

Article

A Conceptual Approach to the Stakeholder Mapping of Energy Lab in Poor Urban Settings

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Abstract: Various efforts are presently being undertaken to set up and maintain open, inclusive, participatory, and transparent processes, whilst at the same time, strengthening stakeholder partnerships in implementing SDGs remains a challenge. This paper enriched the discussion of multi-stakeholder approaches through a dynamic multi-level system view of stakeholder mapping, along with important theoretical frameworks and key empirical results to tackle the lack of security of energy services in poor urban settings. The study attempted to develop comprehensive cases for Africa-based experiences of the pilot project launched through a set-up of an energy living lab in the Groenheuwel community, as well as achieve an improved understanding of social-technical benefits of gendered energy security and innovative solutions at the household level. The contents are two-fold. The first part assesses the theoretical models available for stakeholders and outcome mapping. The second part focuses on the preliminary identification of stakeholders and their primary interests at all levels. The results of this study found that the energy living lab in poor urban settings recognised the importance of stakeholder mapping and the development of new solutions. Findings indicated that all stakeholders should support the government in the development of policies and strategies. Findings also suggested that key players should proactively agree and negotiate with the local government on energy outcome measures. It was also found that multi-stakeholder involvement improved transparency and accountability for decision making.



Citation: Chen, X.-Q.; Musango, J.K. A Conceptual Approach to the Stakeholder Mapping of Energy Lab in Poor Urban Settings. *Sustainability* **2022**, *14*, 6233. <https://doi.org/10.3390/su14106233>

Academic Editor: Luisa F. Cabeza

Received: 11 March 2022

Accepted: 27 April 2022

Published: 20 May 2022

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Keywords: community evaluation; evidence-based decision making; energy living labs; multi-stakeholder engagement; people–public–private partnerships (4Ps); stakeholder mapping; sustainable development goals (SDGs); urban Africa

1. Introduction

Global urban scholars Gilbson [1] (2006), Luederitz [2] (2013), and John [3] (2015), among other researchers, contend that if cities are to come close to developing along sustainable lines, they must adhere to principles that uphold human–environment integrity, human well-being, intra- and intergenerational equity, resource maintenance and efficiency, democratic governance, precaution, and adaptation [1–3]. Hence, it is no surprise that the integrated challenges of economic development, social justice, and ecological integrity demand our cities become more innovative, inclusive, and smart [4]. In this regard, as an answer to urban sustainability challenges, the concept of living labs has emerged [5].

The term living lab emanated from the global north [6], and multiple definitions of the living lab have been proposed including the European network of living labs (ENoLL) which envisages the living lab approach as “open innovation and co-creation processes in real-life settings involving stakeholder groups” [7]. Westerlund (2018) et al. argued that living labs as platforms should address shared resources and different activities and network methods [8].

Even though there are differences in focus and approach, some common characteristics can be identified. Living labs enable underlying mechanism creation services, engage

public, private, and citizen participation as a catalyst for economic growth through entrepreneurship and new ventures in business, and provide community-based solutions [9]. By successfully addressing possibilities for open innovation at both city and local levels, living labs can be a strategic tool to support dissemination and impact societal, policy-related, academic, and commercialisation opportunities, inspire projects elsewhere, and thereby have a global impact [10].

Taking into consideration the proposed scope in this study, as a way to a wider agenda of building capacity and reducing gender inequity and energy insecurity in urban poor areas to tackle the emerging constraints, we essentially defined the energy living lab as a research and innovation concept for “experimental and experiential learning in a real-life environment, involving users and multiple private and public stakeholders, and aimed at (i) co-designing, prototyping, testing, and observing new solutions and novel organisational structures in an iterative fashion; and (ii) stimulating changes in the socio-technical regime to create the most favourable conditions for the scaling-up of innovations” [11].

As its most prominent aspect in a rapidly evolving world, one of the greatest global challenges is embedded in the sustainable generation and use of energy [12]. Energy is central to the fourth industrial revolution [13,14]. This is universally acknowledged in five of the United Nations Sustainable Development Goals (SDGs), namely: gender equality (SDG5), affordable and clean energy (SDG7), reduce inequalities (SDG 10), sustainable cities and communities (SDG11), and partnerships for the goals (SDG17) [14]. Hence, these enormous challenges are being tackled by numerous stakeholders comprising politicians, industries, universities, NGOs, and boundary groups [12].

According to a High-level Dialogue of the Ministerial Thematic Forum, the reports (HDMTFTR) stated that “Gender Equality is Human Right” [15]. They also discussed energy access and enabling SDGs through inclusive and just energy transitions and accelerating the integration of gender-transformative approaches into all energy access and transition pathways that are required to close gender gaps and empower women by, among other things, ensuring gender parity in employment, policy, and decision-making processes [15]. In this intervention, the UNE compact pledged to work with partners to provide access to clean and affordable energy to 500 million additional people, focusing on the most vulnerable communities [16].

The International Energy Agency (IEA) with particular contrary concern elucidated that the energy sector remains one of the least gender-diverse sector [17]. Leading scholars in urban Africa studies, as an important addition, revealed that “with emerging evidence on the gendered energy transition of urbanising Africa to deal with energy insecurity which remains weak, gender mainstreaming debates only persist at the conceptual level” [18]. Nam and Pardo (2011), among other researchers, identified the problems of urbanisation as that social and sustainable innovations and political and organisational strategies are to some extent tangled, and called all partners and participatory innovators to take into account management, policy, and technology as the way to benefit the living lab experiments which “lack of systemic unified and empirically tested models that can integrate the social technical and spatial features of urban ecosystems” [19]. Specifically, Veekman (2013) and other researchers also addressed that living labs still lack empirical research on the practical implementation and related outcomes [20].

Leveraging living labs for sustainable energy transitions is important, especially in the global north and particularly in developed world contexts [6]. Yet, southern and gender-energy-poor urban-oriented living labs, which also exist, remain less documented and assessed. In a broader context, Kovacic (2019) et al., disclosed that “urban development in Africa is a very diverse and ambivalent phenomenon with aspects that do not fall neatly into global standards. Informal settlements in urban environments are gendered”, hence calling for consideration of gender equality, stipulated in SDG 5, and therefore challenging governance by standards [21]. In sub-Saharan Africa, the informal urban which constitutes households residing in poor urban environments is the fastest-growing category, and surprisingly, most of the informal urban areas are unelectrified or have unfulfilled energy

services [22]. Ultimately, the existing policy approaches are therefore gender-neutral, fail to focus on the urban poor, and have limited consideration for the unfulfilled energy security beyond electrification. In this respect, the United Nations (UN) addressing the global slum population in principle has been instrumental to communicate the magnitude of the phenomenon and to set development priorities, such as through the inclusion of a goal on cities in the Sustainable Development Goals of 2015 [23]. This operational definition was proposed by the UN as a way to count informal settlements and monitor their emergence and development, but the report made clear that informal settlements are a complex and varied phenomenon, which is hard to capture in metrics [24]. From the national level, Mqadi (2018) et al. argued that although SA national plans and policies are aimed at supporting the country's strategic sustainability policy imperatives in the energy sector, there is a lack of coordination between the national department and ministries due to the diverse and varied constituencies and driven by different coalitions of interest groups. The challenges of non-alignment within the country's energy planning process need more attention [25].

