Mainstreaming gender to achieve security of energy services in poor urban environments

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Abstract

Addressing energy insecurity in poor urban areas in Africa is gendered. However, emerging evidence on gendered energy transitions of urbanising Africa to deal with energy insecurity remains weak. Energy transition studies in Africa that have focused on the gender-energy nexus are mostly limited to rural areas. Further, debates persist about the conceptualisation of gender mainstreaming. This paper therefore builds on the emerging *energy-gender-poor urban* nexus research in urbanising Africa. We focus on conceptualisation and understanding of gender mainstreaming, energy security and poor urban environments, identifying the emerging issues and gaps in our current understanding of gender and energy research, and in framing further research in poor urban environments in Africa. Our central message is threefold: First, we need more evidence-based research on the *gender-energy-poor urban* nexus to understand progress towards universal access to energy for all. Second, we need to reconceptualise our understanding of gender mainstreaming as a *long-term strategy aimed at bridging gender awareness into consciousness and daily routines*. Finally, policies and research to improve energy security in poor urban environments need to *shift the focus to securing energy services* and to consider the gendered aspects of everyday energy use practices.

Keywords: Gender mainstreaming; energy insecurity; empowerment; environmental sustainability; slums; urban Africa

1 Introduction

The links between energy and gender are primarily explored and articulated in the literature [1]. ENERGIA,[1] an international network founded in 1995, links organisations involved in gender and sustainable energy to create informed policy and practical solutions in developing countries. In academia, energy journals have focused on several gendered aspects, including sustainable energy transition, women empowerment and gender audits, as observed in the special edition of *Energy for Sustainable Development* [2] and several papers in *Energy Research & Social Science* [3]. Similarly, institutional frameworks, such as the Sustainable Development Goals (SDGs), have combined energy and gender equality agendas to understand the synergies between them in attaining specific SDG indicators.[2]

A particularly neglected concern in the gender equality efforts and initiatives for energy security solutions is the consideration of poor urban environments. UN-Habitat principally addressed the importance of adopting antidiscriminatory practices to empower women and girls in urban life [4,5]. In 2004, the Congress of Local and Regional Authorities of the Council of Europe adopted Resolution 176 *Gender mainstreaming at the local and regional level: a strategy to promote equality between women and men in cities and regions* [6]. Lately, the United Nations Agenda 2030 has asserted that gender equality is an underlying human right as well as an indispensable basis for a peaceful, prosperous and sustainable world [7]. Additionally, urban studies have demonstrated the reproduction of bias in energy-related policies that arise from gender inequalities in local economic, social and political contexts [8]. The presence of gender inequalities in urban environments exacerbates energy insecurity and unfulfilled energy services.

Although research indicates considerable gendered impacts arising from energy insecurity [9,10], the policies and practices designed to address energy access tend to be *gender blind* and thereby insufficiently respond to the requirements of the urban poor [11,12]. This paper

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[1] www.energia.org

[2] Energepidia

discusses this *energy-gender-poor urban* nexus gap and explores how the concept of gender mainstreaming is linked to the urban poor when dealing with energy insecurity.

Underlying this paper is the recognition that Africa is urbanising. The United Nations estimates that the population that will live in urban areas will increase from 400 million people in 2010 to about 1.26 billion people by the year 2050 [13,14]. Most of the population moving to urban areas end up living in impoverished environments. Utilising the UN-Habitat [15] definition of slums, Tusting [16] estimates that 53 million urbanites in sub-Saharan Africa lived in slums in 2015. A shortcoming of the United Nations slum definition, however, is the failure to include energy security as an indicator of a slum [17], despite the fact that two-thirds of the population of sub-Saharan Africa (close to 600 million) live without access to electricity [18], hence exhibiting an unmet energy market [19]. While reliable statistics on the proportion of the population without access to electricity in urban areas or slums are unavailable, there are claims that at least 110 million[3] people living in urban areas are without access to electricity. We believe that the majority of these people live in slums as the population moves from rural to urban areas and ultimately experiences energy poverty.

Energy poverty is the crucial energy insecurity challenge impacting urban poor environments in sub-Saharan Africa, particularly women and children. Reddy et al. [20] define energy poverty as "the absence of sufficient choice to access adequate, affordable, reliable, quality, safe, and environmentally benign energy services that can support economic and human development". Households in urbanising Africa that lack access to adequate energy services generally rely on traditional fuels, such as biomass, charcoal or paraffin, for everyday energy practices. Additionally, Kovacic et al. [12] identified slums as gendered, with differentiated roles for men and women in the productive and consumptive capacity of the city. Failure to attend to gender inequality remains one of the factors that hinders the achievement of *access to energy for all* in sub-Saharan Africa [21].

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[3]   https://www.greentechmedia.com/articles/read/living-under-the-grid-110-million-of-africas-unconnected-customers-represen

African urbanisation thus holds opportunities and challenges for migrating households, urban planners, governments and local and national economies in how to improve energy security. At the household level, urbanisation may drive changes in the energy services requirements as well as the gendered knowledge and roles in addressing energy insecurity. However, how gender mainstreaming is manifested in dealing with energy security in poor urban settings has rarely been considered.

