mathare

The Power-Interest Grid (Figure 4.1) maps stakeholders involved in electricity access in Mathare according to their relative levels of power (influence over outcomes, institutions, and infrastructure) and interest (concern, urgency, or involvement in the issue). This placement was derived through thematic coding of qualitative interview data collected from Groups A–G, comprising residents, informal providers, government officials, Kenya Power staff, and community leaders. Stakeholder placement relied on interview evidence and field observations, supported only for triangulation purposes by the eCAP report by the Nuvoni Centre for Innovation Research (2024) (Nuvoni Centre for Innovation Research, 2024) and the Energy experts at Nuvoni Centre for Innovation Research.

Power was assessed in terms of formal authority, regulatory scope, infrastructure control, or operational decision-making capacity. Interest was defined by the degree to which stakeholders are directly affected by or actively engaged in electricity access issues in Mathare. Observational insights, such as how stakeholders described their own influence or marginalisation, were essential in identifying both overt and latent forms of power.

Kenya Power occupies a high-power, high-interest position due to its formal responsibility for grid expansion, billing, and enforcement. This was consistently supported by interviews with Kenya Power officials (Interview G1) and government stakeholders (Interview F2), who described the company's role as both technical implementer and regulator.

Informal electricity providers, though lacking formal authority, were also placed in the high-power, high-interest quadrant. Residents (Interviews A4, A5) and informal suppliers themselves (Interview D2) described these actors as gatekeepers to actual electricity access. Their control over informal networks, territorial influence, and financial incentives give them operational leverage that competes with formal systems.

Government actors were placed in the high-power, lower-interest quadrant. While national and county governments set energy policies and control regulatory frameworks, several interviewees (Interviews E2, F1) noted that officials often show limited day-to-day engagement with informal settlement challenges, especially where land tenure remains unresolved.

Community-Based Organisations (CBOs) and residents were consistently positioned in the high-interest, low-power quadrant. CBOs were described as trusted intermediaries (Interviews E3, E4), advocating for inclusive energy access but operating with constrained resources and limited influence on formal decisions. Residents (Groups A–C) were the most directly affected, reporting unsafe connections, high tariffs, and bureaucratic exclusion (Interviews A5, B6, C5), yet lacked structural power to influence grid expansion or pricing models.

No stakeholders were placed in the low-power, low-interest quadrant. All actors interviewed demonstrated either institutional influence or deep engagement with electricity issues in Mathare.

The draft grid and its underlying classifications were reviewed and validated by energy experts from the Nuvoni Research Institute. Their assessment confirmed that the stakeholder placements aligned with their own applied research and engagement in Mathare's electrification processes. This external validation reinforces the credibility of the grid as a tool for grounded stakeholder mapping.

By mapping stakeholders along the power and interest dimensions, using interview evidence rather than fixed scoring scales, this grid offers a context-sensitive engagement framework. It underscores the importance of designing engagement strategies that respond not only to formal institutional authority but also to lived experiences and informal systems that govern electricity access on the ground.

4.1.6. Stakeholder Map

The integration of informal settlements into the formal electricity network requires collaboration among multiple stakeholders. Each stakeholder plays a distinct role, influencing the efficiency, affordability, and sustainability of electricity access (Baugh, 2015). Effective coordination between these actors is critical to developing inclusive, practical and resilient frameworks for energy access (Arnstein, 1969).

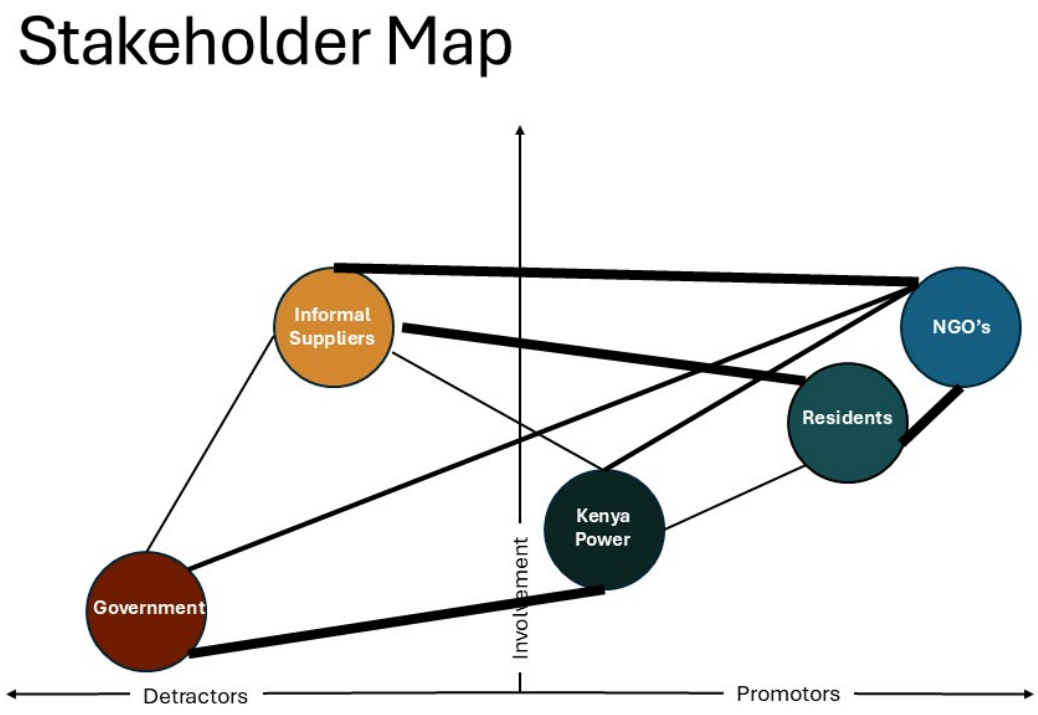

Figure 4.2: Stakeholder Map for Integrating Informal Settlements into the Formal Electricity Network

Explanation of the Stakeholder Map

The positioning of stakeholders and the thickness of the connecting lines in the stakeholder map were based on thematic analysis of interviews, field observations, and validation from the energy department of the Nuvoni Research Institute. Power and involvement levels were determined using criteria similar to those applied in the stakeholder matrix: formal authority, operational presence, and expressed interest or engagement in electrification efforts. The relative strength of the relationships, represented by the thickness of the lines, was informed by how frequently the stakeholders referenced each other, described ongoing collaborations, or identified tensions during interviews and group discussions. These interpretations were further validated through expert input from the Nuvoni Energy Department, ensuring the map accurately reflects both practical dynamics in Mathare and institutional insights into stakeholder interactions.

The stakeholder map presents the key actors involved in electricity access in informal settlements, positioning them based on their involvement and support for integration into the formal electricity network. It also considers their specific roles and functions within the electricity ecosystem of Mathare.

- **Community-Based Organizations (CBOs)** are positioned as highly involved promoters. They actively advocate for energy access, community engagement, and policy change. In practice CBOs serve as advocates, mediators, and capacity builders. They facilitate grassroots mobilisation, share knowledge on energy rights and safety, and act as intermediaries between residents and formal actors. However, their influence on formal policymaking remains limited, as also mentioned in (Jones, 2019).
- **Residents** are crucial beneficiaries and are positioned towards the promoter side. Their level of involvement varies, but they generally seek affordable and legal electricity solutions. Residents not only shape local energy demand but also participate in informal regulation by negotiating with providers, reporting faults, or engaging with CBO-led initiatives. Economic constraints and bureaucratic barriers often hinder their transition to formal connections.

- **Kenya Power** is a moderately involved actor, tasked with grid expansion, maintenance, and revenue collection. Although aligned with government objectives to promote formalisation, Kenya Power faces significant difficulties in enforcing regulations, addressing illegal connections, and adapting infrastructure to high-density informal settings. Its role is central but often reactive due to limitations in outreach and technical capacity.
- **Informal Electricity Providers** play a significant but informal role and are positioned as influential detractors. Operating outside legal frameworks, they fulfil utility-like functions in underserved areas: installing connections, collecting payments, maintaining lines, and resolving service disputes. Their local knowledge and customer proximity grant them operational efficiency, but they often resist formalisation due to fears of income loss and regulatory control.
- **Government Officials (National and County)** appear as less involved detractors due to administrative and coordination hurdles. National government agencies are responsible for policy design and strategic direction, while county governments manage implementation and local enforcement. Both are critical for enabling formalisation through policy reforms, infrastructure funding, and land tenure recognition. However, misalignment between levels of government and limited engagement with local actors frequently result in delays and fragmented execution.

The thickness of the connecting lines in the stakeholder map reflects the relative strength and intensity of relationships between actors. Thicker lines indicate strong collaboration, interdependence, or frequent interaction, while thinner lines point to weaker relationships, limited engagement, or potential areas of conflict and misalignment.

For example, the thick line between Residents and CBOs illustrates a strong, trust-based connection. These organisations frequently work directly with the community, advocating for improved energy access, offering technical support, and facilitating dialogue with formal actors. A similarly thick line connects Informal Suppliers and Residents, emphasising the high level of dependency on informal electricity services. Despite the safety and reliability concerns, residents continue to rely on these providers due to affordability and accessibility.

Another strong link is seen between the Government and Kenya Power, representing close institutional collaboration. Kenya Power operates under national policy directives and relies on government funding and regulatory frameworks to implement electrification programs, making this relationship central to formal energy planning and enforcement.

In contrast, the thinner line between Government and Residents signifies weak engagement. Structural barriers such as land tenure issues, limited outreach, and administrative inefficiencies hinder effective interaction. Likewise, the relatively thin link between Kenya Power and Informal Suppliers reflects a conflicted and largely informal relationship. Kenya Power seeks to eliminate illegal connections, while informal suppliers resist formalisation efforts that threaten their income and control.

Overall, the stakeholder map not only visualises actor positioning based on involvement and support but also captures the strength and nature of their interactions. These relationship dynamics are critical for understanding both the opportunities and barriers in transitioning to a safer and more reliable electricity system in Mathare.

4.2. Improvement Approaches

Following the stakeholder analysis in the previous section, this part of the study explores concrete improvement approaches for integrating Mathare's informal electricity network into a safer and more reliable system. Drawing on interview data, focus group discussions, and secondary sources, this section outlines the current access landscape, reasons behind reliance on informal connections, and community perceptions regarding electricity services. These insights inform the development of possible approaches aimed at addressing technical, economic, and governance challenges. The section concludes with a comparison of these approaches to guide decision-making for future interventions.

4.2.1. Interview Insights

The interview findings provide a comprehensive understanding of the various aspects of electricity access in Mathare, including the roles of different stakeholders, the challenges faced, and potential solutions. The findings are grouped into several key themes.

4.2.2. Access to Electricity

Residents in Mathare rely on both legal and informal electricity connections. Legal connections through Kenya Power and Lighting Company are often inaccessible due to high connection fees, lengthy bureaucratic processes, and the need for documentation such as title deeds and rental agreements, which many residents lack *(A1, A3, B2, B4)*. The costs of legal connections are considered prohibitive, with some estimating the cost at 25,000 KES for a meter installation *(B1, B3, B7)*. Additionally, Kenya Power's presence in informal settlements is often minimal, with limited offices and inadequate outreach efforts *(E1, E3, F1)*. This is largely due to the administrative challenges associated with informal housing structures, lack of formal land tenure, and concerns over the financial viability of serving low-income areas with high rates of electricity theft and non-payment.

Informal electricity connections are widespread and provided by local suppliers who tap into transformers and redistribute power within their neighbourhoods. These suppliers, known as Mulika Mwizi operators, offer cheaper and faster access, with costs ranging from 200-500 KES per month *(A2, A4, A6, A9)*. However, these connections are often unsafe and unreliable, with frequent power outages and risks of electrical fires *(A5, A7, A10, D1)*. Residents frequently report that their appliances are damaged due to voltage fluctuations, and that power availability is inconsistent, particularly during peak hours *(A8, A12, A13)*.

4.2.3. Reasons for Choosing Informal Connections

The preference for informal electricity connections is largely driven by affordability, accessibility, and perceived reliability. Informal connections offer flat-rate payments, allowing residents to use electricity without fear of sudden disconnections due to exhausted prepaid tokens *(A2, A3, A6, A11)*. This payment model is especially appealing to low-income residents who cannot afford to purchase tokens regularly or predict their monthly consumption accurately *(A1, A5, C3)*.

The process of acquiring legal electricity is often bureaucratic and expensive. Kenya Power's procedures involve multiple steps, including filling out forms, waiting for approval, and paying high upfront fees *(B1, B4, B7, F1)*. The waiting period for legal connections can range from weeks to several months *(B3, B5, E2)*. Additionally, some residents report instances of bribery or favouritism, where individuals with connections to Kenya Power officials receive quicker service *(B6, E4)*.

Residents without legal documents or sufficient funds are effectively excluded from accessing formal electricity *(C1, C4, C5)*. For many, the upfront costs are too high, especially when combined with the need to pay for wiring installations within their homes *(C2, C3)*. Some residents also fear that formal connections will result in higher monthly expenses compared to the flat-rate systems provided by informal suppliers *(A8, A10, D2)*.