Technology is an enabler increasing the diffusion of information and acts as a fundamental dimension of social change, yet technology alone does not fuel collaboration [12]. Although the theoretical and empirical work on collaboration has proliferated in the last decade and various efforts are presently being undertaken, many struggle to set up and maintain open, inclusive, participatory, and transparent partnership processes [26]. The need to strengthen stakeholder partnerships in implementing SDG 17 should thus be emphasised. In this process, the UN 2030 Agenda for sustainable development goals (SDGs) plays a substantial role to assign stakeholders in implementation, follow-up, and review, and also to ensure that stakeholders from different sectors are called on to play diverse roles in implementing to attain the goals of the 2030 Agenda at all levels [27]. It is clear that many governments have recognised the potential of SDGs in this regard through these actions, and the Voluntary National Reviews (VNR 2016–2019) wrote that: "even though the majority of governments report on engaging stakeholders in processes related to the implementation and follow up of the 2030 Agenda and the SDGs, many struggles to set up and maintain open, inclusive, participatory, and transparent processes. In many cases, engagement strategies are at an early stage, insufficient or superficial'. This may be due to reluctance to engage stakeholders where this is less common. Governments have also indicated the need for support to address practical challenges on identifying relevant and new stakeholders, the level and type of engagement at different stages, resources for engagement, cultural barriers, and technical and social constraints. There are various efforts to support national governments in strengthening stakeholder engagement in implementing the SDGs [27].

As noted by the 2030 Agenda, stakeholders in practice can play supplementary roles by tracking implementation or engaging in advocacy activities, holding governments accountable for their actions, as well as providing inputs to policymaking by aligning their own actions or by providing services to make their 'own contributions' to implement the SDG 17 [28]. Due to the COVID-19 pandemic, achieving universal access to modern energy services for all by 2030 is sliding further out of reach. The dialogue between governments and people and become more important than ever, yet in terms of guiding government action and maintaining social cohesion, we may have lacked resources or dedicated less attention to engaging stakeholders [27].

Against the above background, the objective of this study was to propose an overview of different conceptual models available for stakeholder identification, with a focus on stakeholder mapping of the different disciplines and multi-stakeholders involved in strategically identifying specific key players and their interests in the co-design, co-implement, and co-monitor initiatives. The overall objective was also to solicit lessons of experience for identifying a multi-stakeholder outcome-mapping framework as a way to obtain stakeholder partnerships, community participation, and the empowerment of community evaluation

for evidence-based and informed policy decision making that relates to the sustainable development goals (SDGs).

The rest of the paper is organised as follows: Section 2 discusses the methodology and why it is appropriate for this study, with a conceptual tool description and a stakeholder map visualising different qualities and affiliations of stakeholders and their relations. Section 3 proposes conceptual approaches to stakeholder engagement. Section 4 presents a diagram depicted for a case study on multi-stakeholders involved in strategically identifying specific key players with their primary roles and responsibilities in the various stages of setting up an energy living lab, as well as illustrates change models of gendered energy interest groups in the context of the evaluation policy and implementation outcomes, to allow the multi-level stakeholders to improve their understandings on the specific factors that may determine the value and usefulness of stakeholder mapping. Section 5 attempts to address emerging issues with an extensive list of recommendations to stimulate the debate among different disciplines involved in the energy living lab, strategically identifying specific stakeholders, their primary interests, and key values in the emerging gender–energy–poor urban nexus. Section 6 draws conclusions for conceptual approaches to stakeholder mapping and future research for supporting gendered energy innovation in urbanising Africa.

2. Methods

This study theoretically and empirically focused on conceptual approaches to stakeholder mapping through a case study of the Groenheuwel community to identify interest groups, as a way to track critical trends and tendencies through the energy living lab as a pilot project. We focused on conceptualising stakeholder mapping for the living lab that supports gendered energy innovation, enhances stakeholder participation, and empowers community evaluation for evidence-based and informed policy decision making that relates to the sustainable development goals (SDGs). The energy living lab is at the planning stage and the various initiatives and projects have not been implemented. For further information on the set-up, steering, and management of the energy living lab, as well as the explanation of the pilot project

To reach the overall objectives, we explored the two research questions: (i) what are the conceptual approaches and frameworks of stakeholder mapping to address the specific and new relevant stakeholders needed at all levels, and the type of engagement at different stages in the set-up, steering, and management of the energy living lab to support gendered energy innovation in poor urban environments? (ii) What are the key emerging issues and practical solutions for the improvement of the quality of the multi-stakeholder partnerships and the empowerment of community evaluation, with a focus on the most vulnerable groups and their interests, to ensure sustainable outcomes of the living lab that support gendered energy innovation?

We applied inductive and explorative methods for the case study analysis to generate an in-depth multi-faceted understanding of a complex issue in a real-life context. We first utilised secondary data of existing and ongoing studies (e.g., recent publications, reports, and unpublished research papers) to undertake the narrative overview and identify the conceptual approaches and frameworks of stakeholder mapping. Secondly, we proposed an emerging research agenda and practical solutions to ensure sustainable outcomes in the living lab that support gendered energy innovation. The study utilised a mixed methodology with a predominantly qualitative approach, and the data were analysed using ATLAS.ti coding, categorisation, interpretation, and summarisation methods. Specifically, we combined the frameworks from GTZ 2007 and SDC 2011 to conceptualise the stakeholders mapping, with more details described in the result and discussion sections. Moreover, the syntheses of the findings were deliberated under each theme in the emerging issues section. Consequently, the study provided a set of recommendations to stakeholders involved in such projects as a lesson learnt as well as priorities for future research.