Therefore, we focus on the energy-gender-poor urban nexus gap for several reasons. Figure 1 illustrates the conceptualisation of and motivation for mainstreaming gender to achieve energy security in poor urban environments. First, most of Africa's urbanising households end up in informal settlements, challenging urban planners on the obligation to build sustainable cities and communities, related to SDG 11. Little is still known globally about how the rapidly growing number of urban dwellers in Africa [22] will meet their energy requirements or about the implications of energy technology development for resource availability, access to services and environmental impact [23].
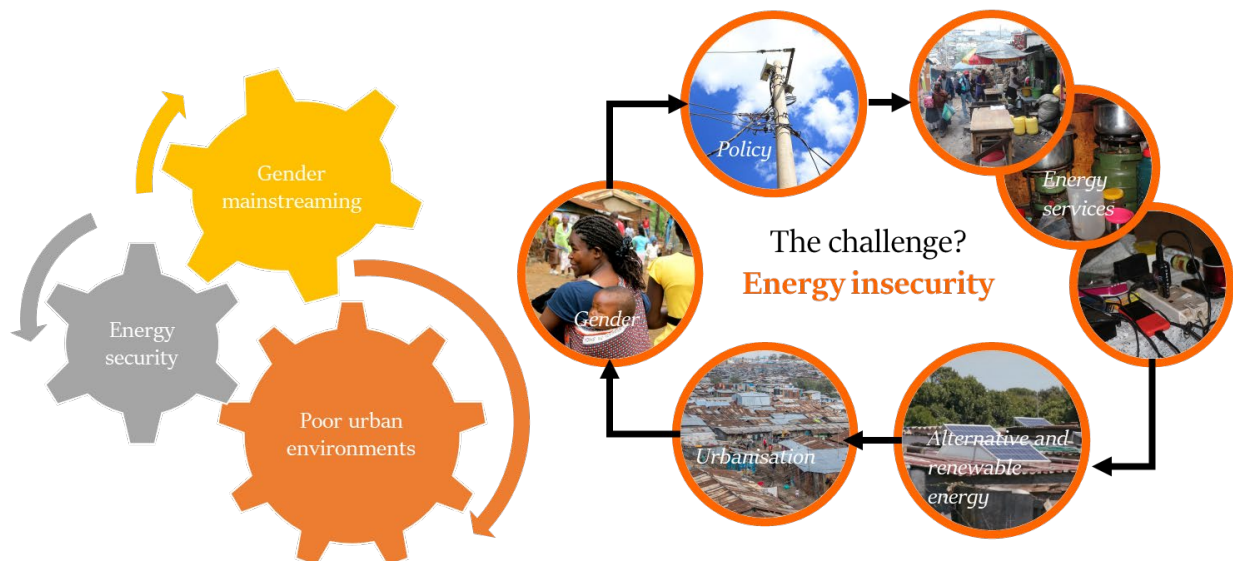

Figure 1: Conceptualising a gendered perspective for energy security in poor urban environments
Source: Authors.

Second, the informal settlements in urban environments are gendered [12] and hence call for consideration of gender equality, stipulated in SDG 5. Clancy et al. [9] have demonstrated the links between energy and greater inclusion of gender concerns in the energy sector to improve development outcomes. However, in practice, gendered energy approaches have focused on technological solutions that meet women's immediate needs but ignore the contextual aspects of culture, socioeconomics and politics that are crucial to attaining substantial gender equity [24].

Third, the policy approaches and initiatives designed to tackle the energy insecurity challenge remain partial. Their focus is mostly on expanding grid connection to households. Some examples include the Last Mile Connectivity initiative in Kenya, whose target was to achieve 70% access to connectivity by 2017 and universal access by 2020.[4] Similarly, the Lighting Africa initiative of the World Bank and the International Finance Corporation focuses on off-grid solutions in 26 countries in sub-Saharan Africa.[5] The electricity connection initiatives exist in three categories: rural, formal urban and informal urban programmes [25]. The informal urban category, which constitutes households residing in poor urban environments, is the fastest growing in sub-Saharan Africa. Most of the informal urban areas are unelectrified or have unfulfilled energy services. The existing policy approaches are therefore gender neutral, fail to focus on the urban poor and have limited consideration for the unfulfilled energy services beyond electrification. In other words, electrification does not equate to fulfilment of household energy services.

Fourth, achieving energy services for all, as stipulated in SDG 7, impacts almost every aspect of everyday life as well as the wellbeing of individuals [1] living in poor urban environments. A disconnect between the everyday realities in poor urban environments and the policy objectives of building sustainable cities and communities [26] impacts the ability to achieve

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[4] The Last Mile Connectivity initiative in Kenya is run by the Ministry of Energy and Petroleum. The implementing agency is the Kenya Power and Lighting Company. See this link: https://energy.go.ke/?p=914.

[5] See the Lighting Africa initiative at this link: https://www.lightingafrica.org/.

sustainable energy for all. Long-term solutions to energy security are not only a matter of applying technical solutions [27] related to the provision of alternative and renewable energy. Other fundamental considerations include assessing the relevance of gender in energy [28], the communities' role and the political and socio-cultural context where these solutions are applied [23]. Further, adopting appropriate user-centred business models and product-service systems [29-31] is crucial.

Therefore, this paper questions the assumption that we understand the concepts of gender mainstreaming, energy security and poor urban environments and argues that these need to be reconceptualised. Utilising an integrative literature review, we explore the following three questions: (i) What are the conceptualisation and understanding of gender mainstreaming, energy security and poor urban environments? (ii) What are the key emerging issues that inform the need to advance evidence-based gender and energy research in poor urban environments? and (iii) What are the opportunities for utilising gender mainstreaming as a strategy to achieve energy security in poor urban environments in Africa?

We contribute to the existing gender and energy literature and advance the state of knowledge, explore the key emerging gaps and present insights to move from theory to practice in energy-gender-poor urban nexus research. To the best of our knowledge, the cross-cutting theme of mainstreaming gender as a strategy to achieve security of energy services in poor urban environments in Africa has received limited attention. The newly launched Africa-UK Trilateral Research Chair that will build research focusing on Mainstreaming Gender for Energy Security in Poor Urban Environments aims to contribute explicitly to energy-gender-poor urban nexus research with two case studies in South Africa and Kenya. This paper is of benefit to energy researchers, energy policymakers, urban development practitioners and planners, not only on the African continent but also in other developing countries, to help support gender mainstreaming when dealing with energy insecurity in poor urban environments.

2   Methods

The paper utilises an integrative literature review, a form of research that generates new knowledge of the topic reviewed [32]. It reviews, critiques and synthesises representative literature on a topic or concepts in such a way that a new framework or perspective on a topic or concept is generated [32]. It is also useful for policy and practice in catalysing future research. While Sovacool et al. [33] do not discuss the integrative literature review as a research method in energy social science, we consider it to have similarities with narrative research, which uses search criteria, explicit parameters and a sample to explore a particular topic.