Informal suppliers provide immediate connections without the delays associated with legal applications *(D1, D3, D4)*. Residents also prefer informal suppliers because they can use energy-intensive appliances like irons, refrigerators, and heaters without worrying about high costs *(A3, A4, A7)*. The flexibility offered by informal suppliers allows residents to customise their energy consumption based on their needs and financial capacity *(A9, A11)*.

4.2.4. Costs and Pricing

Costs related to electricity access in Mathare vary significantly depending on the type of connection and the supplier. These costs are shaped by affordability, reliability, and predictability, which influence residents' preferences.

Formal connections through Kenya Power involve substantial upfront expenses, including meter installation fees, connection charges, and the need to purchase prepaid tokens *(B1, B3, B6)*. For many low-income residents, these costs, often exceeding several thousand KES, are prohibitively high. In addition, the prepaid system disconnects electricity once credit is depleted, which is particularly inconvenient for households with irregular incomes or sudden energy demands. As a result, residents tend to prefer informal alternatives despite the risks.

Informal connections, by contrast, offer a more flexible and predictable payment structure. Most residents pay a fixed monthly fee ranging from 200 to 500 KES, which allows for unlimited electricity use regardless of consumption *(A2, A4, A8, D1)*. This flat-rate model is attractive to larger households or those who sublet power to neighbours or tenants *(A6, A9, C2)*. However, the system is also vulnerable to price manipulation. Informal suppliers have been reported to raise prices arbitrarily, particularly after technical failures or infrastructure repairs *(A5, A7, A12)*. In some instances, households are asked to

collectively fund transformer replacements or contribute to cable maintenance, creating unexpected financial burdens *(A10, D2)*.

The presence of multiple informal suppliers further complicates pricing. Different providers charge different rates depending on location, quality of wiring, and type of service (e.g., lighting only vs. appliances). For example, one resident reported paying 300 KES per month to a nearby supplier for basic lighting, while another paid 600 KES for a more stable connection capable of powering a refrigerator and TV *(A6)*. Some suppliers offer more reliable service but at a premium, while others provide cheaper yet more erratic electricity. This variability forces residents to make trade-offs between cost, quality, and reliability, often choosing based on household priorities or existing social ties to specific suppliers.

Category	**Cost Structure**	**Reliability and Quality**	**Resident Preferences / Notes**
Formal Connections (Kenya Power)	High initial connection fees; prepaid tokens required	Generally more stable when functional; subject to prepaid disconnections	Viewed as unaffordable; preferred by few with higher or stable incomes
Informal Connections (Single Supplier)	Flat monthly fee (200–500 KES); sometimes additional fees for repairs	Unreliable; risks include outages, fires, voltage fluctuations	Preferred for affordability and unlimited use; vulnerable to price manipulation
Mixture of Formal and Informal Suppliers	Mixed payment modes; formal (token-based), informal (fixed monthly); can pay both	Quality varies by source; most use formal for lightning and informal for high energy demanding products	Used to balance reliability and cost; households diversify to reduce disconnections and outages

Table 4.3: Comparison of Electricity Access Cost and Preferences in Mathare

4.2.5. Reliability and Risks

Informal electricity connections are often unreliable and prone to frequent outages, voltage drops, and fires *(A4, A7, A10)*. Overloaded transformers, exposed wires, and inadequate safety measures result in significant safety hazards *(A5, D3, D4)*. In some cases, live wires are left exposed on the ground or hanging from poles, creating a high risk of electrocution, especially for children *(A8, A12, E3)*.

Residents report frequent electrical shocks, power surges that damage appliances, and occasional fires due to overloaded connections *(A7, A9, D2)*. However, many prefer informal connections because they offer continuous access compared to Kenya Power's prepaid system, which disconnects once credit runs out *(A3, A6, A11)*.

One major risk factor is the presence of multiple informal suppliers operating in close proximity, often without coordination. This fragmented system results in overlapping wiring networks, inconsistent service quality, and increased chances of system overload or short circuits. The technical skills of informal power providers also vary widely; while some have acquired basic electrical knowledge through experience, others lack formal training*(D1, D2, D4)*, leading to poor installations and unsafe practices.

Additionally, the physical conditions of housing in Mathare further exacerbate these risks. Many structures are built using flammable or non-insulated materials, and limited space makes it difficult to safely route electrical wiring*(A1, A5, B3)*. Combined, these factors create a highly volatile environment where minor electrical faults can quickly escalate into major hazards.

4.2.6. Interviews Findings Summery

The findings illustrate a multifaceted and often contentious landscape of electricity access in Mathare, characterised by varying degrees of formality, affordability, safety, and reliability. The coexistence of legal and informal networks underscores the complexity of providing equitable energy access in an environment where socio-economic constraints, infrastructural limitations, and institutional weaknesses prevail. While informal suppliers offer a flexible and accessible alternative for many residents, their operations are fraught with safety risks, service inconsistencies, and legal uncertainties.

Achieving a safer, more reliable, and affordable electricity network in Mathare requires a coordinated approach involving all relevant stakeholders. Enhanced collaboration between Kenya Power,

government agencies, community-based organisations, and informal suppliers is essential for developing inclusive policies that address the unique needs of Mathare's residents. Integrating informal suppliers into the formal grid, improving governance structures, and ensuring affordability through flexible payment mechanisms are critical steps toward achieving sustainable electrification.

Furthermore, building trust between stakeholders, particularly between residents and formal providers such as Kenya Power, is essential for fostering long-term collaboration. The evidence gathered suggests that participatory governance models, where community leaders and informal suppliers are actively involved in decision-making processes, could significantly enhance the effectiveness of future electrification initiatives. Ultimately, a comprehensive, inclusive, and context-sensitive strategy is essential to improve Mathare's electricity network, ensuring that it meets the economic, social, and safety needs of all residents.

4.2.7. Proposed Approaches

This study adopts a comparative analysis of distinct approaches for improving electricity access in Mathare: the Approach 1: Community-Based Energy Cooperatives (CBEC) and the Approach 2: Government-Sponsored "Last Mile" Electrification Expansion. These approaches were deliberately selected to provide a balanced exploration of stakeholder-driven and government-led solutions, reflecting the contrasting pathways that could be pursued to achieve safer and more reliable electricity access in informal settlements.

Rationale for Selecting the Approaches

The decision to focus on two approaches is grounded in several methodological and practical considerations. First, the two selected approaches: CBEC and Last Mile, represent contrasting governance and stakeholder engagement paradigms. CBEC is inherently bottom-up and community-driven, emphasising local ownership and active participation of Mathare residents. This approach is informed by collaborative governance theory (Ansell & Gash, 2008a; Emerson et al., 2012) and was developed from insights gained during interviews with Kenya Power and government officials. In contrast, the Last Mile approach is top-down and government-led, reflecting a formalised, state-supported strategy for expanding electricity access, grounded in Arnstein's Ladder of Participation (Arnstein, 1969).

Second, focusing on two approaches allows for a comparative analysis that captures a spectrum of governance possibilities, from grassroots empowerment (CBEC) to centralised implementation (Last Mile). This comparative perspective enhances the depth of analysis, providing insights into how different governance structures impact stakeholder alignment, service reliability, and community engagement. The decision also reflects a commitment to methodological rigour, ensuring that each approach is explored in sufficient depth without overextending the study's scope.

Third, the development of these approaches was directly informed by stakeholder input. CBEC emerged from discussions with Kenya Power and government officials, who emphasised the need for structured partnerships to protect infrastructure and improve service legitimacy. Conversely, the Last Mile approach was shaped by feedback from residents, informal providers, and community leaders, who voiced concerns about affordability, distrust of Kenya Power, and the need for community-led governance.

Community-Based Energy Cooperatives (CBEC) Approach

The Community-Based Energy Cooperatives (CBEC) approach is conceptualised as a stakeholder-driven, cooperative strategy aimed at formalising electricity provision in Mathare while leveraging existing informal providers. This approach is grounded in the principles of collaborative governance (Ansell & Gash, 2008a; Emerson et al., 2012), emphasising stakeholder coordination, legal recognition, and capacity building. By integrating informal providers into a formalised cooperative structure under the oversight of Kenya Power, the CBEC approach seeks to balance regulatory compliance with community ownership.

Stakeholder coordination is a core element of the CBEC approach, achieved by establishing community-based energy cooperatives that bring together residents, informal providers, and Kenya Power as equal partners. These cooperatives serve as institutional intermediaries, facilitating dialogue, managing service delivery, and ensuring that community interests are represented in decision-making.

Legal recognition is provided to informal electricity providers by formalising them as cooperative members. This transition ensures that they operate within a legally recognised structure, promoting compliance with safety standards and reducing the risk of punitive enforcement actions.

The CBEC approach adopts a phased formalisation strategy, allowing informal providers to gradually transition to legal status without abrupt enforcement measures. This gradual approach fosters trust, providing informal providers with time to adapt to regulatory requirements.

A revenue-sharing and cost recovery mechanism is integrated into the CBEC model. Cooperative members receive a share of revenues generated through electricity sales, while Kenya Power retains sufficient earnings to cover operational costs. This financial structure aligns the interests of all parties, promoting sustainability.

Capacity building is a fundamental component of the CBEC approach. Technical training is provided to cooperative members, equipping them with skills in safe electricity management, metering, billing, and maintenance. These training sessions improve service quality, enhance safety, and ensure that cooperative members can operate independently over time.

This approach is characterised by mutual accountability, shared decision-making, and stakeholder empowerment. Kenya Power functions as a central partner, providing technical support and regulatory oversight, while communities retain a sense of ownership and active participation.

Government-Sponsored "Last Mile" Electrification Expansion Approach

The Government-Sponsored "Last Mile" Electrification Expansion approach is a state-led strategy designed to achieve universal electricity access in Mathare through direct government intervention. This approach is informed by the principles of centralised governance and social equity, where the state assumes primary responsibility for expanding electricity infrastructure and ensuring affordable access (Arnstein, 1969).

Direct government investment is a defining characteristic of the Last Mile approach. The government funds the expansion of electricity infrastructure, including grid extension, meter installation, and maintenance, with Kenya Power as the implementing agency responsible for technical operations and customer management.

Community engagement is ensured through participatory planning sessions, where residents and community leaders can articulate their needs and preferences. This participatory approach is guided by Arnstein's Ladder of Participation, emphasising citizen empowerment and inclusive decision-making.

Affordable access is promoted through flexible payment options, such as pre-paid meters, which allow residents to manage their electricity expenses. In addition, targeted subsidies are provided for vulnerable households, ensuring that cost does not become a barrier to access.

Safety and standardisation are integral to the Last Mile approach. All electricity connections must comply with regulatory safety protocols, using certified equipment and trained technicians to minimise the risk of accidents.

The Last Mile approach is characterised by its top-down structure, where the government, through Kenya Power, plays a central role in planning, funding, and managing electricity access. This centralised model ensures consistency in service delivery, regulatory compliance, and safety standards, while community engagement ensures that local needs are considered in project design and implementation.

Together, the CBEC and Last Mile approaches offer two distinct but complementary pathways for improving electricity access in Mathare. The CBEC approach emphasises community ownership, collaborative governance, and incremental formalisation, while the Last Mile approach provides a direct, state-led solution characterised by government investment, affordability measures, and standardised service delivery.

4.2.8. Approach 1: Community-Based Energy Cooperatives (CBEC)

This approach proposes the establishment of Community-Based Energy Cooperatives (CBECs) to formalise the electricity distribution network in Mathare through a decentralised, community-driven approach. The model is designed to integrate existing informal suppliers into a legally regulated cooperative system that provides reliable, affordable, and safe electricity to residents.

The CBEC approach functions by transforming informal suppliers into certified distributors known as CEAs. These agents are provided with formal training in electrical safety, maintenance and customer service. Upon certification, they become responsible for tasks such as grid maintenance, consumer support, and ensuring compliance with safety standards.

The cooperative acts as an intermediary between Kenya Power and Mathare residents. It purchases electricity in bulk at reduced rates and distributes it to the customers for a flat rate, depending on the

energy demand of the household. By centralising procurement and distribution under a cooperative structure, the model ensures greater transparency in pricing and reduces the exploitative practices often associated with informal suppliers.

Additionally, the CBEC approach emphasises community ownership and management. It encourages the participation of local residents, leaders, and former informal suppliers in decision-making processes. This approach is designed to foster a sense of ownership, accountability, and trust within the community. Revenue generated from electricity sales is reinvested into improving infrastructure, expanding access to underserved areas, and providing affordable services to low-income households.

4.2.9. Approach 2: Government-Sponsored ”Last Mile” Electrification Expansion

This approach proposes a government-led initiative aimed at expanding legal electricity connections through Kenya Power. Unlike the community-driven CBEC approach, the Government-Sponsored ”Last Mile” Electrification Expansion approach takes a top-down approach that leverages institutional resources, policy support, and infrastructural investment.

The approach involves mass registration campaigns designed to simplify the process of acquiring legal connections. These campaigns are targeted at informal settlements such as Mathare, where residents often face bureaucratic obstacles when applying for formal electricity access. Simplified registration processes aim to reduce documentation requirements and expedite approval timelines.