3. Conceptual Approaches to Stakeholder Engagement

3.1. Understanding Stakeholders

The term “stakeholder” has been prominent in the last ten years and has emerged in evaluation practice and theory in the past two decades. It was initially used as a way of designating “people who were not stockholders in a company but without whose support the firm would cease to exist” in 1963 at the Stanford Research Institute [28]. Freeman (1984) regarded this concept in his influential text *Strategic Management: a stakeholder approach* was defined as “any group or individual who can affect or is affected by the achievement of the organisation’s objectives.” Depending on the theoretical foundations of the respective controversies in the literature, various definitions can differ significantly” [29].

Stakeholders, as any individual or organisation affected by the projects, may have an impact and be in contact daily or occasionally as they may have an indirect or direct interest in the project activities with an impact [30], and the stakeholder can be “heterogeneous” (e.g., local political organisations, politicians, local and national NGOs, and local community: families and employees) [11]. The elements influencing ‘effective’ stakeholder collaboration are comprised of joint decision making, trust, reconciling powers, inclusive participation, inter-dependency, shared responsibility for objectives, perceived benefits, organisational support, reciprocity, information awareness, and long-term relationships (partnerships) [31].

According to the Food and Agriculture Organisation (FAO) 1995 cited in as Hauck et al. (2016), the “involvement of interest groups may refer to different contents, such as planning, decision making or M&E” [32,33]. It can happen on different levels, ranging from information and consultation to active collaboration and transferring decision-making powers into the hands of the public [34]. Fidrmuc and Noury (2003) emphasised that various interest groups can overlap as collections of individuals who share a specific common interest [35].

Bryson (2002&2015) proposed that a power versus interest grip arrays stakeholders along with their power to place a claim on the organisation’s attention, resources, or output and in accordance with their interest in the organisation’s attention, resources, or output. Four categories of stakeholders are “players” (high power and high interest); “context setters” (high power and low interest); “subjects” (high interest and low power); and “crowd” (low interest and low power) [36]. It is illustrated that ‘context setters’ are not interested enough to be players. ‘subjects’ are subject to the power of others. In all instances, the mission must take the ‘players’ and ‘context setters’ into account, even if the organisation’s ultimate purpose is to serve the subjects or crowd [37].

3.2. Stakeholder Mapping

International Atomic Energy Agency (IAEA) stated that “stakeholder mapping involves the identification of the interested parties, their interests, possible impacts and influences and how they interact between themselves or within the process.” However, stakeholder mapping is not a one-time process. As a part of the strategy review process, it’s important to update stakeholder communication plans and review stakeholder groups regularly as stakeholder groups change and evolve alongside organisations [38]. Reed 2009 cited in Reed & Curzon 2015 noted that the stakeholder mapping process “(i) defines aspects of a social and natural phenomenon affected by a decision or action; (ii) identifies individuals, groups, and organisations who are affected by or can affect those parts of the phenomenon (this may include non-human and non-living entities and future generations); and (iii) prioritises these individuals and groups for involvement in a decision-making process” [39].

In terms of key stakeholder identification, the GTZ 2007 [40] and SDC 2011 [41] depict that the conceptual tool description of a stakeholder map visualising different qualities and affiliations of stakeholders and their relations, and narrow down the number of key stakeholders to differentiate between three core attributes or features, namely: legitimacy,

resources, and networks that are crucial for holding a key position regarding the issue at stake [40,41].

According to the International Development Research Centre (IDRC), the first developed concept of outcome mapping was in 2001, as an alternative to and complementing conventional methods of planning and evaluating complex results-focused programs and activities. Outcome mapping is applied by development and research organisations worldwide and can be used to determine changes in the behaviour or attitudes of stakeholders and their participation also within participatory management [42]. Outcome mapping is a tactic method for project planning, monitoring, and evaluation. Inspired by the outcome mapping technique, outcomes are defined as observable behavioural change (alteration of activities, relationships, and actions) of different stakeholders [43]. More specifically, it refers to changes in behaviours. Outcomes are well-defined as technique monitors and they evaluate changes related to stakeholders, a project's strategies, and organisational practices [42]. Outcome mapping also allows one to determine long-term outcomes and impacts.

Outcome harvesting as a concept is also suitable for managing knowledge within projects involving diverse stakeholders [44] and aims to provide insights to decision makers by monitoring and evaluating changes, thus enabling a learning process, and determining impact. This approach is especially useful if the outcomes and causal relationships cannot be easily controlled or if the project takes place in "dynamic, uncertain circumstances" [45]. Moreover, anticipated, or unexpected outcomes can be identified. If outcome mapping was used to plan the M&E, outcome harvesting could be used to compare the outcomes achieved against the plan [46].

3.3. Stakeholder Participation

Arnstein 1971 [47] as cited in Basheka and Mubangizi, 2015 [48] stated that from "interaction" and "consultation" to "cooperation" and "power-sharing", participation embraces a range of significance. From the literature, it is observed that the word participation "often veils a relationship marked by authoritarianism and submission" and while there may be an implicit claim of equality and a suggestion of negotiated power relations, these elements indicate different relations of mutual engagement [47,48]. The forms of engagement and participation and the purpose need to be negotiated and constantly reviewed. The International Association for Public Participation (IAP2) [49] as cited in Ababio (2004) [50] distinguishes five levels of participation: inform, consult, involve, collaborate, and empower.

The constitution (1996) in section 196 stipulates the basic values and principles governing public administration. These basic values and principles serve as building blocks for the promotion of community participation in South Africa [51]. According to the Department of Constitutional Development (1998) [52], "municipalities must now lead, manage and plan for development, their task together with the national and provincial government is to eradicate poverty, boost local economic development, job creation, and carry forward the process of reconstruction and development". Consequently, local communities are to be involved in the decision-making processes of local government. Hence, community participation in local government is important. When proper community participation does not occur and an integrated development plan (IDP) is not properly implemented, the development of the local economy may be detrimentally affected. Services may not be delivered promptly, and as a result, community members may complain about the lack of service delivery.

The concept of community participation derives from section 152 (1) (e) of the constitution (1996) [51], which mandates "municipalities to encourage the involvement of communities and community organizations in local government matters". The provisions on community participation in the Local Government: Municipal Systems Act (2000) [53] therefore has a constitutional base. In this regard, the Municipal Structures Act (No. 17 of 1998) [54] also stipulates that "the participation by the local community in the affairs of the municipality needs to take place through political structures set up for its purpose

such as ward committees". Ijeoma (2015) argued that municipalities in South Africa face a huge mountain to climb if they are to sustain good community participation for the sole benefit of the community [55]. It should thus be emphasised that in terms of the community participation, if it is to succeed [56], "rather than being rhetoric and merely done for formality's sake, it has to be done with the pretext of benefiting the community at large" [57].