An integrative literature review applies to topics that have experienced rapid growth and have not benefited from a comprehensive review and update during an extended period [32]. This approach is also used to review new emerging topics. Hence, this makes the approach appropriate for the cross-cutting issue of mainstreaming gender for energy security in poor urban environments.

2.1   Literature search process

The initial search process began on 24 July 2019 with a second iteration carried out on 2 March 2020 to update, verify and ensure rigour as part of the manuscript review process. We utilised Scopus as the main search engine and Google Scholar for snowballing and identifying relevant grey literature. We also undertook a focused search in the *Energy Research & Social Science* journal.

The key search concepts were 'gender mainstreaming', 'energy security' and 'poor urban environments' and how these overlapped in the literature. In the first phase, the authors screened the titles, abstracts and keywords for relevance and ability to provide a conceptualisation of the concepts of 'gender mainstreaming', 'energy security' and 'poor urban environments'. For example, as observed in Table 1, the number of results returned for 'energy security' limited to review articles was exceedingly high (767). However, we only identified 19

papers as relevant for pearl growing or snowballing. In contrast, the search for 'poor urban environments' produced only 13 review articles and none focused on the definition of the term. Thus, none of the papers made the final list, which resulted in reliance on the urban poverty literature to provide a robust definition of poor urban environments.

Table 1: Initial search terms as at 26 September 2019

Search term	Scopus (all fields)	Scopus (limited to title/ keywords/ abstract)	Scopus (limited to review articles)	Final selected papers for pearl growing OR snowballing	Total sample
Gender mainstreaming	5 186	968	98	29	48
Energy security	24 676	9 042	767	19	
Poor urban environment	173	-	13	0	

After the initial search, other related terms or synonyms that emerged were included. These were 'gender equity', 'gender equality', 'energy access', 'energy services' and synonyms for the term 'environment', which included 'areas', 'communities', 'settings', 'settlement', 'economy', 'informal settlement' and 'slum' (see Table 2). We set the search start for 1985 to correspond with when the term 'gender mainstreaming' was first mentioned at the United Nations Conference on Women in Nairobi in 1985.

Table 2: List of search terms and synonyms

	AND	OR	OR
Gender	Mainstreaming	Equity/Equality	Equality
Energy	Security/Services	Access	
Poor urban	Environment	Areas/Communit*/Settings/Settlement/Economy/	Informal Settlement/Slum

This process was followed by the development of specific Boolean phrases or search strings, for example:

- (Gender) AND (Mainstream*) OR (Equity OR Fairness) OR (Equality).

- (Energy) AND (Secur*) OR (Access) OR (Service*)
- (Poor urban) AND (Environment) OR (Areas) OR (Communit*) OR (Settings) OR (Settlement) OR (Informal settlement) OR (Slum)

In the first review process, the results returned were screened based on the 'relevance' and 'highest citation' of the paper titles. We then limited the search to 'title, keywords and abstract'. From this round, we undertook another screening by 'relevance' and 'high citation'. Finally, from this search, we utilised title and abstract analysis to identify an initial sample for further screening to include in the sample of papers for a full review.

The literature sources overlapped between more than one search string at a time. For example, Table 3 indicates that there are 20 documents on Scopus that contain the phrases 'gender mainstreaming' and 'energy security' or 'energy access'. However, when we added the phrases 'poor urban environment' or 'urban informal settlement' or 'slum', we found only 1 data source on Scopus. When the phrases 'gender equity' or 'gender equality' were substituted for 'gender mainstreaming', the results increased to 5 and 12 sources, respectively. Following the same process on Google Scholar yielded a greater number of results. However, these were still greatly reduced from the initial search string results. This observation indicates the limited literature that represents the overall theme of gender mainstreaming for energy security in poor urban environments.

Table 3: An illustration of search string combinations in Scopus

Search combination	Scopus	Total sample
1. Gender mainstreaming AND Energy security OR Energy access	20	
2. Gender equity AND Energy security OR Energy access	44	177
3. Gender equality AND Energy security OR Energy access	94	
1 AND Poor urban environment OR Informal settlement OR Slum	2	
2 AND Poor urban environment OR Informal settlement OR Slum	5	

| 3 AND Poor urban environment OR Informal settlement OR Slum | 12 | |

The second review process was updated to identify the emerging issues in gender-energy-poor urban nexus literature by searching the string of keyword combinations in *Energy Research & Social Science*. As the sample sizes were small, they were all screened by title and abstract, based on relevance, as illustrated in Table 4 . A point to note is that using the search term 'poor urban environment' did not return any results. Hence, we replaced the keyword with 'urban'. There were overlaps and duplicates in the papers, and only nine papers made the final sample after screening for duplicates within the journal and those captured in Scopus.

Table 4: Search terms from *Energy Research & Social Science* as at 2 March 2020

Search term	Scopus (all fields)	Title and abstract screening	Total sample
Gender AND Energy	422	22	
Gender mainstreaming AND Energy	11	9	
Gender AND Energy AND Urban	194	16	
Gender mainstreaming AND Energy AND Urban	4	4	74
Gender AND Energy AND Urban	24	13	
Gender AND Energy services AND Urban	64	9	
Gender AND Energy security AND Urban	46	1	

2.2   Literature selection criteria

We based the final selection on whether the paper applied to the research questions of this study. The probing question for inclusion or exclusion was whether a paper was relevant to providing a conceptualisation of the three terms of focus (gender mainstreaming, energy security and poor urban environments) in the context of the study, that is, urban Africa. Given the limited outcome of the papers that focused on 'urban', we then identified the evidence-based issues emerging from the existing literature. Therefore, we expanded the selection criteria to include (i) developing countries in and outside Africa; (ii) urban as well as rural contexts; and (iii) nonpoor contexts (as in Castán Broto et al. [34] and Greene [35]) in order to

identify a range of emerging issues in mainstreaming gender for energy security research. However, we limited the scope for the papers that produced evidence-based results in the analysis; that is, authors needed to provide empirical results. The implication was that some gender and energy papers included did not focus on the urban context. However, this was essential to identify emerging issues. Additionally, we included some papers that provided insights necessary to undertake evidence-based research in the final selection.