Subsidised connection fees and flexible payment models are integral to this approach. By offering discounted first-time connections and allowing residents to pay through instalment-based plans, the approach seeks to reduce financial barriers that prevent low-income households from accessing legal electricity. Step tariffs are also incorporated to ensure that the poorest consumers benefit from lower electricity rates.

The Government-Sponsored ”Last Mile” Electrification Expansion approach also seeks to redefine the roles of informal suppliers by training and certifying them as ESTs. These technicians are tasked with responsibilities such as meter installation, grid maintenance, emergency repairs, and customer support. By providing formal employment opportunities, the approach aims to mitigate resistance from informal suppliers who may otherwise oppose formalisation efforts.

Comprehensive infrastructure upgrades are a central aspect of this approach. Kenya Power will install additional transformers, secure distribution lines, and implement modern prepaid metering systems to improve service reliability and prevent power theft. Enhanced infrastructure will also reduce the risk of overloaded transformers and electrical fires, thereby improving safety for residents.

4.2.10. Conclusion

Both approaches aim to address critical challenges identified during the research process, including high connection costs, inadequate infrastructure, exploitative pricing by informal suppliers, frequent outages, and safety hazards associated with unregulated electricity networks. Additionally, they seek to improve governance mechanisms by providing structured avenues for collaboration between Kenya Power, CBOs, informal suppliers, residents, and government agencies.

4.3. Comparative Analysis of Electrification Approaches in Mathare

This section presents the findings from the FGDs conducted with various stakeholders, including Residents, Kenya Power representatives, government officials, community members, and informal suppliers. The purpose of these discussions was to gather insights on the strengths, weaknesses, opportunities, and threats associated with the two proposed approaches for formalising electricity access in Mathare: Community-Based Energy Cooperatives (CBEC) and Government-Sponsored ”Last Mile” Electrification Expansion. The goal of this FGD was to collaboratively develop a SWOT-analysis of the two proposals.

The session involved ten participants selected by the researcher based on their demonstrated expertise or institutional role. Some had participated in prior interviews and were identified as particularly knowledgeable or representative of key perspectives. Others were chosen through online research and outreach, particularly officials from Kenya Power and local government agencies whose positions

made them relevant to implementation planning.

The session was conducted as a single plenary discussion. After the researcher introduced the two electrification approaches and explained the purpose and structure of a SWOT analysis, participants introduced themselves and engaged in an open, facilitated group dialogue. A neutral facilitator from the Nuvoni Centre guided the process without contributing substantive input, ensuring inclusive participation and balanced discussion.

Participants were encouraged to comment on both approaches and to offer critical reflections across all four SWOT categories. All points were documented in real time on large paper sheets posted visibly on the wall, allowing participants to react to and refine each other's contributions. The discussion was also audio-recorded for reference.

Consensus on SWOT points was reached through open discussion rather than voting. A point was included in the final matrix only if it was explicitly agreed upon by multiple participants during the session. This ensured that the final list reflected shared, rather than individual, viewpoints.

The resulting SWOT matrix thus represents the collective judgement of a cross-section of key stakeholders, validated through live discussion and visible documentation. It offers a grounded, co-produced evaluation of the two proposed models for expanding electricity access in Mathare.

4.3.1. Approach 1: Community-Based Energy Cooperatives (CBEC)

The CBEC approach was generally well-received by stakeholders for its emphasis on community ownership, inclusivity, and affordability. The discussions highlighted several key points:

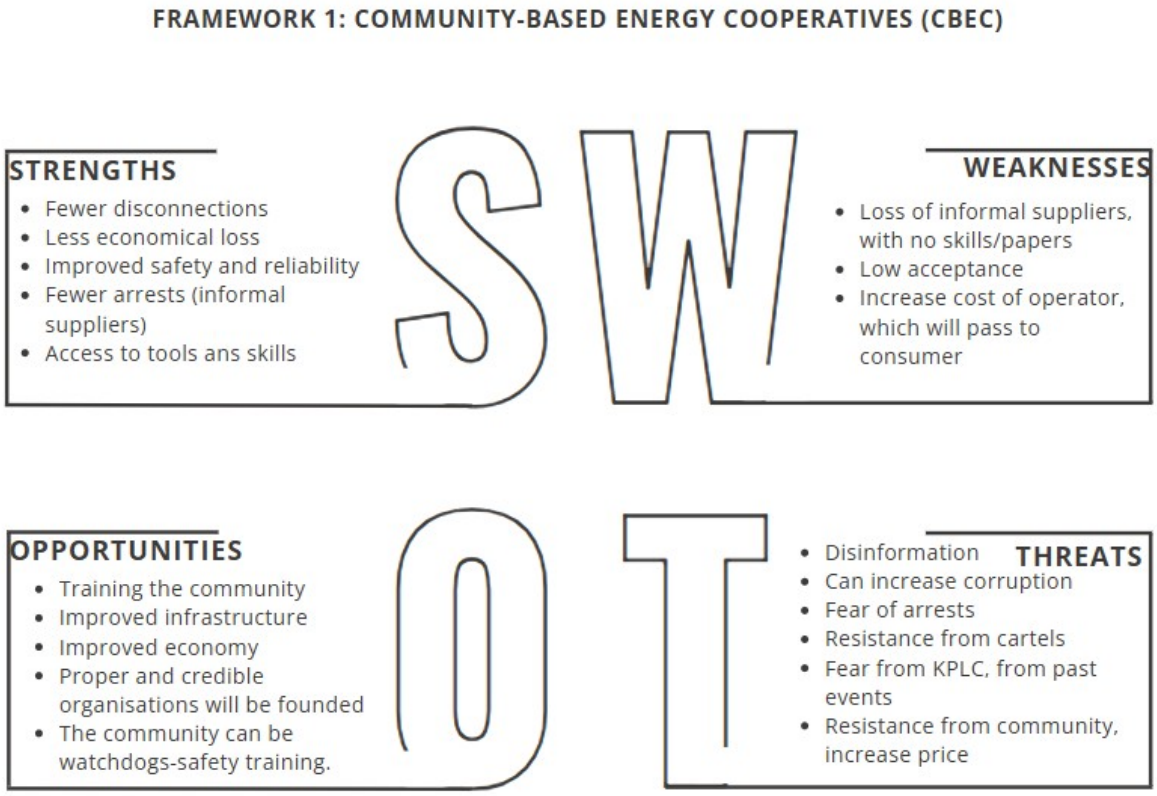

Figure 4.3: SWOT Analysis Proposal 1

Strengths

- **Fewer Disconnections:** Operating under a legal approach is expected to enhance stability and reliability of electricity access, resulting in fewer disconnections compared to the current informal network.
- **Reduced Economic Losses:** Formalising the network would minimise revenue losses for Kenya Power and reduce financial exploitation of residents by informal suppliers.

- **Improved Safety and Reliability:** Legalised operations ensure compliance with safety standards, reducing risks of electrical fires and improving overall service quality.
- **Fewer Arrests:** Providing legal roles for informal suppliers would decrease the likelihood of arrests and conflicts with authorities.
- **Access to Tools and Skills:** Training community members to become Community Energy Agents (CEAs) will provide them with certified skills, enhancing their employability and technical expertise.

Weaknesses

- **Loss of Informal Suppliers:** Some informal suppliers may lack the skills or certification to transition into formal roles, leading to job loss or exclusion.
- **Low Acceptance:** Resistance from informal suppliers and residents accustomed to the informal system may hinder acceptance of the cooperative model.
- **Increased Operational Costs:** Formalisation could increase operational costs, potentially resulting in higher electricity prices for consumers.

Opportunities

- **Training the Community:** Creating training programs for community members to become certified CEAs, enhancing skills and employability.
- **Improved Infrastructure:** Revenue from formal operations can be reinvested in local infrastructure improvements such as roads, lighting, and electrical grids.
- **Economic Growth:** Formalising the network would integrate informal suppliers into the formal economy, contributing to GDP growth.
- **Establishment of Credible Organisations :** Developing credible cooperatives that can act as watchdogs and provide safety training for community members.

Threats

- **Disinformation:** Misleading information from opposing groups could undermine efforts to establish the cooperative model.
- **Increased Corruption:** Potential for exploitation by officials or cartels resistant to formalisation.
- **Fear of Arrests:** Historical fear of enforcement actions could hinder participation from informal suppliers.
- **Resistance from Cartels and Residents:** Cartels benefiting from illegal networks and residents fearful of increased prices may resist the cooperative model.
- **Fear from Kenya Power (KPLC):** Past negative experiences with KPLC could lead to distrust and reluctance to formalise.

4.3.2. approach 2: Government-Sponsored ”Last Mile” Electrification Expansion

The ”Last Mile” Electrification approach was noted for its structured, top-down approach aimed at integrating informal suppliers into the formal electricity network through training and certification. Key findings include:

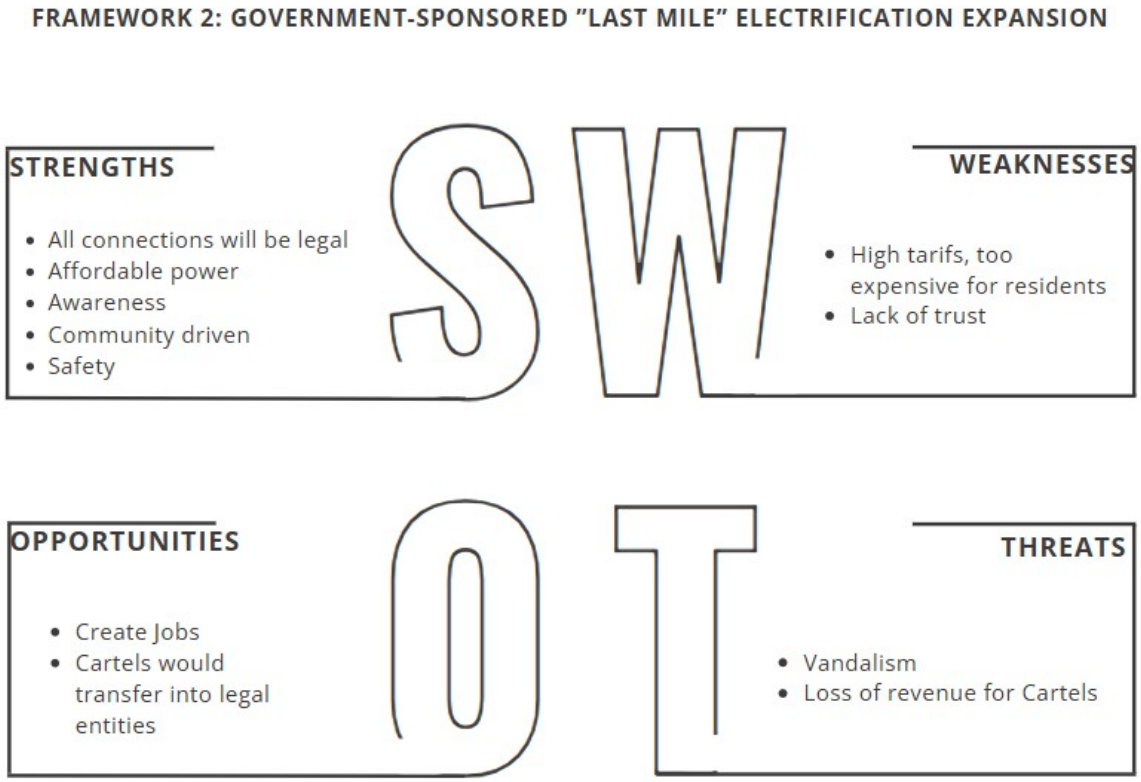

Figure 4.4: SWOT Analysis Proposal 2

Strengths

- **Legal Connections:** All connections will be made legal, ensuring compliance with safety standards and providing residents with formal access to electricity.
- **Affordable Power:** The approach aims to provide electricity at affordable rates, making legal connections more appealing to residents.
- **Increased Awareness:** Government support and formalisation efforts will raise awareness about the benefits of legal connections.
- **Community Driven:** Involving community members in the process promotes a sense of ownership and responsibility.
- **Improved Safety:** Legalisation reduces risks associated with illegal connections, such as electrical fires and electrocutions.

Weaknesses

- **High Tariffs:** The cost of legal connections may still be too expensive for some residents, limiting accessibility.
- **Lack of Trust:** Past negative experiences with formal actors such as Kenya Power may undermine community trust in the initiative.

Opportunities

- **Job Creation:** The approach provides opportunities for employment, particularly for informal suppliers transitioning into formal roles.
- **Transition of Cartels:** Formalising the network provides an opportunity for cartels to transform into legal entities, reducing criminal activities.

Threats

- **Vandalism:** Infrastructure improvements could be sabotaged by individuals or groups opposed to formalisation efforts.

- **Loss of Revenue for Informal Suppliers:** Formalisation threatens existing informal suppliers, potentially leading to resistance or sabotage.

4.3.3. Comparison of the Approaches

The FGDs highlighted significant differences between the approaches. While the CBEC model emphasises community involvement and empowerment, the ”Last Mile” Electrification Expansion relies on a structured, institutional approach driven by Kenya Power and government agencies.

The CBEC approach was preferred by many participants due to its community-driven nature, perceived affordability, and inclusivity. However, concerns about implementation challenges and resistance from informal suppliers were raised. The ”Last Mile” Electrification Expansion, while providing a more formalised solution, was viewed as costly and lacking community ownership.