3.4. Quality of Stakeholder Engagement

In terms of stakeholder engagements, UN Habitat (2004) [26] in this respect outlined that transparency is widely recognised as a core principle of good governance. At its most basic level, transparency means "sharing information and acting openly". Transparency is important for a number of reasons. It allows stakeholders to gather the information that may be critical to uncovering abuses and defending their interests". Moreover, UN Habitat (2004) posited that, in addition to reducing the scope for corruption, transparency instils greater citizen confidence in the institutions of governance. Transparency also fosters greater accountability through all stakeholders having the information they require to hold others accountable. Specifically, UNDESA [27] depicts the principles and dimensions of the analytical framework on the quality of stakeholder engagement which consist of (i) inclusion (e.g., non-discrimination and accessibility); (ii) participation (e.g., access to information and influence in decision making); and (iii) accountability (e.g., transparency and responsiveness).

Governance mechanisms in the future may include stakeholder groups and other civil societies and interest groups that should negotiate with the government on policies and regulations concerning energy in poor urban households. Governance mechanisms include governmental private sector and civil society arrangements and require participation. As such, for better understanding of the stakeholder engagement in a theoretical and practical manner, the ESCAP [58] and IAP2 [49] illustrate that purposeful, inclusive, transformative, and proactive are the criteria for planning and accessing the quality of engagement.

3.5. Community Evaluation

According to Fetterman (1996) [59] and as cited in Cloete, De Coning, Wissink, and Rabie (2018) [60], the goal of empowerment evaluation is "fostering self-determination through the capititation and illumination of program participants and clients to enable them to conduct their own evaluations" [59,60]. The approach includes these main advantages: "(i) the evaluation is useful to the stakeholder group; (ii) the evaluation promotes a sense of ownership; (iii) participants can use the evaluation findings throughout the project, not just after the completion of the evaluation; and (IV) it builds capacity and provides illumination and liberation for those involved in the evaluation" [61]. Rossi, Lipsey, and Freeman (2004) [62], as an important addition to the above advantages, revealed that "empowerment evaluation alerts the balance of power in the program context by enhancing the influence of stakeholders." Two separate trends identified by McDonald (2007) emphasise the central role of government in development linked to the emergence of community evaluation causing many community-based organisations (CBOs) to shift their role from being service providers toward advocacy, civic engagement, and public participation: "First, the rights-based approach increasing adopted by civil society organisations holds the government squarely responsible for service provision meant to sure people's rights. Second, over the last decade or so, the donor discourse on development has increasingly emphasised the role of the stakeholders in development" [63].

McDonald (2007) implied that it is important to note that "the donors would like to ensure that the aid being channelled through governments is reaching the intended beneficiaries (poor communities) and is leading to the desired impact" [63]. Morkel (2015) also argued that "community evaluation is key in the proportion of good governance in the South African public sector. The involvement of the public in policymaking and the emerging trend of performance monitoring and evaluation needs to be promoted. Service

delivery projects of government in all spheres in SA may face huge challenges toward achieving their intended goals outside the context of community participation [57]. Morkel expanded by saying that “community evaluation tools being developed and applied by CBOs are not merely limited to monitoring the access to a quality of services, but also to monitor the government’s response to human rights violations, tracking environmental degradation, monitoring and evaluating government contracts with the private sector and taking the implementation of any public policy”.

4. Results

4.1. Visualising Different Qualities and Affiliations of Stakeholders and Their Relations

Inspired by the GIZ (2007) and the SDC (2011) conceptual tool description of a stakeholder map visualising different qualities and affiliations of stakeholders and their relations [40,41], Figure 1 illustrates how the stakeholder identification attains valuable information to comprise all key actors with a basic characteristic which consists of the public sector (e.g., policy actors), private sector (e.g., industry actors), and civil society (e.g., user or customer actors). Precisely, we listed potential key actors in gender–energy–poor urban settings to be assigned into one of three groups, namely, key stakeholders, primary stakeholders, and secondary stakeholders. This also contained veto players who can create key stimulus or hinder and scope the reform [40,41].

This section is divided into subheadings. It provides a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

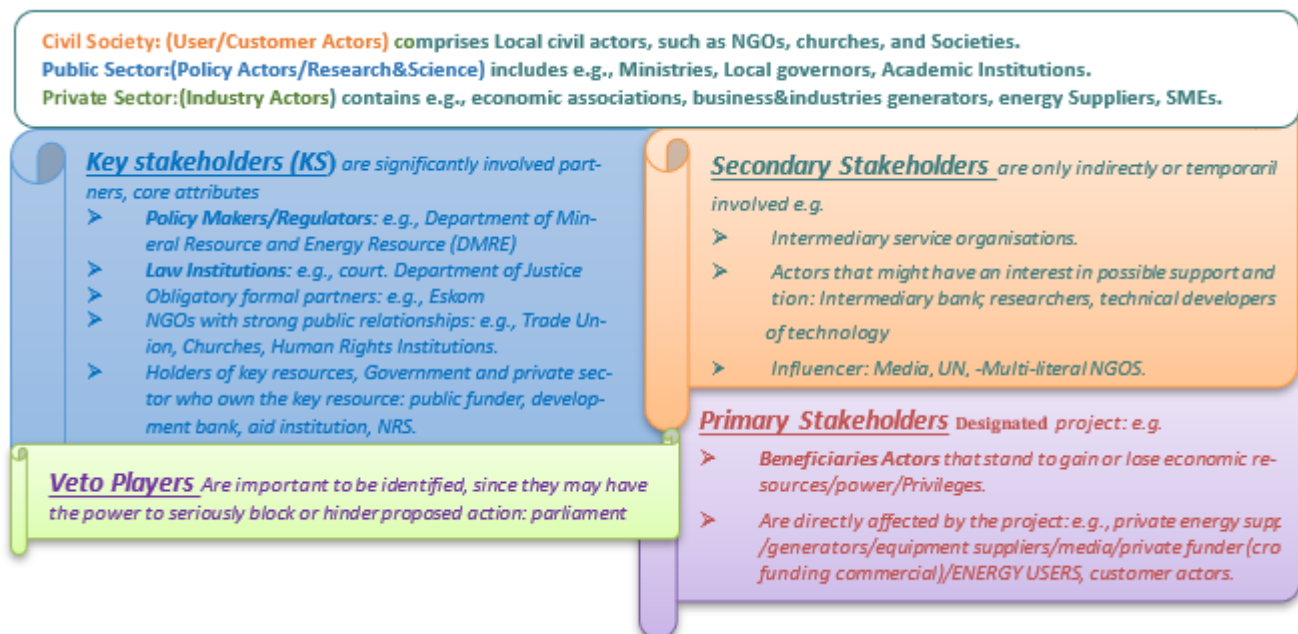


Figure 1. Stakeholder mapping. Inspired by and based on GTZ 2007 and SDC 2011. Source: [40,41], modified and added, case study based on gender–energy–poor urban settings in South Africa.