We cross-checked the total number of papers for duplicates from the Scopus search and the focused search in the *Energy Research & Social Science* journal. Noting that a substantial number of articles formed part of the grey literature, our snowballing from Google Scholar began with ENERGIA-published work.

We searched for leading authors in the field, particularly the works of Clancy, to identify grey literature uncaptured in the Scopus search engine. In the grey literature selection, we looked for documents focusing on developing countries in and outside Africa and identified their study location and research focus. Figure 2 summarises the literature search process and the final sample selected constituting 143 papers, of which 6 were books, 102 were journal articles, 31 were grey literature and 4 were recommended during the review process.
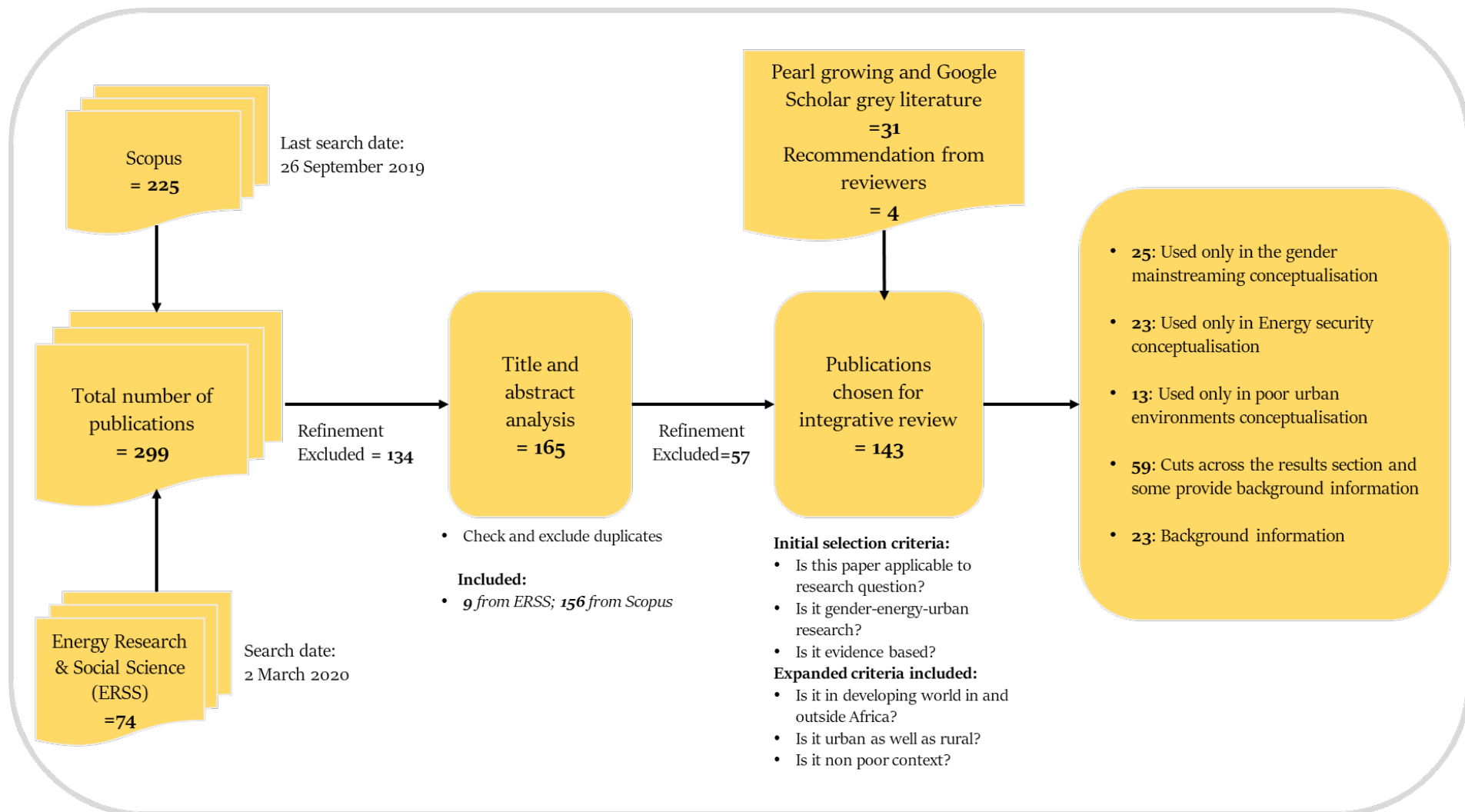
Figure 2: Summary of papers utilised in the review

Source: Authors.

2.3 Data abstraction

For the final included papers, we first abstracted the following data: the definition or conceptualisation of 'gender mainstreaming', 'energy security' and 'poor urban environments'. We then obtained data on the location of case studies, the study research aim or research question, how gender mainstreaming was measured or an indicator of gender mainstreaming, energy technology(ies) or service utilised and the energy service(s) addressed.

We synthesised the results narratively into three major sections that corresponded to the research questions of this paper. These entailed sections discussing the conceptualisation of the three concepts (Section 3), classifying the emerging issues and gaps in energy-gender-poor urban nexus research (Section 4) and opportunities for utilising gender mainstreaming as a strategy to achieve energy security in poor urban environments in Africa (Section 5). We did not provide statistical analysis as the paper is an exploratory evaluation.

3 Conceptualisation of gender mainstreaming, energy security and poor urban environments

Gender mainstreaming, energy security and poor urban environments constitute cross-cutting themes for designing sustainable solutions to deal with the energy insecurity challenge. Debates on the conceptualisation of these concepts exist. In this section, we aim to address the first research question by providing the reconceptualisation of these concepts and to position our argument to advance evidence-based research in Africa on the energy-gender-poor urban nexus.