The findings indicate that each approach has distinct strengths and weaknesses, which should be carefully considered when developing strategies for integrating Mathare's electricity network into the formal system.

5

Roadmap to a Safer and More Reliable System

This chapter presents a comprehensive roadmap for the implementation of the Community-Based Energy Cooperative (CBEC) approach in Mathare. Drawing on the stakeholder analysis presented in Chapter 4.1, the formalisation strategies outlined in Chapter 4.2, and the comparative evaluation of the implementation approaches in Chapter 4.3, this chapter provides a structured, phased plan to support the transition from informal to formal electricity provision. Central to this approach are the principles of inclusive stakeholder engagement, incremental implementation, and proactive risk mitigation.

5.1. Overview of the CBEC Approach

As described in Section 4.2.7, the CBEC approach seeks to formalise existing informal electricity provision in Mathare by establishing a cooperative composed of current informal suppliers. This cooperative is envisioned to operate in partnership with Kenya Power. Kenya Power is positioned to take the lead in this roadmap, as the only institution with both the infrastructure control and regulatory mandate necessary to coordinate stakeholder alignment and formalisation efforts. The approach is designed to address key challenges of safety, affordability, and accessibility while simultaneously safeguarding the livelihoods of local electricity providers. In contrast to conventional top-down interventions, the CBEC approach promotes community ownership, localised employment generation, and adaptable pricing mechanisms that align with the lived realities of Mathare residents and the commercial sustainability objectives of Kenya Power.

5.2. Stage 1: Cooperative Formation and Mobilisation

The initial stage of implementing the Community-Based Energy Cooperative (CBEC) approach focuses on the formal establishment of the cooperative, transforming existing informal electricity providers (Section 4.1.1), into legally recognised entities. Kenya Power should initiate this phase by convening inter-stakeholder meetings to assess current informal connections and begin trust-building with community actors. This transition is driven by the recognition that while these providers currently operate outside legal frameworks, they perform a critical role in ensuring electricity access in Mathare (Interview A3, Interview D1). Rather than criminalising their activities, the CBEC approach seeks to integrate them within a regulated structure, ensuring both compliance and continued service provision.

Stakeholder engagement is the foundation of this stage, directly addressing the high levels of distrust identified among informal suppliers, community members, and Kenya Power (see Table 4.2 and Figure 4.2). Building trust is essential for cooperative success, as highlighted by both the literature on collaborative governance (Ansell & Gash, 2008a) and empirical findings from the focus group discussions, where community members expressed scepticism toward formalisation (Focus Group).

Initial engagement should be led by trusted intermediaries such as Community-Based Organisations (CBOs), including the Ghetto Foundation, which has established credibility within Mathare (Interview C1, C2). These CBOs will facilitate community workshops, dialogue forums, and participatory planning

sessions. The role of these trusted actors is critical, as they bridge the gap between Kenya Power, informal providers, and community residents, promoting transparency and reducing resistance.

To further build legitimacy, case studies of successful energy cooperatives from similar contexts should be presented during these engagement sessions. Such evidence reinforces the viability of the CBEC approach, demonstrating that formalisation can benefit all parties involved. This educational component aligns with the principles of Arnstein's Ladder of Participation (Arnstein, 1969), ensuring that stakeholders are not only informed but actively involved in designing the cooperative.

Once stakeholder consensus is achieved, the cooperative must be formally registered with relevant regulatory bodies, such as the Ministry of Cooperatives and Micro, Small and Medium Enterprises Development. This registration process should be transparent, and the cooperative's charter must clearly define its operational and governance structure. Specifically, the charter should include:

1. A democratic governance structure, ensuring that all cooperative members, including former informal providers, have an equal voice in decision-making. This aligns with collaborative governance principles (Emerson et al., 2012).
2. Mechanisms for income-sharing, ensuring that former informal providers retain a financial stake in the cooperative, providing them with a tangible incentive to participate and comply with legal standards.
3. Advisory roles for CBO representatives and residents, ensuring that community interests are consistently represented in cooperative management.
4. Transparent financial management protocols, including periodic audits and public reporting, which are essential for maintaining accountability and preventing elite capture (Baugh, 2015).

The onboarding process should prioritise the most active and influential informal providers, as these individuals can serve as early adopters and advocates for the CBEC approach. This approach is supported by focus group feedback, where participants noted that early buy-in from influential suppliers is critical to broader community acceptance (Focus Group). These individuals will undergo governance training covering leadership responsibilities, decision-making processes, and cooperative values. Such training is vital for ensuring that the cooperative remains accountable and inclusive, rather than being dominated by a small group of powerful actors.

In summary, Stage 1 is designed to transform informal electricity providers into legitimate, cooperative entities, grounded in principles of transparency, stakeholder engagement, and collaborative governance. This approach not only formalises existing providers but also empowers them, fostering a sense of ownership and ensuring their continued role in electricity provision within Mathare.

5.3. Stage 2: Tariff Negotiation with Kenya Power

Following the formal establishment of the cooperative, the next critical step is to initiate tariff negotiations with Kenya Power. These negotiations are essential for ensuring that electricity remains affordable for residents while maintaining the financial sustainability of both Kenya Power and the Community-Based Energy Cooperative (CBEC). This stage is directly motivated by stakeholder concerns identified in the interviews and focus group discussions, where residents emphasized the importance of affordability (Interview A3, Focus Group), while Kenya Power representatives highlighted the need for cost recovery and loss reduction (Interview F1).

Negotiations should be guided by a multi-stakeholder approach, ensuring transparency and fairness. The Energy and Petroleum Regulatory Authority (EPRA) must be involved as a regulatory body to provide oversight and ensure that the negotiated tariff structure aligns with national pricing standards. This involvement is consistent with best practices in collaborative governance (Ansell & Gash, 2008a) and ensures that the process is transparent and accountable.

The CBEC will serve as the primary negotiator on behalf of residents and former informal suppliers. Its role is to mediate between conflicting interests: residents prioritize affordability, former informal suppliers seek income continuity, and Kenya Power aims to achieve revenue security and reduce losses associated with illegal connections. This stakeholder alignment is critical for ensuring that the negotiated tariff is accepted by all parties.

Two pricing models have been identified as viable options for the CBEC:

The two pricing models: Flat-Rate Tariff and Stepped Tariff Model, were established for the CBEC approach based on a careful analysis of stakeholder interests, existing electricity pricing practices in

Mathare, and best practices in energy governance. Each model was selected for specific reasons that align with the socioeconomic realities of Mathare, stakeholder feedback, and theoretical principles.

1. The **Flat-Rate Tariff Model** is a simplified, predictable pricing mechanism where users pay a fixed monthly fee for electricity access, regardless of their actual consumption. It is aligned with existing informal practices in Mathare (KES 200–500 per month, Section 4.2). This model is suitable because it offers affordability, simplicity, and predictability for residents with irregular incomes. It is familiar to the community, minimises administrative complexity, and ensures a stable revenue stream for the CBEC.
2. The **Stepped Tariff Model** is a more sophisticated pricing approach where the cost of electricity increases with higher consumption. It promotes energy efficiency by encouraging lower consumption among residents while aligning with Kenya Power's standard pricing practices. This model provides a pathway for the CBEC to transition to a more advanced pricing structure over time as residents' economic conditions improve.

Based on stakeholder feedback and Mathare's socioeconomic context, the flat-rate model is initially recommended. It offers simplicity, predictability, and aligns with existing informal billing practices. However, to ensure sustainability and adaptability, the stepped tariff model may be introduced as a future option, following successful pilot testing in selected villages. This phased approach allows for a gradual transition, providing Kenya Power with the flexibility to balance cost recovery with community affordability.

EPRA's involvement is also essential to ensure that the negotiated tariff is fair and that both Kenya Power and the CBEC adhere to regulatory guidelines. This regulatory oversight protects consumers from exploitation and ensures that the cooperative's pricing practices are transparent. Kenya Power should lead technical assessments and pilot programs in partnership with CBOs and informal providers.

Finally, CBOs such as the Ghetto Foundation should be included in the negotiation process to advocate for consumer protection and ensure that the community's voice is adequately represented. These organisations can monitor the negotiation process and facilitate communication between the CBEC, residents, and Kenya Power.

In summary, Stage 2 is designed to establish a fair and transparent pricing model that balances the interests of all stakeholders. The CBEC's role as an intermediary ensures that community concerns are addressed, while EPRA provides regulatory oversight to maintain transparency and accountability.

5.4. Stage 3: Technical Training and Professionalisation

A central pillar of the CBEC implementation strategy involves enhancing the technical capacity of cooperative members, particularly those transitioning from informal electricity provision roles. As discussed in Section 4.2.6, many of these actors, despite playing critical roles in local energy access, lack formal training in electrical systems, safety procedures, and regulatory compliance. This capacity gap presents a significant risk to the reliability and safety of the emerging formal network. Therefore, Stage 3 focuses on professionalising these individuals through structured, accessible training programs that equip them to serve as Community Energy Agents (CEAs).

The decision to prioritise training is grounded in best practices for community energy governance, where capacity building is recognised as essential for sustainable service delivery (Emerson et al., 2012). Moreover, this approach directly addresses stakeholder concerns regarding unsafe installations and unreliable service, which were identified as significant barriers to trust in the formalisation process (Focus Group, Interview D1).

The objective of this stage is twofold: first, to ensure that electricity infrastructure is installed, operated, and maintained in accordance with national safety standards; and second, to integrate former informal suppliers into the legal energy sector in a manner that preserves their income-generating role while enhancing service quality. Achieving these goals requires targeted interventions in training design, delivery, and certification.

The training programme should be developed in collaboration with Kenya Power, relevant vocational training institutions, and NGOs experienced in community-based technical capacity building. Kenya Power should formalise service models, integrating vetted informal providers through regulated CBEC structures under its supervision. The curriculum of the training should be carefully designed to address the specific needs and constraints of Mathare's informal energy sector. While comprehensive technical

certification is ideal, the immediate aim is to deliver an intensive introductory course that emphasises practical safety knowledge and essential operational skills.

Given the need for rapid deployment and low barriers to participation, the training will be structured as a short, intensive program lasting one to two days. Despite its brevity, the programme will integrate both theoretical foundations and hands-on exercises. Core topics to be covered include:

- Basic electrical theory relevant to low-voltage distribution systems;
- Safe wiring practices and techniques for preventing electrocution and short circuits
- Identification and mitigation of fire hazards associated with overloading, poor insulation, or exposed conductors
- Standard procedures for emergency response, including first aid and fire suppression
- Basic troubleshooting methods for resolving common household electricity problems

The training should be tailored to the participants' educational backgrounds and prior experience. Instruction will make use of visual aids, live demonstrations, and simplified manuals translated into local languages where necessary. Practical exercises should take place in real or simulated environments representative of typical conditions in Mathare. Trainers may be drawn from Kenya Power's technical team, retired professionals, or instructors from polytechnic institutes familiar with informal settlement contexts.

Financing for the programme will be provided entirely by Kenya Power, as part of its broader investment in the CBEC approach. From a business perspective, this training represents a cost-effective intervention: it helps mitigate future risks related to grid faults, customer dissatisfaction, and infrastructure damage issues that often arise in environments where electricity is managed without sufficient technical oversight. Moreover, it strengthens community relations by signalling Kenya Power's commitment to inclusive development and capacity building.

Upon completion of the training, participants should receive a certificate of participation jointly endorsed by Kenya Power and the training institution. While this certificate may not immediately qualify them for independent electrical work outside the CBEC approach, it provides formal recognition of their skills and marks the first step toward more advanced accreditation. Over time, additional modules could be developed for CEAs who demonstrate strong performance and interest in further professional development.

In summary, this training initiative provides the technical foundation for a safer, more professional, and community-integrated energy distribution system. It empowers former informal suppliers with essential knowledge and formal recognition, thereby improving the quality and legitimacy of electricity services within the cooperative structure.

5.5. Stage 4: Infrastructure Deployment and Service Launch

Following the establishment of a cooperative structure, completion of technical training, and agreement on tariffs with Kenya Power, the next critical phase involves the installation and activation of electricity infrastructure. This stage marks the material transition from an informal and often hazardous network to a regulated and technically robust distribution system.

The infrastructure deployment will include the installation of essential grid components, such as transformers, low-voltage distribution lines, service connections to households, and prepaid metering systems at the generator. These components are selected based on their reliability, scalability, and alignment with Kenya Power's operational capabilities (Kenya Power and Lighting Company, 2023). To ensure effective implementation and minimise operational risks, the rollout will be conducted in a structured, phased approach.

The process begins with the identification and selection of pilot zones. These zones are chosen based on specific criteria, including areas with high safety risks, such as frequent electrocution incidents or fire hazards, and underserved regions where residents have limited access to legal electricity connections. By focusing on these critical areas, the pilot phase allows the cooperative to test installation procedures, identify technical challenges, and optimise community engagement strategies. This approach ensures that operational procedures are refined before broader implementation.