4.2. A ‘Co-Design, Co-Implement, and Co-Monitor’ Paradigm for the Set-Up, Steering, and Management of the Energy Living Lab

The illustration in Figure 2 is a framework that conceptualises the dynamics for the set-up, steering, and functioning management of the energy living lab and its impacts on supporting gendered energy transitions, as well as the response of multi-stakeholder engagements.

By taking into account this model, the key and practical problems on the challenges of energy insecurity and gender inequality could be analysed and consequently, aims and strategies could be formulated containing general statements of solutions and taking into account all the stakeholder motives and needs. In this process, lessons of experience for

improving the community evaluation emerged and evidence-based information for policy decision making was recorded. The energy living lab is also influenced by the context of sustainable development goal (SDG) indicators set for SDGs 5, 7, 10, 11, and 17, with the purpose to provide evidence-based information for future relevant research perspectives.

We contend that the nature of living labs predisposes impacts emerging within the participants’ daily life, and the opportunities to measure values are limited because of the absence of real-life outcomes and methods to measure the generated public value. This argument is based on the findings of the studies on the digital technologies that are underused in evaluated living labs [5]. Leveraging living labs as a methodology to enhance user-centric innovation has large potential in bringing inventions to the marketplace, but their performance can benefit more from evaluation [64]. In an African context, living labs have emerged primarily as outputs of action research only. However, it is important to monitor and evaluate progress not only for outputs but also outcome and impact, so that there is sufficient documentation to be able to replicate the achievements and provide evidence of success [65]. It is therefore important that lessons learnt are recorded and considered for future purposes [66]. Specifically, an evaluation of the process may allow for a review of approaches, identification of gaps and challenges, and agreement on the next steps. This can also contribute to trust-building and peer learning [67]. Unlike other participation approaches, all the participants in living labs contribute to the process, and according to most authors, are also innovators, and users act as sources of information and creativity [68]. For this purpose, living labs aim for a high level of participation throughout all stages from the beginning through the co-design and implementation up to the evaluation phase [69].

SETUP, STEERING AND MANAGEMENT OF GENDERED-SENSITIVE ENERGY LIVING LAB						
Key Actors	Policy and Regulation Actors (Government & Local Authorities: e.g. National & Local Administration, Ministries, policymakers and politicians)	Industry Actors (Industry Partners Energy Producers & Bank Intermediaries e.g. Bank, insurance firm, competitors, Industrial Associations e.g. Energy Producers & suppliers)	Research & Science (Research & Innovation: e.g. University, Research Centre) Joint	Third Sector/Civil Society e.g. NGO, Association, Societal pressure groups-Urban Poor household	User/Customer Actors (Customer groups/ Energy Community e.g. End-users of Energy Community& Urban Poor households	Influence r (Alternative Political parties e.g. opposition political parties; International Organisation e.g. UN ICT platform Media e.g. TV, Magazine, Newspapers)
Stages & Activities						
Aim & Strategies	KEY AND PRACTICAL PROBLEMS					NEW TECHNOLOGY INNOVATION AND GENDERED ENERGY TRANSITION SUSTAINABILITY
Joint Research & Analysis	SOLUTIONS People-Public-Private Partnerships (4Ps)/Multi-level stakeholders collaborating for co-researching, co-designing, co-creating, co-monitor, prototyping and testing of integrated gendered energy innovation solutions(from local experimental level to a mainstream level)					
Establishment	Policy & Financing Government support and protection	Commercialisation & Governance	High Skilled Facilitation of the Process	Public Awareness and Policy Changes Community Practices& Ownership	MOTIVATION AND PROMOTE ACTIVE ENERGY CITIZEN PARTICIPATION International, Regional, National, Local, Community, and Household levels)	
Alternative Innovation Process						
Management of Implementation						
M&E of Outcomes	-Monitoring of policy and implementation outcomes -Tracking system of GEN living lab meta-research					
Response to Challenges & Changes	- Evaluation of policy and implementation outcomes -Policy reviews and updates -Programme reviews -Changes to planning and implementations					
SCALE-UP	-Policy advocacy-Publication of research-Conference and Webinar -Roadshow&Exhibit,Communication,Marketing,Branding,Cooperate relations-Exit Strategies handover the ownership				Community Practices& Ownership	
COMPETITIVENESS						

Figure 2. Diagram of a conceptual approach to the stakeholder mapping in the set-up, steering, and management of the energy living labs. [Source: Authors, 2022].

As such, it is regarded as essential and advisable to include M&E of outcomes among other living lab activity stages. M&E of outcomes may play a substantial role in interrelating the tracking system of living lab meta-research and M&E of policy and implementation outcomes and impact as a way to provide solutions to respond to challenges correlated

to strengthening people–public–private partnerships (4Ps) [14] and multi-stakeholder collaborations via co-design, co-implement, and co-monitor the prototyping and testing of integrated gendered energy innovative solutions from a local experimental level to a mainstream level, and address practical changes including advocate programme reviews, policy adjustments, and changes to planning and implementations, as well as solicit lessons of experience for improving the community evaluation for the purpose of evidence-based informed policy decision making in the context of sustainable outcomes in implementing SDGs.

The use of multi-stakeholder analyses can help frame issues that are solvable in ways that are technically feasible and politically acceptable and that advance the common good [70]. In almost all instances, the relationship dependency between the living labs and the stakeholders is more often stakeholder-dominant rather than living lab-dominant [71]. This means that the living labs often become dependent on the stakeholders and their will to collaborate and contribute to the living labs. Notably, the factors influencing stakeholder involvement include cultural sensitivity to the participatory process, differences in values and worldviews of stakeholders, proper communication of level of risks, and abilities of the living labs [72]. It is suggested that random sampling is promoted, and it is advisable to avoid the discrimination and exclusion dynamics to guarantee a gendered approach outcome in the living lab [73,74]. Inclusive of all stakeholders in the early phases to identify the needs of the citizens and users, this process should ensure that all stakeholders follow a common goal or vision and are aware of the potential impacts of the process [75]. It also reveals that in practice, the multi-stakeholders might not contribute equally or with the same intensity to be involved in all phases of the living lab project. In some instances, it has also been recognised that stakeholder groups may have varying interests in different stages of the process. The stakeholder mapping helps to determine the actors for the different phases around a core group [76].