3.1 Gender mainstreaming

Gender mainstreaming surfaced as an international concept that first appeared after the United Nations Conference on Women in Nairobi in 1985 [36] and was subsequently bolstered through the 1995 Platform for Action at the United Nations Conference on Women that took place in Beijing [37,38]. While we identified several definitions of gender mainstreaming (see Table 5), the most cited one was that of the Council of Europe [39] that referred to it as follows: "… entail[s] (re)-organisation, implementation, development and evaluation of policy process in order to incorporate a gender equality perspective in all

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policies at all levels at all stages by actors normally involved in policymaking". Gender mainstreaming is also regarded as "the promotion of gender equality through its systematic integration into all systems and structures, into all policies, processes, and procedures, into the organization and its culture, into ways of seeing and doing" [39].

Table 5: Definitions of gender mainstreaming

	Gender mainstreaming definitions	Source
1	The (re)-organisation, implementation, development and evaluation of policy process so that a gender equality perspective is incorporated in all policies at all levels at all stages by actors normally involved in policymaking.	[39]
2	The promotion of gender equality through its systematic integration into all systems and structures, into all policies, processes, and procedures, into the organization and its culture, into ways of seeing and doing.	
3	Efforts to scrutinize and reinvent processes of policy formulation and implementation across all issue areas and at all levels from gender-differentiated perspectives to address and rectify persistent and emerging disparities between men and women.	[37]
4	A gendered equality strategy that aims to transform organizational processes and practices by eliminating gender biases in existing routines, involving regular actors in this transformational process.	[40]
5	A strategy for theory development to recognize a gendered world rather than a separatist gender theory.	[38]
6	Agenda setting, entailing transformation and implementation of the existing policy paradigm; and integration, entailing introduction of gender perspective without challenging existing policy.	
7	It seeks to find areas of commonality between gender equality and economic competitiveness, while the elimination of gender inequality is at its core.	
8	A transformative strategy with the scope of promoting gender equality in policymaking.	[41]
9	A transformative role in public policies and reinforcing positive action and equality legislation.	[42]
10	An alternative gender equality tool, which would gradually make positive change in favor of women redundant and could serve other policies.	

11	It considers the tensions and dilemmas of feminist theory and practice, it is not, in and of itself, a feminist theory but rather the re-invention, restructuring and re-branding of a key part of feminism in the contemporary era.	[38,43,44]
12	A long-term transformation and a paradigm shift that involves designing programmes and projects informed by knowledge of the diversity of needs of potential participants rather than fitting women into existing structures and systems, or seeking to adjust structures to ensure a better fit.	[45]
13	A process towards a more inclusive democracy which improves gendered democratic practices and involves transforming and redirecting policy paradigms, decision making processes and prioritising the objectives of gender equality.	[46]

Source: Compiled by authors from various sources.

The emergence of gender mainstreaming, however, has a much longer history, stemming from three waves of feminism, each connected to particular political campaigns for gender equality [36]. The first wave of feminism, according to Booth and Bennett [36], related to the women's suffrage movement in the 1900s, which fought for equal rights and treatment before the law. It was followed by the second wave, campaigning for positive action and separate women's provision in the 1960s. The third wave entailed a shift towards a gender perspective in the 1990s. The gender perspective recognises the diverse needs of women and men, the need to expand equality at work to all services and providers, and the involvement of men in the process of change [36]. These three perspectives are interdependent and complementary, illustrated in Booth and Bennett [36] by the metaphor of a three-legged stool, the 'equality stool' (see Figure 3).
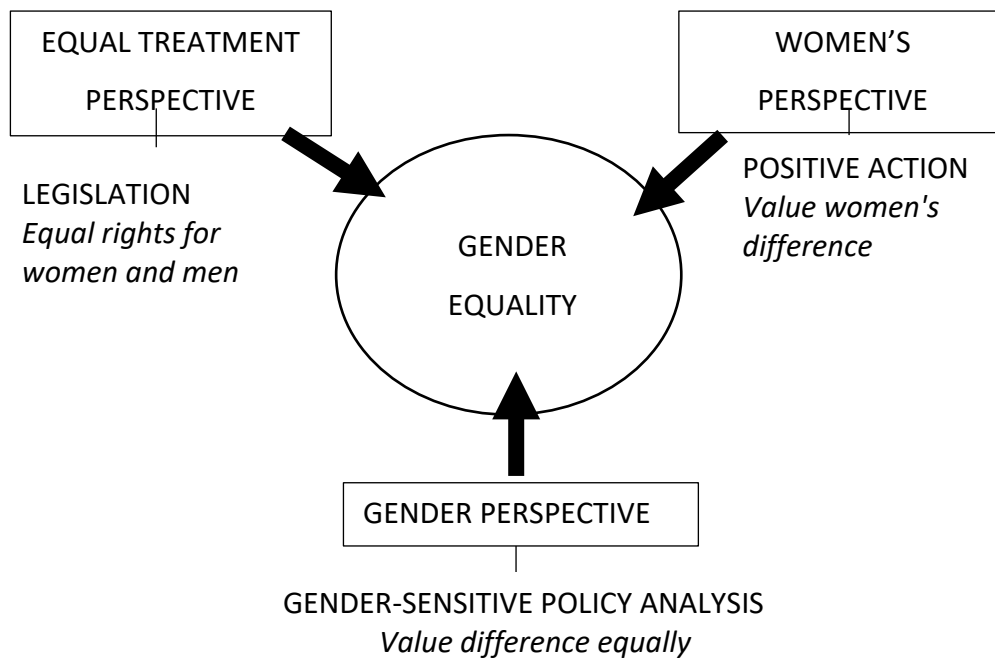
Figure 3: The equality stool

Source: Booth and Bennett (2002).

The literature demonstrates that gender mainstreaming is a contested concept and practice with divergent interpretations and definitions, which in turn affect its application and implementation in dealing with societal challenges such as the provision of security of energy services. For example, promotion of gender equality happened through the Millennium Development Goals and is currently emphasised in the SDGs, notably SDG 5 [7]. However, despite international interest in gender equality and some progress towards achieving the SDG targets, tangible results are still elusive while significant challenges remain, mainly within sub-Saharan Africa [7, 46-48]. The Gender Development Index[6] for Africa, as an illustration, indicates that African women, on average, only achieve 87 per cent of men's development levels [49]. The Gender Inequality Index,[7] interpreted as the loss in human development due to inequality between men and women, indicates that all but six African countries have substantial gender-inequality issues [49].