Following the successful completion of the pilot phase, the deployment will expand using a cluster-based approach. Clusters are defined by the logical grouping of households around existing trans-

former coverage areas, leveraging Kenya Power's existing technical infrastructure. This method facilitates efficient planning, resource allocation, and load balancing, reducing the risks of overloading or voltage instability (International Energy Agency, 2019). The cluster-based expansion also allows the cooperative to scale operations gradually, maintaining flexibility to adapt to emerging technical or community-related challenges.

In the final phase, the rollout extends to cover the entire area of Mathare. This phase emphasises network optimisation and redundancy, ensuring that the system is resilient and capable of maintaining consistent service quality. Technical measures, such as the introduction of looped network configurations, are integrated to maintain service continuity even in the event of localised failures (McCarthy, 2018a).

The financial responsibility for infrastructure deployment rests primarily with Kenya Power, positioning this initiative as a strategic, long-term investment rather than a donor-driven or subsidised approach. This approach is justified by a clear economic rationale: Kenya Power can convert current revenue losses from electricity theft and unmetered consumption into stable, legal revenue streams through more formal connections. Although the initial capital outlay for installing transformers, wiring, and generator meters may be significant, the anticipated benefits, including increased legal connections, reduced system losses, and improved billing compliance, justify the expenditure (Business Daily Africa, 2024). In effect, Kenya Power's infrastructure investment in Mathare should be viewed as a commercially sound intervention that enhances its financial sustainability.

To ensure that the infrastructure functions as intended and that service quality is maintained, the cooperative will establish a basic yet effective monitoring and evaluation (M&E) system. This system will include the collection of data on monthly outages, performance of routine technical inspections, and the administration of regular household satisfaction surveys. These surveys will capture consumer feedback, providing insights for continuous improvement. Additionally, internal audits will be conducted to verify that tariffs are correctly applied, revenues align with projections, and financial management remains transparent.

Kenya Power should oversee monitoring and enforcement mechanisms while ensuring continuous community dialogue and service adaptation.

The findings from this monitoring process will be transparently reported in community forums held quarterly, where the CBEC will present performance reports, financial updates, and future plans. This participatory approach reinforces accountability and strengthens community trust, ensuring that the transition from an informal to a formal network is not only technically sound but also socially accepted. Such transparency aligns with the principles of collaborative governance, where stakeholder engagement is integral to successful service delivery (Ansell & Gash, 2008b).

5.6. Potential Implementation Risks and Mitigation

While the roadmap outlined above provides a structured approach, the CBEC approach still faces several potential risks that could undermine its success if not adequately mitigated.

First, resistance from informal suppliers remains a key risk. These individuals may feel threatened by the shift to a regulated system and could either refuse to participate or attempt to undermine the initiative. Mitigation strategies include ensuring early inclusion, offering income guarantees, and formally recognising their new roles as Community Energy Agents (CEAs), as discussed in Section 5.2.

Second, disputes over pricing could emerge between the cooperative, residents, and Kenya Power. If tariffs are perceived as unfair, public support may wane. To manage this, a multi-stakeholder tariff committee that includes representation from EPRA, Kenya Power, the cooperative, and CBOs should be established to oversee transparent pricing reviews and conflict resolution.

Third, inadequate technical training or weak oversight could result in poor service delivery, infrastructure faults, or safety risks. Continuous mentoring by Kenya Power engineers and periodic recertification of CEAs will help maintain quality standards and ensure that service reliability meets regulatory expectations.

Fourth, governance failures such as elite capture or financial mismanagement could erode community trust in the cooperative. These risks necessitate the institutionalisation of transparent leadership elections, regular third-party audits, and mechanisms for resident grievances.

Finally, there is a risk of infrastructure vandalism or theft, particularly during the early phases of rollout. To counter this, the CBEC should collaborate with local security committees and conduct public

education campaigns to emphasise the long-term communal benefits of the new system.

5.7. Roadmap

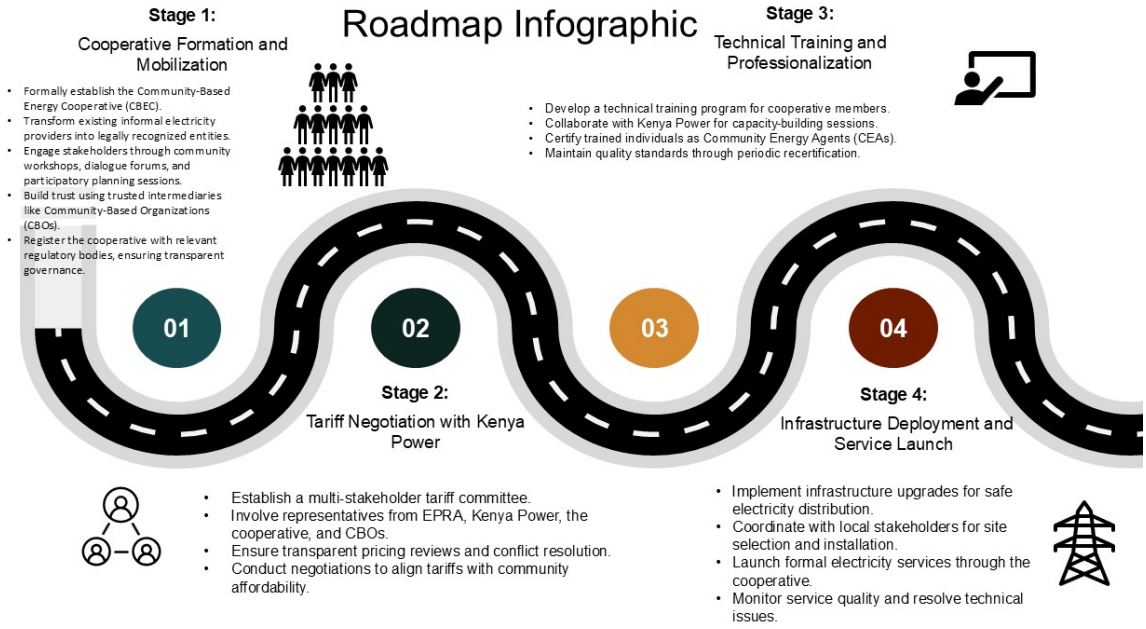

Figure 5.1: Roadmap

The roadmap was developed to provide a clear, visual representation of the structured, step-by-step approach required to formalise the informal electricity network in Mathare. The creation of this roadmap was guided by the detailed analysis and findings presented in Chapter 4, where the need for a phased, inclusive, and stakeholder-driven approach was emphasised. The roadmap was designed using a sequential pathway model, which allows stakeholders to clearly understand the transition from the current informal system to a safer, more reliable, and legally compliant electricity network. The choice of a road metaphor with four distinct stages reflects the journey-like nature of the transition process, emphasising that each stage builds upon the previous one. Each stage of the roadmap is directly linked to the analysis of challenges and opportunities discussed in Section 4.2.7 and is informed by stakeholder feedback, risk assessment, and best practices in collaborative governance (see Section 4.1).

Specifically, the design of the roadmap ensures clarity and accessibility for diverse audiences, including community members, Kenya Power, and local government stakeholders. The icons and visual markers for each stage were chosen to communicate the core activities and objectives of each phase effectively. The use of bullet points under each stage provides a concise summary of key actions, making the figure an effective tool for both presentation and stakeholder communication. This visual roadmap is not only a guide for implementing the CBEC approach but also a tool for stakeholder engagement, as it can be easily presented in community workshops to facilitate understanding and support.

6

Conclusion and Discussion

This chapter provides a comprehensive conclusion and discussion of the findings of this study, which explored how an informal electricity network in Mathare can be integrated into a safer and more reliable system through enhanced stakeholder collaboration and strategic alignment. The chapter is structured to systematically address the research questions that guided this study.

First, it begins by directly answering the sub-questions, each in a dedicated section, providing clear and concise conclusions based on the analysis presented in the previous chapters. These sections offer a focused discussion on the roles, relationships, and impacts of key stakeholders (Section 4.1), the comparative evaluation of electrification approaches (Section 4.2), and the detailed roadmap for the Community-Based Energy Cooperative (CBEC) approach (Chapter 5).

Following the sub-question analysis, this chapter directly addresses the main research question: *"How can an informal electricity network be integrated into a safer and more reliable system through enhanced stakeholder collaboration and strategic alignment?"* This section synthesises the key findings and provides a holistic answer, emphasising the importance of multi-stakeholder engagement, participatory governance, and technical capacity building.

The chapter then transitions into a broader discussion, where the findings of this study are critically analysed in relation to existing literature. This section explores how this research contributes to academic knowledge, highlights its practical implications, and identifies areas where it extends or challenges existing theories on stakeholder governance in energy access.

Subsequently, the chapter acknowledges the limitations of this research, providing a transparent account of factors that may have influenced the findings. These limitations are discussed to ensure a balanced understanding of the study's scope and validity.

Recommendations for further research are then presented, suggesting specific areas where future studies can build upon this work. These recommendations are designed to guide researchers interested in exploring similar contexts or further refining the CBEC approach.

Finally, the chapter concludes with practical recommendations for stakeholders, including Kenya Power, government agencies, and CBOs. These recommendations are grounded in the study's findings and offer actionable strategies for improving electricity access in informal settlements.

6.1. How do Key Stakeholder Interests and Relationships Influence Electricity Access in Mathare?

This section addresses the first subquestion of the study: *'How do key stakeholder interests and relationships influence electricity access in Mathare?'* Chapter 4 revealed that electricity access is shaped by a complex interplay of stakeholder interests and relationships, marked by both collaboration and conflict, among residents, informal providers, Kenya Power, government agencies, and CBOs.

Residents prioritise affordability and accessibility, often relying on informal providers due to the high costs and bureaucratic barriers of formal connections. While informal providers fill a critical gap, their operations are largely unregulated, raising safety and reliability concerns. Their resistance to formalisation stems from fears of income loss, despite their local influence and proximity to consumers.

Kenya Power seeks to expand legal access and reduce losses from illegal connections, but is constrained by procedural requirements like land tenure that many residents cannot meet. As a result, formal access remains limited, and informal alternatives persist.

Government agencies are responsible for regulation but struggle to enforce safety standards in informal settlements due to jurisdictional ambiguities and limited local engagement. This absence enables informal providers to operate unchecked.

CBOs, such as the Ghetto Foundation, play a key intermediary role. Trusted by residents, they advocate for safe and affordable access, facilitate dialogue with formal actors, and promote community education. However, their limited formal authority restricts their impact.

Stakeholder relationships in Mathare reflect both mutual dependence and institutional gaps. Residents and informal providers maintain a transactional but risky relationship. Tensions persist between Kenya Power and informal suppliers due to competing interests. Meanwhile, the government's regulatory presence is weak, and CBOs attempt to bridge the resulting trust and coordination gaps.

These misalignments contribute to persistent issues of unsafe, unreliable, and unaffordable electricity. A solution requires aligning stakeholder incentives and enhancing collaboration, which underpins the CBEC approach proposed in Chapter 5.

6.2. What Are Approaches to Make Informal Electricity Networks Safer and More Reliable?

This section answers the second sub-question: *"What are approaches to make informal electricity networks safer and more reliable?"* Chapter 4.2 outlines two contrasting strategies: the Community-Based Energy Cooperative (CBEC) and the Government-Sponsored "Last Mile" Electrification Expansion.

The CBEC approach emphasises community ownership by formalising informal electricity providers into a legal cooperative. This approach focuses on stakeholder alignment, safety, and local capacity building. Informal providers are transformed into certified Community Energy Agents (CEAs) through training, while cooperative governance fosters trust and inclusivity among residents, Kenya Power, and local authorities.

CBEC's strengths lie in its adaptability, affordability, and potential for long-term sustainability. It reduces resistance by integrating existing providers rather than displacing them. However, success depends on consistent engagement, the willingness of informal providers to formalise, and financial viability, particularly with respect to tariffs negotiated with Kenya Power.

In contrast, the Last Mile Expansion is a top-down approach led by the government and Kenya Power, focused on rapid grid extension and subsidised formal connections. This approach aligns with national electrification targets and removes reliance on informal suppliers. It ensures legal and safe infrastructure but often lacks community involvement and may set unaffordable tariffs, especially in low-income areas. Additionally, it excludes existing informal actors, risking resistance or infrastructure sabotage.

The comparative analysis in Chapter 4.2 shows that while the Last Mile approach accelerates access, it faces sustainability and social legitimacy challenges. CBEC offers a more context-sensitive and participatory path forward, aligning better with local needs and stakeholder dynamics in Mathare.

Therefore, although both approaches aim to improve safety and reliability, the CBEC approach is better suited to the informal, community-driven context of Mathare, fostering long-term stakeholder collaboration and system resilience.

6.3. Which Single Approach Can Be Implemented to Create a Safer and More Reliable Electricity System in Mathare, and How Can It Be Implemented?

This section answers the third sub-question: *"Which single approach can be implemented to create a safer and more reliable electricity system in Mathare, and how can it be implemented?"* Based on the analysis in Chapter 4.2, the Community-Based Energy Cooperative (CBEC) approach was identified as the most suitable solution. Unlike the Government-Sponsored "Last Mile" expansion, CBEC offers long-term sustainability, local ownership, and inclusive stakeholder alignment.