It is also apparent that the empowerment of the user through this participatory co-designing, co-implementing, and co-monitoring environment helps address the user oversights in top-down innovation processes. The living lab that is gender-sensitive and user-focused can ignite contextual energy innovation through co-design between private, public, and local users to produce energy solutions (products and services) to fulfil energy needs [77]. It is crucial that socio-technical experiments are not only aimed at testing and improving the innovation but also at stimulating changes in the socio-technical regime to create the most favourable condition for scaling up the innovation (e.g., through intervention in the policy, regulative, or financial level). In other words, scaling up relates to moving the innovation (and its initially deviant socio-technical practices) from a local experimental level to a mainstream level [11].

4.3. The Case of Interest Groups of Urban Informal Settlement in South Africa

The Groenheuwel case demonstrated the different interest groups in the low-income energy sector, assisted in the preliminary identification of stakeholders, and illustrated their primary interests at multiple levels in the gender–energy–poor urban nexus. We proposed that the difference between the current exiting energy policy and the prospective new policy influences the outcomes of multi-stakeholder engagements illustrated in Figures 3 and 4.

Advocating for policy reviews, updates, and adjustments can influence more interest groups with a focus on the vulnerable community such as poor urban households and the social pressure groups. This can result in increasing ownership-decentralised decision making and increased attention to researchers and entrepreneurs in inter-, and multi-disciplinary research. An emphasis should also be placed on technical innovative solutions and access to enhance capacity building and on implementation to solicit lessons learnt to empower community evaluation to result in evidence-based information for policy decision making. This area of importance is also meant to strengthen 4Ps and multi-stakeholder collaborations that can bring about transparency and accountability of regulation bodies and the mass media. This process can provide incentive schemes to create alternative energy

providers, empower private sector energy producers in the small to medium enterprises (SMEs) with additional supports from inclusive governmental institutions (from top-down to bottom-up) as well as dynamic banks and innovative intermediaries.

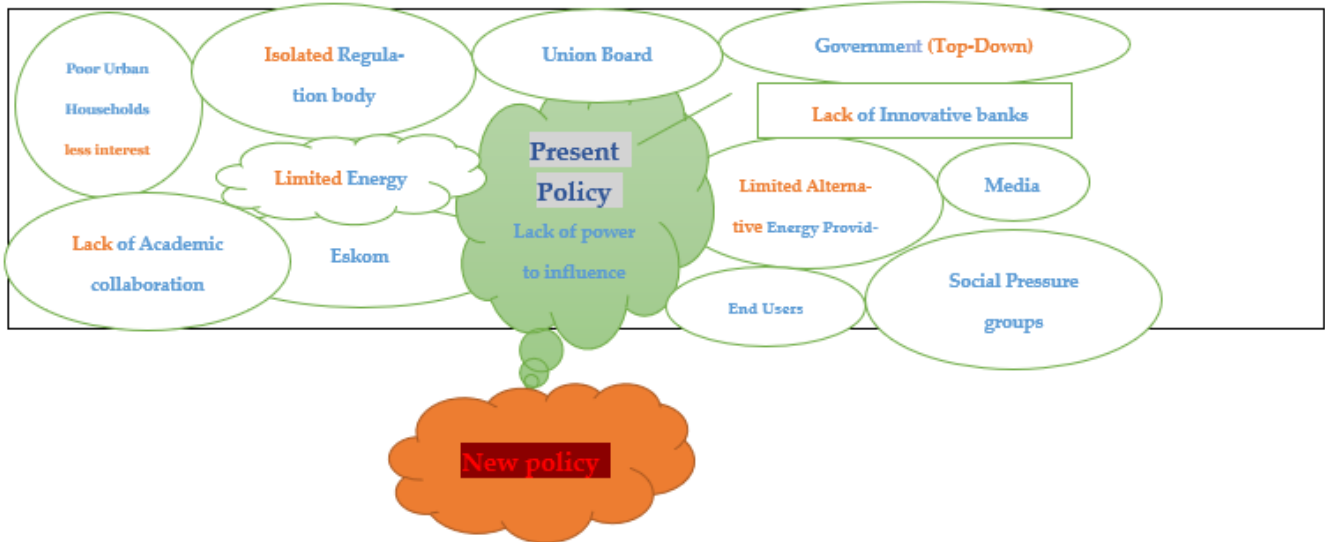


Figure 3. Present Interest Group: Urban Informal Settlement.