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[6] The Gender Development Index measures differences between male and female achievements in three basic dimensions of human development, namely health, education and income.

[7] The Gender Inequality Index reflects gender-based inequalities in three dimensions: reproductive health, empowerment and economic activity. The closer the figure is to zero, the less gender inequality there is.

We observe that the standard definition of gender mainstreaming does not imply or translate into a universal understanding of the concept and practical implementation. The latter is context specific and based on practical experiences and socio-cultural aspects. The dominant implementation occurs at various international global bodies in their research and development work [e.g. 50,51,52]. The United Nations adopts the concept across its various units [e.g. 53,54]. However, Rees [41] highlights the lack of clarity of the concept of gender mainstreaming for implementers despite its widespread adoption. This is possibly due to its consideration as a universal norm with little application at local levels [55].

The literature also highlights that the intention of gender mainstreaming is to be a long-term strategy and process [56]. However, these discussions, as highlighted in Moser [57], tend to focus on the short-term strategy aspects of gender mainstreaming. Further, there is a tendency to focus on gender mainstreaming at the policy level rather than viewing it from multiple levels of perspective where change needs to happen. These levels are macro (society), meso (organisational level) and micro (households and individual), which are all interconnected. The focus thus far has been at the meso level, hence, facing tensions at the macro- and micro level. Further, limited discussion exists that integrates gender mainstreaming at households and individual level and, particularly, to inform and drive gendered innovation processes.

We thus argue that similar to sustainability issues, gender mainstreaming remains a long-term strategy with a focus on everyday practices. We thus reconceptualise gender mainstreaming as *a long-term strategy aimed at bridging gender awareness into consciousness and daily routines*.

A fundamental step to mainstreaming gender for energy security in poor urban environments is to understand that poverty and gender are inextricably linked and related to the challenges of access to resources, decision making, control [58,59] and energy services. In sub-Saharan Africa, ongoing efforts to mainstream gender in energy planning are in place. However, limited understanding of the relationship between gender, energy security and poverty exists [60].

3.2 Energy security

The energy security concept emerged in the early 20th century concerning the supply of oil for armies [61]. Similarly, academic studies on energy security that appeared in the 1960s related to the oil crisis in the 1970s. However, the literature on energy security declined in the 1980s and 1990s as oil prices stabilised and embargos receded. The interest re-emerged in the 2000s following rising demand in Asia, supply disruptions in Europe and pressure to decarbonise energy systems [61-63]. The major energy security issues of the 1970s and 1980s differ from the current and existing issues that extend beyond the security of supply to include equitable access to modern energy and climate change mitigation. As a result, the concept of energy security has been intensively re-examined [64].

The literature provides varied definitions of energy security, illustrated in Sovacool's [65] review of 45 definitions. Based on a conventional definition from the Australian government, emphasised in Parag [66], 'energy security' refers to an "adequate, reliable and competitive supply of energy", whereby 'adequacy' is "the provision of sufficient energy to support economic and social activity", 'reliability' is "a provision of energy with minimal disruptions to supply" and 'competitiveness' is "a provision of energy at an affordable price that does not adversely affect the competitiveness of the economy and that supports continued investment in the energy sector".

Traditionally, the definition of energy security has focused on dimensions related to the security of supply, mainly the availability of supply and prices [67] and the share of renewable energy [68]. Ang et al. [69] expand the themes of energy security to include infrastructure, societal impact, governance, environment and energy efficiency. Other parameters observed in the literature are equity and environmental concerns [70] and public acceptability [65,71]. Public acceptability relates to social, psychological and cultural obstacles, such as adverse perceptions of generation technology that may interfere with supply [66]. Notably, the definitions ignore gender aspects that relate to the issue of energy security.

While evidence of energy security definitions at the national level as well as consensus on what it should include exists both in academic literature and policy documents, there is still ongoing exploration on what it should be [69] and how it should be understood, particularly at a household level. Pasqualetti and Sovacool [72] illustrate that energy security is important at every level of consideration and that energy policy decisions need to be adjusted for this reality. Further, sensitivity to energy security varies with context, not only on smaller scales but also nationally, hence requiring a nuanced nonlinear approach to policy formation. We summarise some of the definition of energy security and related terms that are relevant at a household level (see Table 6).

Table 6: Definitions of energy security and related terms

	Energy security definitions	Source
1	The provision of sufficient energy to support economic and social activity with minimal disruptions to supply and at an affordable price that does not adversely affect the competitiveness of the economy and that supports continued investment in the energy sector.	[66]
2	At a household level, it is assured and regular supply of clean energy fuels at an affordable price for various household activities.	[73]
3	The amount of energy needed to meet the basic needs of daily life of the individual and household in terms of cooking, lighting, washing/cleaning, warming/cooling the house.	[74]
4	Energy insecurity – an inability to meet basic household energy needs adequately.	[75]
	Energy insecurity – the status quo derived from the interplay of inadequate and insufficient energy consumption that prevents households from meeting basic energy needs.	[74]
5	Energy services security – the extent to which the population in a defined area (country or region) can have access to affordable and competitively priced, environmentally acceptable energy services of adequate quality.	[71]

Source: Compiled by authors from various sources.

Based on Jain [73], household energy security can imply ensuring assured and regular supply of clean energy fuels at an affordable price for various household activities. Until recently,

limited studies have defined energy (in)security at the household level. Hernández [75] defines energy insecurity as "an inability to meet basic household energy needs adequately". Similarly, Phoumin and Kimura [74] define household energy insecurity as "the status quo derived from the interplay of inadequate and insufficient energy consumption that prevents households from meeting basic energy needs". They further argue that household energy security is the "amount of energy needed to meet the basic needs of the daily life of the individual and household in terms of cooking, lighting, washing/cleaning, warming/cooling the house". Both these definitions focus on 'basic needs', which are a context-specific quantity rather than a quality given the multiple energy fuel types utilised in different regions, and on energy consumption rather than on the security of energy services.