The CBEC approach integrates informal providers into a legally recognised cooperative. It empha-

sises safety, affordability, and capacity building while promoting community participation. The implementation consists of four sequential stages:

6.3.1. Stage 1: Cooperative Formation
Informal providers are formally organised into a cooperative through stakeholder dialogues led by CBOs such as the Ghetto Foundation. Legal registration and a transparent governance structure ensure community involvement, democratic decision-making, and protection against elite capture.

6.3.2. Stage 2: Tariff Negotiation
The cooperative negotiates a fair tariff with Kenya Power, supported by EPRA and CBOs. A multi-stakeholder committee discusses pricing models (flat-rate or stepped tariff) that balance affordability with operational sustainability, ensuring adherence to national standards.

6.3.3. Stage 3: Technical Training
In collaboration with Kenya Power and vocational institutions, cooperative members receive training in electrical safety, wiring, and customer service. Certified as Community Energy Agents (CEAs), they gain legal status and professional skills, improving service quality and reducing safety risks.

6.3.4. Stage 4: Infrastructure Deployment
Infrastructure installation begins with pilot zones and expands in phases. The CBEC manages operations, maintenance, and revenue collection via prepaid meters. Regular reviews and transparent reporting promote accountability and service reliability.

In sum, the CBEC approach provides a realistic and inclusive pathway for improving electricity access in Mathare, addressing both technical and governance challenges through phased, participatory implementation.

6.4. Addressing the Main Research Question
This section answers the central research question: *"How can an informal electricity network be integrated into a safer and more reliable system through enhanced stakeholder collaboration and strategic alignment?"* Based on the findings from the sub-questions, the proposed solution is the Community-Based Energy Cooperative (CBEC) approach, which emphasises stakeholder alignment, community participation, and regulatory support.

Electricity access in Mathare is shaped by conflicting interests among residents, informal providers, Kenya Power, government agencies, and community-based organizations (CBOs). While residents seek affordable access, informal providers prioritise income, Kenya Power focuses on compliance and revenue, and government agencies aim to uphold safety standards. The lack of coordination among these actors has led to unsafe and unregulated networks.

The CBEC approach addresses these issues by integrating informal providers into a legal cooperative structure. Promotes collaboration between all stakeholders: residents, Kenya Power, government bodies, and CBOs, ensuring inclusive decision-making, accountability, and shared responsibility. Informal providers are trained and certified as Community Energy Agents (CEAs), enabling them to operate safely and legally.

Community participation is a core element of the approach. Residents are engaged in cooperative governance and contribute to the system's sustainability through active involvement. Capacity building through technical training empowers former informal providers and enhances service quality.

Regulatory alignment is maintained through formal registration and close cooperation with Kenya Power and EPRA. A negotiated tariff model ensures affordability for residents and financial sustainability for the cooperative.

The implementation plan follows four stages: (1) cooperative formation, (2) tariff negotiation, (3) technical training, and (4) infrastructure deployment. This phased approach allows gradual transition, minimising resistance while improving safety and reliability.

In conclusion, the CBEC approach offers a practical pathway to formalize informal electricity systems in Mathare by aligning stakeholder interests, fostering local ownership, and ensuring regulatory

compliance. It presents a scalable solution for improving electricity access in similar informal settlements.

6.5. Discussion

This section provides a critical reflection on the findings of this study, situating them within the broader academic literature on informal electricity networks, stakeholder collaboration, and community-based energy approaches. The discussion highlights how this study confirms, contradicts, or extends existing knowledge, examines the theoretical contributions of the research, and explores its practical implications for Kenya Power, government agencies, and community-based organisations (CBOs). Finally, this section considers the broader applicability of the Community-Based Energy Cooperative (CBEC) approach to other informal settlements beyond Mathare.

6.5.1. Findings in Relation to Existing Literature

The findings of this study align with existing research on the dynamics of informal electricity networks, which consistently emphasise the role of stakeholder interests and relationships in shaping access, safety, and reliability. Prior studies have documented the prevalence of informal electricity providers in low-income urban areas, where they fill a critical gap left by formal utilities (Mimmi, 2014). This study confirms these observations in the context of Mathare, where informal providers have established a parallel electricity network that, despite being unsafe and unreliable, serves the immediate needs of residents who lack access to formal connections.

However, this study also extends existing knowledge by demonstrating that informal providers are not merely exploitative actors but are, in many cases, community members with strong social ties and local influence. Their resistance to formalisation is not simply a matter of profit-seeking but is driven by legitimate concerns about income loss and social status. This insight aligns with the work of (Gibson, 2019), who emphasised the socio-economic motivations of informal suppliers. By recognising these motivations, the CBEC approach provides a pathway for integrating these providers into a formal system without undermining their livelihoods.

The CBEC approach also builds on existing research on stakeholder collaboration and participatory governance. While studies such as (Emerson et al., 2012) and (Ansell & Gash, 2008a) have emphasised the importance of multi-stakeholder engagement in resource management, this study operationalises these principles in the specific context of electricity access. It demonstrates that stakeholder alignment can be achieved through a structured, four-stage process that prioritises trust-building, transparent governance, and shared decision-making. This approach not only improves service safety and reliability but also enhances community ownership and accountability.

Moreover, this study extends the theoretical framework of Arnstein's Ladder of Participation (Arnstein, 1969), which classifies levels of citizen participation from manipulation to citizen control. The CBEC approach exemplifies a high level of participation, where community members, including former informal providers, are not only consulted but are actively involved in the governance and management of the electricity network. This participatory approach contrasts with the conventional top-down approaches documented in the literature, where residents are often passive recipients of external interventions.

Furthermore, the analysis in this study consistently applied theoretical vocabulary from Arnstein's and Ansell and Gash's approaches to evaluate stakeholder dynamics. For example, Kenya Power's engagement with informal residents largely reflects a tokenistic form of participation, falling into the lower rungs of Arnstein's Ladder. Meanwhile, the principles of collaborative governance, such as trust building, shared accountability, and iterative dialogue, are used as benchmarks to assess the inclusivity and long-term viability of the proposed interventions. By embedding these concepts into the interpretation of qualitative data, the study aligns empirical findings with established participatory governance literature, reinforcing the academic robustness of the conclusions drawn.

6.5.2. Scientific Relevance

This study makes a meaningful theoretical contribution by applying existing frameworks, specifically Collaborative Governance Theory and Arnstein's Ladder of Participation, to the challenge of integrating informal electricity networks. Collaborative Governance Theory, as outlined by (Emerson et al., 2012), highlights the value of inclusive, structured processes that enable diverse stakeholders to jointly

engage in decision-making. The CBEC approach applies this theory by establishing a legally recognised cooperative that includes residents, informal providers, Kenya Power, government agencies, and CBOs, thereby creating a shared governance structure.

Similarly, the CBEC approach operationalises Arnstein's Ladder of Participation by facilitating a level of citizen involvement that moves beyond passive consultation. Community members are not merely informed or consulted but are actively involved in decision-making. This is achieved through democratic structures in which all cooperative members have equal voting rights and through the training and certification of Community Energy Agents (CEAs), which equips local residents with technical knowledge and formal recognition.

While the study does not develop new theory, it contributes by demonstrating how these established frameworks can be applied and adapted to complex urban contexts. Specifically, it illustrates how collaborative governance and participatory models can be implemented in informal settlements characterised by fragmented authority and competing stakeholder interests.

The research further enriches the practical understanding of stakeholder alignment in service delivery, showing that alignment is not an abstract concept but a tangible outcome of structured engagement. The CBEC approach provides a pathway for aligning stakeholders with conflicting interests through mutual recognition, shared responsibility, and iterative engagement processes.

However, the theoretical contribution remains context-specific. The findings are grounded in the unique stakeholder dynamics and regulatory constraints of Mathare. Their applicability to other informal settlements will depend on the presence of similar enabling conditions. Future research should therefore explore how these applied models function across different geographies to evaluate the broader relevance of stakeholder alignment as a tool for informal energy transitions.

6.5.3. Practical Implications

The findings of this study have several practical implications for Kenya Power, government agencies, and NGOs. For Kenya Power, the CBEC approach offers a sustainable strategy for reducing losses from illegal connections while expanding its customer base. By partnering with legally recognised cooperatives, Kenya Power can ensure that electricity is delivered safely and reliably, while minimising the risks of revenue loss associated with informal networks. Moreover, Kenya Power's involvement in training Community Energy Agents (CEAs) helps maintain safety standards and strengthens its relationship with the community.

For government agencies, the CBEC approach demonstrates the importance of creating an enabling regulatory environment for community-based energy initiatives. Government bodies, such as the Ministry of Cooperatives and EPRA, can support the formalisation of CBEC's by streamlining registration procedures, providing regulatory oversight, and facilitating tariff negotiations with Kenya Power. This approach aligns with the government's broader electrification goals while ensuring that low-income communities are not excluded from legal electricity access.

Community-Based Organisations (CBOs) also play a critical role in the CBEC approach, serving as trusted intermediaries that facilitate dialogue, build trust, and promote education on energy safety. For CBOs, the approach provides a clear framework for advocating for community interests while maintaining constructive engagement with formal institutions. CBOs can leverage their local credibility to ensure that the cooperative remains responsive to community needs and that its governance is transparent and accountable.

6.5.4. Broader Applicability of the CBEC Approach

Although this study focuses on Mathare, the CBEC approach has broader applicability to other informal settlements that face similar challenges of unsafe, unreliable, and unregulated electricity networks. The approach's core principles, stakeholder alignment, community participation, capacity building, and regulatory support are not specific to Mathare but are broadly relevant to any context where informal service providers operate outside legal frameworks.

The phased implementation approach of the CBEC approach also makes it adaptable to diverse settings. By starting with stakeholder engagement and cooperative formation, the approach can be tailored to the specific socio-economic conditions of different communities. The technical training component ensures that local residents are equipped with the skills necessary to maintain safe and reliable electricity services, while the involvement of government agencies and utilities ensures regulatory compliance.

However, the success of the CBEC approach in other contexts will depend on the willingness of stakeholders to engage in collaborative governance and the capacity of local intermediaries, such as NGOs, to facilitate trust-building and dialogue. In contexts where informal providers are highly resistant to formalisation or where government agencies lack regulatory capacity, additional strategies may be required to achieve stakeholder alignment.

In conclusion, this study not only provides a scalable approach for improving electricity access in Mathare but also contributes to the broader academic understanding of how informal service networks can be transformed through stakeholder collaboration and community empowerment. The CBEC approach represents a departure from conventional top-down electrification approaches, offering a sustainable, locally owned, and adaptable solution that can be applied to other informal settlements.

6.6. Limitations

While this study provides valuable insights into the integration of informal electricity networks into safer and more reliable systems, it is important to acknowledge its limitations. These limitations relate to the study's geographic focus, methodological approach, the use of paid incentives for participants, and the inherent challenges of stakeholder engagement in complex, informal settings.

6.6.1. Geographic Focus on Mathare

The study is geographically focused on Mathare, one of Nairobi's largest informal settlements. Although the findings provide a detailed understanding of the dynamics of electricity access in this context, the extent to which they can be generalised to other informal settlements, either within Kenya or in other countries, is limited. Mathare has unique socio-economic, cultural, and political characteristics that influence stakeholder relationships and electricity access. Other informal settlements may exhibit different stakeholder dynamics, regulatory environments, or local governance structures, which could affect the applicability of the Community-Based Energy Cooperative (CBEC) approach. Future research should explore the implementation of the CBEC approach in other contexts to assess its broader applicability.

6.6.2. Potential Bias Due to Reliance on Interviews and Focus Groups

The study primarily relies on qualitative data collected through interviews and focus groups. While these methods provide rich, in-depth insights into stakeholder perspectives, they are also subject to potential biases. Participants may have provided responses that they believed were socially desirable, particularly in focus group settings where social dynamics can influence individuals' willingness to express dissenting opinions. The interpretation of qualitative data is also inherently subjective, and the findings may be influenced by the researcher's interpretation of participant responses. Although measures were taken to ensure data validity, such as using direct quotations and cross-referencing findings with multiple data sources, there remains a risk of interpretive bias.

6.6.3. Impact of Paid Incentives on Participant Responses

A potential source of bias in this study arises from the use of paid incentives for interview participants and focus group attendees. While compensating participants for their time is a common practice in qualitative research, it may have influenced participant responses. Some participants may have provided answers they believed the researcher wanted to hear to increase their chances of being invited to the paid focus group discussions. This dynamic could have led to socially desirable responses rather than honest accounts, particularly regarding sensitive topics such as the willingness to participate in the CBEC approach or perceptions of existing electricity providers. While efforts were made to encourage openness and honesty during data collection, the influence of financial incentives cannot be entirely discounted.

6.6.4. Role of Partner Organisations

While the involvement of Nuvoni and the Ghetto Foundation was essential in enabling access to the field and building trust within the Mathare community, their role introduces potential limitations in terms of sampling and influence. Nuvoni facilitated the initial connection to the Ghetto Foundation, which in turn provided access to local community researchers who assisted in identifying and recruiting interview participants. Although participant selection was based on clearly defined criteria, such as diversity of origin within Mathare and English proficiency, the process was mediated by actors embedded in the

community. Despite assurances that selection was conducted as randomly as possible, the reliance on local intermediaries may have introduced unintentional sampling bias, particularly toward individuals already engaged or familiar with CBO-related activities.