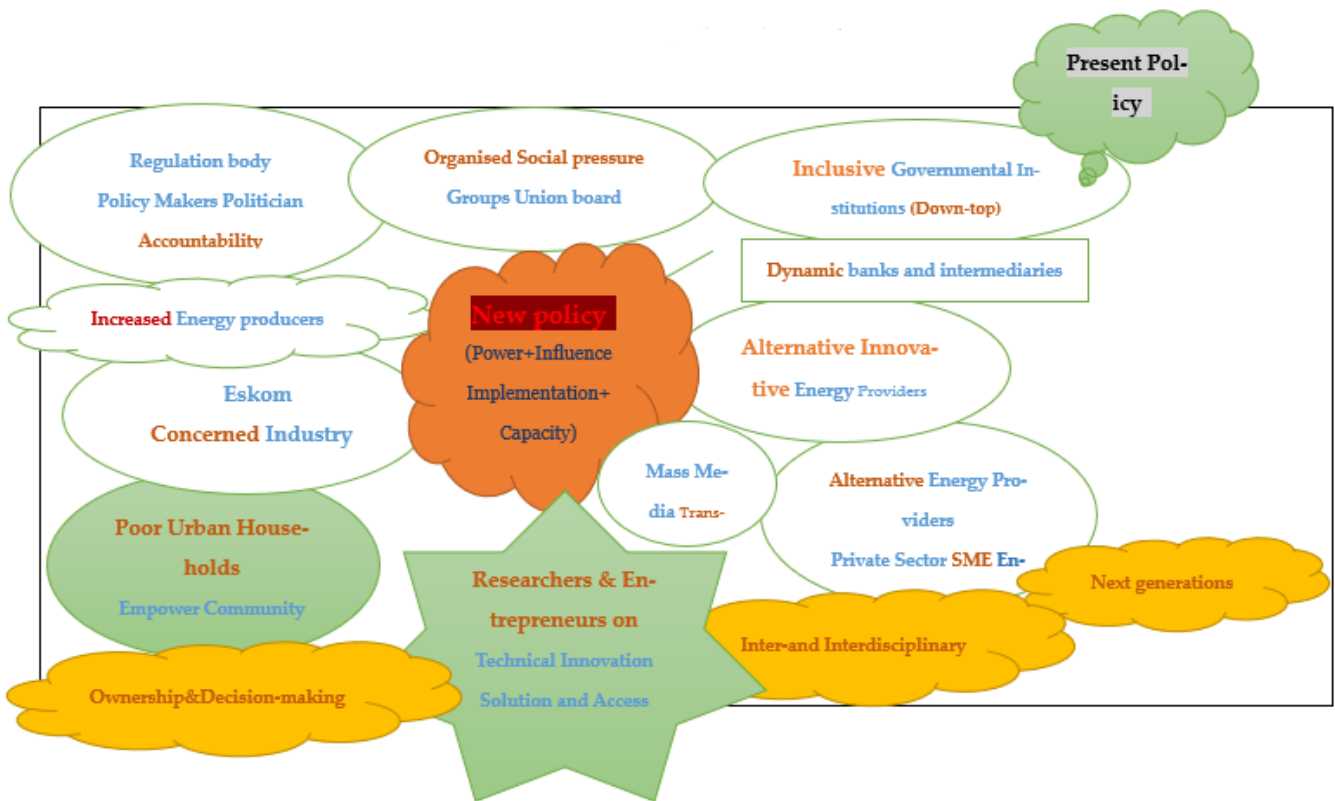


Figure 4. Future Interest Group: Urban Informal Settlement [Source: Authors, 2022].

Stakeholder groups outside these formal structures may also exist. It became evident that key success factors include institutionalisation and a systematic representation of relevant stakeholders [70,78]. Specifically, strong commitment and common key interests provide an important basis for the success of co-design processes. Hence, stakeholder mapping can best include stakeholders by supporting the facilitators of such processes and

understanding the importance of showing multi-level governance [39] in the coordination of multi-stakeholders at all levels. In other words, the greater the partnership's capacity to realise its goals, the more effective the partner's corporate social responsibility efforts can be. For the development of an inclusive engagement plan, we should consider intercultural differences in communication styles or preferences and connectivity and device access accommodations due to age, language, ability, and other factors [14]. There is a strong aspect of shared commitment to key interests in the process, representativeness of the issue, and heterogeneity of participants related to gender, culture, background, and perspectives, and the power to make decisions is an important element for an effective living lab process [11].

4.4. The Findings on Emerging Issues in the Study

The findings of the study revealed that activities involve multi-stakeholders, including users, researchers, industries, NGOs, policymakers, and experts, and are based on user-centred, co-designed, and participatory approaches, through which users and stakeholders are enabled and empowered to take part in the innovation process. Stakeholders are therefore immersed in the creative social space for co-designing and experiencing their own future [11]. Although baseline information is scarce, sufficient information exists to show that the preliminary identification of the stakeholders and mapping of their roles is a crucially important step in any stakeholder-driven energy planning activity to understand the importance of multi-level governance.

The research findings indicated many results and co-benefits from the fruitful exchange, engagement, and collaborative approaches. Stakeholders have proved resilient in their response to the circumstances but also innovative and dynamic in terms of addressing socio-technical challenges in a sustainable manner. Findings on emerging issues in the gender–energy–poor urban nexus included four research themes as illustrated in Table 1.

Table 1. Findings on emerging issues in gender–energy–poor urban nexus [Source: Authors, 2022].

Research Themes	Emerging Issues
Energy living labs in poor urban settings	<ol style="list-style-type: none"> 1. Recognition of increased emphasis on the importance of stakeholder mapping and identifying energy labs in poor urban environments. 2. Increase collaboration for co-designing, co-implementing, co-monitoring, prototyping, testing, and observing new solutions and novel organisational structures in an iterative fashion and simulating changes in the socio-technical regime in order to create the most favourable conditions for the scaling up of innovations [11]. 3. In many instances, the COVID-19 experience was seen as similar but more severe; the COVID-19 period extended the situation where many stakeholders seldom met each other face-to-face and many research activities ceased to continue.
Policy and strategies	<ol style="list-style-type: none"> 4. All stakeholders should assist and support local governments with long-term planning to address social-economic risks, unsustainable energy consumption patterns, and the emerging issues and gaps of gendered energy insecurity and sustainable development. 5. Multi-stakeholders including energy institutions and bodies should develop their sustainable development policies and gendered aspects of everyday energy strategies aimed at bridging gender awareness into consciousness and daily routines [18], implement these effectively, and monitor and report on results. 6. Planning should also be undertaken in consultation with multi-stakeholders to deal with energy insecurity and gender inequality challenges.

Table 1. Cont.

Research Themes	Emerging Issues
Energy Services	<ol style="list-style-type: none"> 7. It is imperative that key players pro-actively negotiate and agree with local governments on outcome measures to ensure that alternative energy technology and services remain available under various conditions and circumstances. 8. Multi-stakeholders are encouraged to, under circumstances, explore energy uses and energy-saving methods, ICT technology and services options, and alternative energy resources including solar, wind energy, hydroelectric, ocean energy, geothermal energy, biomass, hydrogen. 9. Multi-stakeholders are encouraged to utilise the energy living lab as a platform to promote gendered energy innovative solutions and socio-technical awareness, responsible energy use, and support for sustainable development outcomes.
Multi-stakeholder Engagement	<ol style="list-style-type: none"> 10. Stakeholder participation can take many forms, ranging from information and consultation to partnership and collaboration to citizen power [50]. Planning should also be undertaken in consultation with multi-stakeholders to deal with energy insecurity and gender inequality challenges. 11. Transparency and accountability with decision-making designs that facilitate mutual understanding and bonding among partners are likely to increase the chances that partners form positive relational ties, as high partner heterogeneity in multi-stakeholder partnerships makes them susceptible to inter-partner conflict [26]. The institutional arrangement is also related to energy efficiency [79,80]. 12. To ensure a well-functioning co-design process and to deal with potential conflicts, issues, and constraints that may arise, identifying and addressing stakeholder values, interests, and knowledge is a crucial step in the living lab process. 13. Stakeholder cooperation and coordination should focus on a sustainable development management approach, based on addressing the gendered mainstreaming of informed innovation and transformation challenges to the potential and sustainability of socio-technical outcomes for wider agenda of building capacity and reducing inequality of women in urban poor areas to tackle energy insecurity [14,18].

5. Discussion

Reflecting on the insights, it was elucidated that although a vast amount of qualitative evidence exists that gendered energy innovation has a major impact on development, adversely, the present national statistic does not capture information on this basis. An urgent need exists for a systematic approach to record and interpret quantitative and statistical information on the socio-technical benefits of alternative energy technology and services, which contain significant informal economic potential but are not recognised as such. Subsequently, the community of practices is an important priority in the context of the weak and vulnerable socio-economic conditions in which our communities find themselves. The major emphasis needs to be placed on efforts to encourage women and youth to be more active and to increase participation in gendered energy innovation initiatives in poor urban environments.