Pasqualetti and Sovacool [72] discuss the different energy security scales, namely household, workplace, national and global, and their related energy security concerns. The concerns at a household level relate to equitable and reliable access to energy services, pollution and public health. These household concerns are evidenced most in the Global South where improved access to energy services is essential to economic development. Further, these concerns intersect with other cross-cutting issues of gender equity, social justice, environmental degradation [72] and poor urban environments [12].

In contrast, Parag [66] calls for a shift from energy security to security of energy services. Security of energy services refers to "the extent to which the population in a defined area (country or region) can have access to affordable and competitively priced, environmentally-acceptable energy services of adequate quality" [71]. The definition expands the end-use perspective to include not only the provision of energy but also ways in which the end-user consumes energy. While energy services are demand driven, the supply system shapes them. Therefore, exploring the security of energy services requires the inclusion of the psychological, social, cultural and political contexts where energy production and consumption take place [76-78].

The development of product-service system innovations combined with distributed energy generation [30] can be a strategic approach to addressing energy insecurity in poor urban environments [79]. This approach considers the technical aspects, such as energy

generation technologies, together with the business model and the human-centred related aspects. As supply and consumption can occur at different levels, the security of energy services requires multilevel assessment, including, bottom-up, top-down and middle-out methods, representing consumers', suppliers' and other actors' perspectives [66].

Such a focus changes the conventional supply approach to socio-technical and user-oriented perspectives. From the users' point of view, be they households, businesses or governments, the supply of kWh or oil barrels is often irrelevant [66]. While Parag [66] points out that what matters is not the source of energy but rather the services provided by it, Smit et al. [80] observed that this was not necessarily true, particularly for the contexts where legitimacy remain firmly held. Emphasis on energy services, therefore, alters the scope and nature of energy security assessments [81]. The security of energy services and uses differs according to the socio-demographic nature of households [81,82]. We agree with Parag [66] that the public and government goal is to secure energy services. Furthermore, *ensuring the security of energy supply* is only one way of achieving the security of energy services. Hence, we emphasise the *shift in focus to securing of energy services* in poor urban environments*.*

3.3   Poor urban environments

The understanding of poor urban environments contributes to SDG 11 regarding building sustainable cities and communities. It is also directly and indirectly linked to other SDGs [23]. One of the direct linkages that has received limited attention is the projected future urban growth in Africa and Asia, with women and girls constituting the majority of these populations [83]. Linking SDG 11 with gender mainstreaming to support SDG 5 regarding gender equality is therefore indispensable. Gendered embodiment and social reality of daily routines at home, in public and on the move shape cities [84]. The book by Chant and McIlwaine [83] is the first to discuss the *gender-urban-slum* interface and the challenges that poorer segments of the female population residing in slums face. However, their discussions utilise the limiting understanding of slums of the UN-Habitat [15] definition that ignores energy access and security of energy services (see Table 7).

Table 7: Definitions of poor urban environments

	Poor urban environments definitions	Source
1	Spatial locations with a concentration of urban dwellers who are deficient of something specified, both in quantity and quality, and are unable to fully meet a need or requirement or service.	GENS (Authors)
2	Informal settlements, or slums, are recognised by the United Nations (UN) Human Settlement programme as households lacking any of the following conditions: (1) access to improved water; (2) access to improved sanitation facilities; (3) sufficient living area – not overcrowded; (4) structural quality/durability of dwellings; and (5) security of tenure.	UN-Habitat 2010

Source: Compiled by authors and own definition highlighted as GENS.

The literature shows various terms synonymous with 'poor urban environments. These include 'poor urban areas' [e.g. 85,86], 'poor urban neighbourhoods' [e.g. 87,88], 'poor urban community' [e.g. 89,90], 'poor urban setting' [91,92], 'poor urban settlements' [e.g. 93] and 'poor urban economy' [e.g. 94].

The usage of these terms in the literature tends to lack clarity on their meaning, which can have multiple interpretations. The common term 'poor urban' observed in the synonymous terms is also unclarified. We rely on the concept of 'poverty' to provide a consistent and robust definition. The World Bank [95] identifies sub-Saharan Africa as a priority region for transformational change in dealing with poverty. The term 'poverty' is associated with a 'lack' or 'deficiency' of necessities required for human welfare [96].

Poverty can have an economic and a social perspective. In economic terms, it is based on income, while in social terms, the basis is the lack of access to the provision of basic needs and services. From an energy poverty point of view, poverty has context-specific gendered implications, including productive and strategic needs, health (smoke from cooking), time use (collecting biomass), livelihood strategies (microbusinesses) and safety and security (street lighting) [58].

The literature describes energy poverty challenges as the gender-energy-poverty nexus [10,58]. However, from the energy security studies that argue to shift the focus from energy poverty to the security of energy services, the nexus can be rephrased as the gender-energy-poverty nexus. Additionally, concepts such as an energy ladder that assesses energy poverty by examining the percentage of households reliant on biomass fuels such as dung, crop residues, wood and charcoal compared to those reliant on kerosene, natural gas and electricity [97-99] are less meaningful. A more substantial approach is to examine the energy services accomplished from the fuels that the households utilise [100].

In the context of this paper, we therefore refer to poor urban environments as *spatial locations with a concentration of urban dwellers who are deficient in something specified, both in quantity and quality, and are unable to fully meet a need or requirement or access a service*. The unmet requirement is the security of energy services.

3.4 Practical implementation and measurement of gender mainstreaming in energy security research

A massive part of the literature on gender mainstreaming remains untheorised. Gender mainstreaming is an ambiguous concept subject to different interpretations, definitions, styles and forms of practical implementation [36]. There is no single definition of gender mainstreaming, and unreflective interpretations are held by policymakers, femocrats [43] and energy researchers. Fathallah and Pyakurel [101] highlight some of the inconsistencies in energy and gender studies, focusing on a Global North perspective. They provide a conceptual approach in order to utilise the terms 'gender' and 'sex' consistently. They point out the need to undertake similar studies in the Global South. Translating the ambiguous concept to practical implementation becomes subject to numerous and implicit assumptions.