In addition, the Ghetto Foundation hosted both the interviews and the focus group discussions, which could have influenced the responses of the participants due to perceived associations with the organisation. While neither organisation has a direct stake in the research outcomes, their involvement may have subtly shaped how participants framed their experiences or the degree of openness they felt during data collection. Efforts were made to mitigate these effects by independently selecting participants for the focus group discussion and cross-validating interview findings through triangulation. However, the potential influence of these gatekeeping dynamics should be considered when interpreting the findings.

6.6.5. Challenges in Capturing All Stakeholder Perspectives

The study faced challenges in capturing the perspectives of all relevant stakeholders, particularly those who may have been reluctant to participate. Informal electricity providers, who are central to the CBEC approach, are a diverse group with varying motivations, economic interests, and social standings. Some providers, particularly those who operate at a larger scale, may have been hesitant to participate in interviews due to fears of exposure or legal repercussions. Similarly, residents who rely on informal electricity connections may have been reluctant to openly criticise these providers due to fear of retaliation. These challenges may have resulted in an incomplete understanding of the full range of stakeholder perspectives.

6.6.6. Potential Errors in Data Collection Due to Translation and Interpretation

The study relied on community researchers to conduct some interviews and focus groups, and in some cases, interviews were conducted in local languages and later translated into English for analysis. This process introduces the possibility of translation errors, where the meanings of participant statements may have been distorted or misinterpreted. Additionally, community researchers may have unconsciously influenced participant responses through their own interpretations or biases. While training was provided to ensure accurate data collection, the risk of miscommunication and misinterpretation cannot be entirely eliminated.

6.6.7. Possible Inconsistencies in Stakeholder Responses

The study's reliance on qualitative methods also introduces the possibility of inconsistencies in stakeholder responses. Participants may have provided conflicting accounts of their experiences, perceptions, and expectations, particularly in relation to sensitive topics such as illegal electricity connections, pricing practices, or the role of Kenya Power. These inconsistencies are not uncommon in qualitative research, where perspectives are shaped by individual experiences and social contexts. However, they present a challenge for data analysis, as the researcher must carefully distinguish between genuinely divergent views and misunderstandings or misrepresentations.

6.6.8. Social Desirability Bias

Social desirability bias is another significant limitation of this study. Participants, particularly those involved in informal electricity provision, may have downplayed their role in unsafe practices or exaggerated their willingness to participate in the CBEC approach. Residents may also have provided favourable views of the CBEC approach due to the presence of CBO representatives during focus group discussions. Furthermore, participants who were aware of the researcher's interest in promoting a safer and more reliable electricity system may have tailored their responses to align with this perceived expectation. Although efforts were made to create a neutral, open environment for data collection, such as using trusted intermediaries to facilitate focus groups, the influence of social desirability bias cannot be completely eliminated.

6.6.9. Limited Scope of Technical Evaluation

While the CBEC approach emphasises safety and reliability through technical training and professionalisation, this study did not conduct a technical evaluation of the existing electricity network in Mathare. The analysis of safety risks and reliability challenges is based primarily on stakeholder accounts rather

than direct technical inspections of the network. As a result, the specific technical deficiencies of the existing informal network, such as faulty wiring, overloading, or inadequate insulation, are not documented in detail; only direct observations have been made. Future studies should include a technical assessment of the electricity infrastructure to provide a more comprehensive understanding of the safety challenges facing Mathare.

6.6.10. Absence of Longitudinal Data

Finally, the study is cross-sectional, providing a snapshot of stakeholder perspectives and network conditions at a specific point in time. It does not capture how these perspectives may evolve over time, particularly as the CBEC approach is implemented and refined. Longitudinal research is needed to assess the long-term impacts of the CBEC approach on electricity access, stakeholder relationships, and community perceptions. Such studies could provide valuable insights into the sustainability of the CBEC approach and identify areas for further improvement.

7

Recommendations

This chapter provides recommendations based on the findings and analysis of this study. These recommendations are divided into two main categories: recommendations for further research and practical recommendations for stakeholders involved in the implementation and sustainability of the Community-Based Energy Cooperative (CBEC) approach. The aim of these recommendations is to enhance the understanding, effectiveness, and scalability of the CBEC approach in improving electricity access in informal settlements like Mathare.

7.1. Recommendations for Further Research

The findings of this study demonstrate that the CBEC approach offers a promising approach for transforming unsafe and unreliable informal electricity networks into safer and regulated systems. However, further research is essential to build on these insights, validate the approach in different contexts, and refine its implementation strategies. One of the primary areas for future research is the comparative study of CBEC implementation across different informal settlements, both within Kenya and in other countries. Such comparative studies would provide valuable insights into how local socio-economic conditions, cultural norms, and governance structures influence the success of the CBEC approach. By examining diverse contexts, researchers can identify factors that facilitate or hinder cooperative formation, stakeholder alignment, and service sustainability.

Another critical area for further research is the long-term impact assessment of the CBEC approach on electricity access, safety, and community empowerment. This study provides a cross-sectional analysis based on stakeholder perspectives at a specific point in time. However, the true effectiveness of the CBEC approach can only be understood through longitudinal studies that track key indicators such as service reliability, customer satisfaction, cooperative financial sustainability, and the incidence of electrical accidents over several years. Such studies would provide robust evidence of the approaches' sustainability and reveal any emerging challenges that may require adaptive management.

In addition to longitudinal studies, future research should explore alternative governance approaches for informal electricity networks. While the CBEC approach emphasises community ownership and stakeholder alignment, other approaches, such as public-private partnerships, micro-grids, or hybrid approaches, may also be effective in different contexts. Comparative studies of these approaches would enhance the understanding of which governance structures are best suited to different socio-economic environments, providing policymakers with a broader toolkit for improving electricity access in informal settlements.

Moreover, the social acceptance of the CBEC approach is a critical factor in its success, yet community perceptions are likely to evolve over time. Future research should include periodic assessments of community attitudes toward the cooperative, exploring factors that influence residents' trust, willingness to participate, and satisfaction with the services provided. Such studies could employ mixed-methods approaches, combining quantitative surveys with qualitative interviews to capture nuanced insights.

Finally, future research should conduct detailed technical and financial feasibility assessments of the CBEC approach. Technical studies should evaluate the capacity of existing infrastructure to support safe and reliable electricity distribution under the cooperative approach, identifying potential technical

challenges and solutions. Financial studies should assess the revenue-generation potential of the cooperative, exploring the impact of different tariff approaches on financial sustainability and community affordability. Such studies would provide a solid foundation for optimising the approach's design and ensuring its long-term viability.

7.2. Practical Recommendations for Stakeholders

In addition to further research, this study provides practical recommendations for key stakeholders involved in the implementation and management of the CBEC approach. These stakeholders include Kenya Power, government agencies, and community-based organisations (CBOs). The successful implementation of the CBEC approach depends on the active engagement, collaboration, and support of these actors.

Kenya Power, as the primary electricity utility, should adopt a more collaborative approach to working with CBECs. This involves viewing CBECs not merely as customers but as partners in the provision of safe and reliable electricity. Kenya Power should provide technical training for cooperative members, particularly for those who transition from informal electricity provision to become Community Energy Agents (CEAs). Such training should cover basic electrical safety, network maintenance, and customer service, ensuring that CEAs are equipped to maintain service quality and minimise safety risks.

Furthermore, Kenya Power should support transparent and inclusive tariff negotiations with CBECs. The pricing of electricity is a critical factor that determines the financial sustainability of the cooperative and the affordability of electricity for residents. Tariff negotiations should involve not only the CBEC management but also community representatives, ensuring that the agreed rates align with local economic conditions. By maintaining open communication with CBECs and providing ongoing technical support, Kenya Power can foster a mutually beneficial partnership that enhances service reliability and customer satisfaction.

Government agencies, including the Ministry of Cooperatives and the Energy and Petroleum Regulatory Authority (EPRA), play a critical role in providing a supportive regulatory environment for CBECs. These agencies should develop clear and accessible regulatory frameworks that facilitate the registration and operation of CBECs, ensuring that they operate transparently and in compliance with national safety standards. Regulatory authorities should also monitor the performance of CBECs, providing oversight to protect consumers from exploitative pricing or mismanagement.

Moreover, government agencies should promote capacity-building initiatives for CBEC members, including training in cooperative governance, financial management, and conflict resolution. Such training is essential for maintaining the integrity and sustainability of the cooperative. In addition, the government should support public awareness campaigns on energy safety, educating residents on the risks of unsafe connections and the benefits of legal, regulated electricity access.

Community-Based Organisations (CBOs) also have a critical role to play in the success of the CBEC approach. As trusted intermediaries, CBOs can facilitate community engagement, ensuring that residents have a voice in cooperative governance and that their concerns are addressed. CBOs should continue to promote awareness of energy safety, advocate for transparent and inclusive governance within CBECs, and mediate conflicts between stakeholders. Their local credibility and social networks make them well-suited to maintaining community trust in the cooperative.

Finally, while this study focuses on Mathare, the CBEC approach has broader applicability to other informal settlements facing similar challenges of unsafe, unreliable, and unregulated electricity networks. Policymakers and practitioners should view the CBEC approach as a flexible framework that can be adapted to different contexts, rather than as a one-size-fits-all solution. Successful adaptation requires sensitivity to local conditions, including socio-economic status, cultural norms, and existing stakeholder relationships. By conducting careful stakeholder analysis and maintaining a commitment to community participation, the CBEC approach can be scaled to other informal settlements, providing sustainable, community-driven solutions for improving electricity access.

In conclusion, these recommendations provide a clear pathway for building on the findings of this study, enhancing the safety, reliability, and sustainability of electricity access in Mathare and beyond. By pursuing further research and implementing these practical recommendations, stakeholders can ensure that the CBEC approach achieves its full potential as a scalable solution for informal electricity networks.

7.3. Personal Reflection

This research has been both academically insightful and practically challenging. While the core research design remained largely intact throughout the study, certain real-world dynamics forced reconsiderations and adaptations. One key assumption, that stakeholders would speak openly about their experiences with electricity access, proved to be overly optimistic. Due to the illegal nature of many electricity connections in Mathare, several interviewees were hesitant or cautious in their responses. This created a discrepancy between interview data and direct field observations and highlighted the sensitive nature of the topic.

To address this challenge, the fieldwork phase was extended to include a multi-stakeholder focus group discussion. This not only allowed for triangulation of earlier findings but also led to a refined and more community-validated version of the CBEC (Community-Based Energy Cooperative) approach. The dialogue in the focus group confirmed certain themes identified in interviews and illuminated areas of agreement and friction across stakeholder groups.

Reaching government officials proved particularly difficult. Multiple follow-ups were needed, and even when access was gained, some officials refused to answer sensitive questions due to fear of consequences. Furthermore, the power dynamics were evident in interactions between Kenya Power representatives and local residents; some residents expressed feelings of marginalisation or exclusion. These dynamics likely influenced some stakeholder feedback and underscore the necessity of trust-building in any future implementation phase.

A critical aspect of this research was acknowledging the positionality of the researcher. As a white Dutch student from TU Delft, I was aware that my identity could influence how stakeholders perceived and interacted with me. On the one hand, informal providers often welcomed me because I approached them without judgment, and they appreciated that I was listening to their perspective rather than criminalising their actions. On the other hand, some residents were sceptical, associating me with other foreign researchers who had visited, collected data, and left without contributing tangible outcomes. To mitigate these dynamics, I participated in a preparatory training course on research bias, organised by Leiden University, which helped me reflect on how my background and assumptions might shape the research process. During interviews and the focus group discussion, community researchers were involved to support participants, explain the research purpose, and ensure comfort and trust. We maintained anonymity throughout the process, which allowed stakeholders to speak more openly and protected them from potential repercussions.

Despite these limitations, the academic frameworks employed, such as the stakeholder power-interest grid and collaborative governance theory, proved useful in organising complex actor relationships. These approaches helped uncover patterns of cooperation and resistance that might otherwise have remained obscured. If more time and resources had been available, piloting a small-scale CBEC prototype could have offered empirical insights into its operational viability and scalability.

Ultimately, the roadmap and recommendations presented in this thesis are grounded in empirical engagement and stakeholder validation. The CBEC approach was discussed in detail with a diverse range of actors, and their feedback directly informed the proposed implementation strategy. Given Mathare's demographic and infrastructure similarities with other informal settlements, such as Kibera, Lucky Summer, and Kiandutu, the findings are likely to have broader applicability. However, the political context and local governance dynamics will play a significant role in determining the success of similar initiatives elsewhere.

Working in collaboration with the Nuvoni Research Institute significantly shaped the direction and rhythm of my research process. While their team provided valuable guidance and access to local knowledge networks, their occasional unavailability prompted me to take strong initiative, particularly in reaching out to difficult stakeholders such as government officials. Nuvoni's emphasis on real-world applicability and solutions influenced my approach, sometimes pulling me more towards practice-oriented results rather than purely academic ones. This contrasted with the more theory-driven research ethos at TU Delft. Due to time constraints and several changes in research direction, I also had to deviate from the traditional TU Delft procedure of conducting the literature review before fieldwork. Instead, I conducted both simultaneously. Although unconventional, this overlap allowed me to observe theory unfolding in real-world contexts. The interplay between academic rigour and practical relevance ultimately strengthened my understanding of applied urban governance and deepened the impact of my findings.