The study repeatedly elucidated that addressing and identifying specific stakeholders' needs is a fundamental base and a vital initial step to ensure a well-functioning process and attain sustainable outcomes to deal with potential conflicts and constraints that may arise amongst multi-stakeholders. In this context, we placed a much-needed focus on conceptual approaches to multi-stakeholders related to energy living labs that support gendered energy innovation in urban informal settlements. Specifically, local experiences provided insight into the importance of co-designing, co-implementing, and co-monitoring the prototyping testing activities in the set-up, steering, and management of the living lab, and into the response from the multi-stakeholder engagements, as well as the necessity to cooperate and collaborate to achieve sustainable options. In doing so, we hope that the findings of this study and the preliminary frameworks developed in this study may

provide the basis to inspire further research to comparatively examine other international best practices and reflect on how we can gather meaningful lessons from these experiences.

The conceptual approaches to the stakeholder mapping of energy living lab experiences illustrated that it is vital for multi-stakeholders to develop sustainable development and gendered energy innovation policies and strategies, to implement them effectively, and monitor and publish such results. It is also important for energy-related organisations and bodies to cooperate with strategic shareholders and partners and to promote collaboration toward sustainable development outcomes.

- The discussion showed that there is a need for the community to engage in the participatory bottom-up approach, holding governments accountable for their actions, as well as providing inputs to policymaking by tracking implementation or engaging in advocacy activities, to monitor and evaluate progress of not only outputs but also outcome and impact [65,79].
- The discussion also exposed that M&E should serve as an enabling tool for gendered energy research as a way to monitor and evaluate the gendered benefits of energy initiatives, collect gender-disaggregated data [16], analyse and publish knowledge products, case studies, toolkits, and success stories to enhance knowledge [66], increase the visibility of women and improve the availability of data on the gender–energy–poor urban nexus, and ensure that services are designed with a perfect fit to the needs of the people [18].
- Moreover, the discussion indicated that MoU should be entered into Statistics South Africa (StatsSA) to improve the quality of data collection by capturing data in metrics, record the informal settlements, and monitor the emergency of the development, as a way to respond to a growing demand for good monitoring and evaluation information, including baseline statistics to ensure evidence-based decision making.

Further open dialogue among different disciplines involved in such a project is necessary for identifying all stakeholders on their key roles and primary interests for energy living labs in urban informal settlements. Bringing various disciplines to such discussions may further the concept and principles that can guide the formulation future policies.

6. Conclusions

The contributions of this study were allowing the various multi-stakeholders to incorporate policymakers, local communities, practitioners involved in the selected partnerships, donors, and influential decision makers to gain a much better and improved understanding of the impact of gendered energy innovation, especially on the socio-technical dimensions of society at large, and to uptake the specific factors that may determine the value and usefulness of stakeholder mapping. The outcomes of the study also include the emphasis on achieving equity, inclusion, and sustainability, which poses great intellectual and practical challenges to the international community and development practitioners.

Given that the current research was only based on a high-level assessment and had a conservative nature, more in-depth research is required to reach a definitive conclusion. We therefore believe that further research needs to be conducted to determine to what extent these factors may have an impact on the developmental perspective of energy living labs, toward attaining the socio-technical-linked SDGs. In addition, in the gender–energy–poor urban nexus, various cross-sectoral links exist, including to other industries, and the cost-competitive advantages that sub-sectors have to offer are vastly underestimated. A need exists to conduct such research to discover a more detailed analysis of the various economic sub-systems that might be involved; specifically, the complementary relationships between various sectors should also be explored. It was found that the development of results-based monitoring and evaluation systems are also weak, and specific recommendations were made in this regard. Importantly, a need exists for further research to establish the monitoring modelling framework with a compendium of relevant indicators to assess such impact against the SDGs by using selected SDG indicators for the purpose of responding effectively to the challenges in the attainment of SDG 5, 7, 10, 11, and 17 [14].

It could be concluded from the research those multiple stakeholders engaged with energy living labs had a major role to play in supporting an inclusive growth path of gendered energy innovation for the socio-technical development of our people, particularly in urban poor spaces and sustainable cities and communities. In this scheme, an energy living lab, if properly supported and managed, has the potential to significantly improve the standard of living of urban dwellers while protecting the environment [14] as well as high development priorities such as employment and job creation. It is important to emphasise that in a social sense, the living lab is often the vehicle that results and co-benefits from a fruitful exchange, engagement, and collaborative approach, and also improves social capital by improving trust, social relationships, and social collaboration that contributes to increased levels of community mobilisation and institutionalisation. Consequently, a living lab provides an arena of innovations for spectators and multi-stakeholders and makes a significant contribution to the well-being of people.

In a nutshell, much more can be achieved, particularly by the national and provincial governments to recognise these trends and make evidence-based policy decisions as a basis for informed planning, implementation, and resource allocation. An equal responsibility exists for multi-stakeholders through living labs to record and establish systematic M&E systems and for the research community through strengthening long-term partnerships, to respond to priority issues on the policy research agenda. As such, we therefore proposed that it is essential to support the evolution of gendered energy transitions through the sustainable living lab to improve the stakeholder identifications on each stage and across diverse levels, with a focus on the innovation not only in the technical, economic, market demand, and usability aspects but also in the political, regulative, environmental, cultural, and social dimensions [26], to enhance capacity building, promote community evaluation for evidence-based and informed policy decision making, strengthen inclusive stakeholder partnerships, and create an innovative resilient and cohesive society toward a new paradigm visualising a harmonious sphere and a sustainable future for Earth and humanity in the urbanising Africa and beyond.

Author Contributions: Conceptualization, X.-Q.C. and J.K.M.; methodology, X.-Q.C. and J.K.M.; software, X.-Q.C.; validation, J.K.M.; formal analysis, X.-Q.C.; investigation, J.K.M.; resources, X.-Q.C. and J.K.M.; data curation, X.-Q.C. and J.K.M.; writing—original draft preparation, X.-Q.C.; writing—review and editing, J.K.M.; visualization, X.-Q.C.; supervision, J.K.M.; project administration, J.K.M.; funding acquisition, J.K.M. All authors have read and agreed to the published version of the manuscript.

Funding: This work is based on research by the Africa-UK Trilateral Research Chair ID SARC118076349612, under the Newton Fund—National Research Foundation of South Africa partnership, grant number 120129.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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