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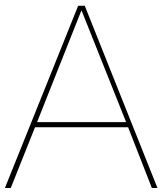

Interview Questions for Residents with Informal Electricity Connections

Electricity Access and Source

1. How did you get your electricity connection? (application process)
2. Why did you choose this option instead of a legal connection?
3. Were there any difficulties in obtaining this connection?

Tariffs and Costs

1. How much do you pay for electricity? How does this compare to Kenya Power's official tariffs?
2. Who is the person who pays for electricity?
3. Who is the supplier of the electricity, and how is your contact with them?
4. What is the occupation of this person?
5. How much do you pay to get connected to the electricity grid?
6. Do you need to buy special equipment to be connected?
7. Do you feel the prices are fair? Why or why not?
8. Have you ever experienced sudden price increases or unexpected additional charges?

Reliability and Risks

1. How reliable is your electricity connection? Do you experience frequent outages?
2. Do you have a secondary connection? If yes, how do you use it, and is it formal or informal?
3. What do you do when there is an issue with your connection? How do you solve it, and is there someone to help you with that?
4. Have you or anyone in your household ever experienced any electrical-related accidents, such as fires or shocks, due to this connection?
5. How severe do you think the risk of electricity-related fires is compared to other risks, such as flooding?
6. Are there any safety measures in place to prevent accidents? If yes, which ones?
7. Are there consequences from Kenya Power or the authorities for having an informal connection? If yes, what are they?

Government and Policy

1. What do you think the government should do to improve electricity access in Mathare?
2. What role should the government and Kenya Power play in addressing informal electricity networks?

3. Would you be willing to switch to a legal connection if it was made more affordable and accessible? What conditions would need to change?

B

Interview Questions for Residents with Legal Electricity Connections

Electricity Access and Experience

1. How did you obtain your electricity connection? (What was the application process?)
2. What challenges, if any, did you face in getting connected?
3. How long did the process take, and was it affordable?

Tariffs and Costs

1. How much do you pay for electricity on average, and what are the connection fees?
2. What is the occupation of the person paying the bills?
3. What do you think of Kenya Power tariffs? Have you experienced unexplained high bills?
4. Are you aware of the tariffs charged by informal providers? How do they compare to Kenya Power?
5. Are you also connected to informal resellers as a secondary connection? If yes, why?
6. When or why do you usually switch to the secondary connection?

Reliability and Risks

1. How reliable is your electricity supply? How often do you experience power outages?
2. What do you do when there is a power outage?
3. Have you ever had any safety concerns with your connection?
4. Do you think informal electricity connections affect the reliability of your power supply?
5. Have you ever reported issues to Kenya Power? How was their response?

Government and Policy

1. What should the government do to make electricity more accessible in Mathare?
2. Do you believe Kenya Power and the authorities are doing enough to regulate electricity access in informal settlements?
3. What measures should be taken to address illegal connections?
4. How can the government and Kenya Power work with the community to improve service delivery?

C

Interview Questions for Households Without Electricity

Electricity Access and Barriers

1. Why do you not have electricity access?
2. Have you tried to apply for legal access?
3. If yes, what challenges did you face?

Alternative Energy Sources

1. What do you currently use instead of grid electricity?
2. How much do you spend on alternative energy sources per month, week, or daily?
3. How frequently do you use these alternatives?
4. How does the lack of grid electricity impact your daily life?

Potential Risks and Informal Providers

1. Have you considered using an informal connection? Why or why not?
2. What are your safety concerns regarding informal connections in your community?
3. What do you think of the current electricity situation in Mathare and your village?

Government and Policy

1. How can the government and Kenya Power help people like you gain access to electricity?
2. If electricity were made cheaper and more accessible, would you be willing to connect legally?
3. What steps should be taken to ensure fair and safe electricity access for all?

D

Interview Questions for Informal Electricity Providers

Business Model and Operations

1. How long have you been providing electricity in Mathare?
2. How did you obtain the knowledge or skills to become an electrician?
3. How do you obtain the electricity you distribute?
4. How do you determine the price that residents pay for electricity?
5. What challenges do you face in supplying electricity?

Tariffs and Costs

1. How much do you charge customers?
2. How does your pricing compare to Kenya Power's tariffs?
3. Do you receive complaints about the cost or service quality from your customers?

Reliability and Risks

1. What measures, if any, do you take to prevent electrical accidents?
2. Have there been incidents like fires or electrocution due to informal connections in the households you supply?
3. How do you handle issues such as power failures or voltage drops?

Regulations and Government Intervention

1. Have you ever faced interference from Kenya Power or government authorities?
2. What do you think about formalizing informal electricity supply? Would you be willing to work under government regulation?
3. What kind of support or incentives would encourage informal providers to transition into formal service providers?

E

Interview Questions for Community Leaders

Electricity Access and Community Concerns

1. What role do community leaders play in addressing electricity access issues?
2. What are the most common complaints from residents about electricity?
3. How do informal electricity providers operate in your community?
4. What do you think about the role of the informal electricity providers?

Stakeholder Engagement and Challenges

1. Have you been involved in discussions with Kenya Power or policymakers about electricity in Mathare?
2. If yes, what were your experiences?
3. How was the process of getting involved?
4. What are the main obstacles preventing better electricity access?
5. Do you think Kenya Power and the government are doing enough to address electricity challenges in informal settlements?

    - If yes, why?
    - If no, why?

Potential Solutions and Government Role

1. What kind of support do you think the community needs to improve electricity access?
2. Do you think informal electricity networks should be formalized? Why or why not?
3. How can the government, Kenya Power, and community-based organizations work together to improve electricity access?

Future of Electricity Access

1. What would be the ideal way to improve electricity access in Mathare?
2. What policies should the government introduce to ensure safe and affordable electricity for all?
3. How can community leaders like yourself be more involved in decision-making about electricity access?

F

Interview Questions for Government Officials

Electricity Access and Policy Implementation

1. What policies exist to improve electricity access in informal settlements like Mathare?
2. How does the government support the integration of informal settlements into the formal electricity grid?
3. What challenges does the government face in implementing electricity policies at the county and national levels?

Regulation and Governance

1. How does the government regulate informal electricity providers, and what steps are being taken to formalize their operations?
2. What measures are in place to reduce illegal electricity connections and their associated risks?
3. What role does the county government play in ensuring safe and affordable electricity access in informal settlements?

Tariffs and Affordability

1. How does the government determine electricity tariffs for low-income households in informal settlements?
2. Are there any subsidy programs or financial assistance available for residents to access legal electricity connections?
3. How does the government address concerns that Kenya Power tariffs may be unaffordable for residents of informal settlements?

Stakeholder Collaboration

1. How does the government collaborate with Kenya Power, informal providers, and community leaders to improve electricity access?
2. Are there existing frameworks for engaging with community-based organizations (CBOs) in energy planning?
3. What role does public participation play in the government's electricity planning process?

Future Plans and Improvements

1. What long-term strategies are in place to improve electricity infrastructure in informal settlements?
2. What additional policies or interventions does the government believe could help reduce illegal electricity connections?

3. How can the government better align with Kenya Power, informal providers, and the community to create a more sustainable electricity access model?

G

Interview Questions for Kenya Power Officials

Electricity Distribution in Informal Settlements

1. What efforts has Kenya Power made to expand the grid into informal settlements like Mathare?
2. What are the key challenges faced by Kenya Power in connecting informal settlements to legal electricity supply?
3. How does Kenya Power address the issue of illegal electricity connections?

Tariffs and Affordability

1. What are the current Kenya Power tariffs for residential customers, particularly for low-income households?
2. Are there any flexible payment plans or subsidies to help informal settlement residents afford legal connections?
3. How does Kenya Power balance financial sustainability with the need to provide affordable electricity access?

Informal Electricity Providers

1. What are Kenya Power's views on informal electricity providers operating in settlements like Mathare?
2. Has Kenya Power explored ways to integrate or formalize informal electricity providers into the legal system?
3. Do you think there is a financial potential for Kenya Power to integrate Mathare?
4. How does Kenya Power deal with electricity theft and revenue losses caused by unauthorized connections?

Infrastructure and Reliability

1. What improvements in electricity infrastructure are planned for informal settlements?
2. How does Kenya Power ensure service reliability in areas with high levels of illegal connections?
3. What role do community-based organizations (CBOs) and local leaders play in Kenya Power's engagement with informal settlements?

Collaboration with Government and Other Stakeholders

1. How does Kenya Power collaborate with the national and county governments to expand legal electricity access?

2. Are there any ongoing partnerships between Kenya Power and community leaders to facilitate legal connections?
3. What steps is Kenya Power taking to increase public awareness about safe and legal electricity connections?

Future Strategies

1. What strategies does Kenya Power have to reduce illegal connections while ensuring that residents still have access to electricity?
2. What innovations or new approaches is Kenya Power considering to improve electricity access in informal settlements?
3. How can Kenya Power better align with government efforts and community needs to create a more effective electricity distribution system?

H

Interview Participant Consent Form

Participant Consent Form

Research on Electricity Access in Informal Settlements (Mathare Case Study)

Interview Code: _____

Researcher: Beau van der Meer, Delft University of Technology (TU Delft)

Introduction

You are invited to participate in a research study on electricity access in informal settlements, specifically in Mathare. This study is conducted by Beau van der Meer from TU Delft and is facilitated by Nuvoni Centre for Innovation Research. The goal of this research is to understand the challenges, opportunities, and policy considerations related to electricity access in informal settlements.

Your participation in this study will involve an interview of approximately 20 minutes. Your insights will help in identifying barriers, stakeholder relationships, and potential solutions to improve electricity access in Mathare.

Confidentiality and Voluntary Participation

Your participation in this research is completely voluntary. You may decline to answer any question or withdraw from the study at any time without any consequences. Your responses will remain confidential. All data will be stored securely, and personal data will be deleted one month after the research. No personal identifiers will be included in the final analysis or reports. The findings of this study may be published, but your identity will remain anonymous unless you explicitly agree to be identified.

With your permission, this interview will be audio and visually recorded to ensure accuracy in data collection. The recordings will be stored securely and used solely for research purposes.

Consent

Please confirm your agreement by ticking (✓) the appropriate boxes.

Name of Participant: _____

Date: _____ **Signature:** _____

Researcher Declaration:

I, as the researcher, have accurately explained the study to the participant and ensured that they understand what they are freely consenting.

Name researcher: Beau van der Meer

Date: _____ **Signature:** _____

Interview Code and Participant Details (For Research Purposes Only)

- Name: _____
- Gender: [ ] Male [ ] Female
- Age: _____ Village: _____
- Occupation: _____
- Household Head Gender: [ ] Male [ ] Female
- Age of Household Head: _____
- Total Number of Residents in Household: _____
- Number of People Under 18 in Household: _____
- Number of People Under 5 in Household: _____
- Date: _____ Time: _____

For More Information

If you have any questions or concerns about this study, feel free to contact:

- Beau van der Meer, TU Delft
- Linda Kamp, TU Delft Supervisor
- Bosibori Barake, Nuvoni Centre for Innovation Research

Thank you for your participation!

Focus Group Discussion Participant Consent Form

Participant Consent Form

Focus Group Discussion on Electricity Network Integration in Mathare

Researcher: Beau van der Meer, Delft University of Technology (TU Delft)

Introduction

You are invited to participate in a focus group discussion on integrating the electricity network in Mathare into the national grid. This discussion is conducted by Beau van der Meer from TU Delft and facilitated by the Nuvoni Centre for Innovation Research and Ghetto Foundation. The objective of this discussion is to explore the two proposals for integration, identify challenges, opportunities, and policy considerations that can improve electricity access in Mathare.

Your participation in this study will involve a focus group discussion of approximately 1.5 hours. Your insights will help in assessing barriers, stakeholder relationships, and potential solutions for better electricity access in Mathare.

Confidentiality and Voluntary Participation

Your participation in this research is completely voluntary. You may decline to answer any question or withdraw from the study at any time without any consequences. Your responses will remain confidential. All data will be stored securely, and personal data will be deleted one month after the research is completed. No personal identifiers will be included in the final analysis or reports. The findings of this study may be published, but your identity will remain anonymous unless you explicitly agree to be identified.

With your permission, this discussion will be audio and visually recorded to ensure accuracy in data collection. The recordings will be stored securely and used solely for research purposes.

Consent

Please confirm your agreement by filling in the fields below:

Name of Participant: _____

Date: _____ **Signature:** _____

Researcher Declaration:

I, as the researcher, have accurately explained the study to the participant and ensured that they understand what they are freely consenting.

Name researcher: Beau van der Meer
Date: _____ **Signature:** _____

FGD Code and Participant Details (For Research Purposes Only)

- FGD Code: _____
- Name: _____
- Gender: [ ] Male [ ] Female
- Age: _____
- Function/Role: _____
- Date: _____ Time: _____

For More Information

If you have any questions or concerns about this study, feel free to contact:

- Beau van der Meer, TU Delft
- Bosibori Barake, Nuvoni Centre for Innovation Research
- Linda Kamp, TU Delft Supervisor

Thank you for your participation!