Gender mainstreaming is considered as both a process and a practice to promote gender equality [38] and gender issues [41], implying that it is not an end in itself but rather a means to an end [37,38,102]. It is also a strategy for theory development to recognise a gendered world rather than a separatist gender theory [38]. Most energy studies equate

gender issues and gender equality with women and girls [101]. Similarly, this is the conceptualisation provided in SDG 5, in which the focus is on women and girls.

Nightingale [103] conceptualises gender as a process whereby subjectivities are produced and shift over time and space. The implication is that gender inequalities and understanding in rural areas may differ from the urban context. The conceptualisation of gender as a process indicates its complex nature [103], namely dynamic and subjective, both as a concept and a practice, further necessitating the need for systems thinking approaches.

Unlike 'gender roles', subjectivities are performed and contested through social interactions instilled with power. Gender thus does not refer to women or differences between men and women. Rather, gender is the process through which differences based on presumed biological sex are defined, imagined and become significant in specific contexts [103]. Gender is not static but is rather redefined continuously and contested in the contexts within which it is applied [103]. Hence, there is a need to constantly update the mental models of individuals.

Skutsch [104] points to the lack of appropriate gender analytic tools as a major reason for limited gender mainstreaming in energy projects and programme planning. Skutsch [104] highlights four common underlying goals for utilising gender analysis. These are to (i) improve the welfare of women and their quality of life and reduce drudgery; (ii) improve production and economic levels of women; (iii) empower women to break through existing gender relations; and (iv) improve project efficiency to ensure success. These common goals influence energy interventions as well as the dominant energy-gender research and emerging issues.

4   Emerging issues in mainstreaming gender for energy security research

In this section, we address the second research question of this paper on the key emerging issues that inform the need to advance evidence-based gender and energy research in poor urban environments. From the pool of cross-cutting papers selected, we identified dominant energy-gender nexus research and classified the key emerging issues into five categories: (i) what matters in gender mainstreaming in the urban household energy sector;

(ii) focus on one technology or energy service; (iii) limited focus on poor urban environment; (iv) access to electricity versus the security of energy services; and (v) everyday energy practices and the role of geography, time and space. We discuss each of these issues in the sections that follow.

4.1   What matters in gender mainstreaming in the urban household energy sector

Limited empirical evidence that measures mainstreaming or gender equality exists. Despite the largely accepted need to include gender in energy policy, practice and research, many studies focus on disaggregation by sex [105,106] to inform energy access and energy efficiency initiatives. This often reproduces stereotypical understandings of sex differences, which can harm rather than promote gender equality [105]. A similar interpretation seems intrinsic in SDG 5, specifically indicators 5.4.1[8] and 5b.1,[9] which are relevant to the energy sector. These indicators focus on representation by sex, age group and location. However, disaggregation by sex alone is limiting to energise equality [105].

With regard to what matters in gender mainstreaming in energy, we grouped the sampled empirical papers into three categories. The first equates gender mainstreaming with women and presents it as a basis for their study [e.g. 107,108]. The second group appears to focus on women but provides disaggregated analysis by sex [109,110]. The final group, which is emerging, questions the existing studies and argue for rethinking gender mainstreaming in energy research and practice [105,106].

We argue that the existing studies have focused on fixing the numbers, whereby the attention is on the participation of women and girls in energy-related initiatives [e.g. 111]. Some studies have emphasised fixing institutions in order to enable or improve the decision-making process at the household level [e.g. 112,113]. A gendered perspective, however, needs to follow a comprehensive approach rather than just utilising women and men as the factors or indicators of gender mainstreaming. The literature recognises the lack of standard methods to support relevant indicators for inclusion from a gendered perspective. For

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[8] Indicator 5.4.1 Percentage of time spent on unpaid domestic and care work, by sex, age group and location.

[9] Proportion of individuals who own a mobile telephone by sex.

example, ENERGIA developed a gender audit method that Clancy and Mohlakoana [109] applied to eight sub-Saharan Africa and Asian countries and that is appropriate at a national level. Clancy et al. [114] highlight how the lack of gender-disaggregated data impedes our understanding of energy use and needs. The situation is particularly concerning in poor urban environments, which are dynamic and fast changing.

In an urban context, Smit et al. [115] developed a questionnaire tool utilising Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism (MuSIASEM) that was piloted and tested in three poor urban environments in Kenya, South Africa and Uganda [12]. MuSIASEM's strength is the ability to capture multiple levels of analysis at individual, household and community level. The approach is capable of providing the time use indicator relevant for SDG indicators 5.4.1 and 5b.1. However, there is a need to move beyond fixing numbers and institutions to fixing knowledge. Fixing knowledge in the energy context may entail contributions from the different genders in designing solutions aimed at fulfilling the household energy services. It entails understanding both the gendered differences and gendered similarities to interventions, initiatives and projects dealing with the energy insecurity challenge. Defining the indicators that would constitute fixing knowledge is therefore crucial.

Shrestha et al. [113] developed a framework for researching gendered differences in household decision making. They highlight subjective variables, objective variables, differences in reasons, differences in decision making, use, purchase and action needed. Similarly, Skutsch [104], although focussing on energy projects in general, highlights gendered questions to enable the collection of relevant data. Skutsch [104] categorises these questions into identification of stakeholders, genderised context definition and genderised appraisal of proposed energy service. Given the need for a standardised tool for data collection, we integrate insights regarding the gendered indicators into the MuSIASEM tool, developed by Smit et al. [115], to propose a broad framework for gendered data collection in poor urban environments. The framework, illustrated in Table 8, can inform the indicators of SDGs 5, 7 and 11.

Table 8: Proposed gender mainstreaming indicators to achieve security of energy services in poor urban environments

Variables	Indicators for data collection	How to collect indicators
Genderised objective variables	⇨ Headship, ownership, ethnicity, family type and location ⇨ Typology indicators: building type, slum type and household type	⇨ Qualitative using MuSIASEM questionnaire ⇨ Typology framework developed in [17]
Genderised subjective variables	⇨ Energy consciousness ⇨ Practice ⇨ Culture ⇨ Attitude ⇨ Time use	⇨ Qualitative using ethnographic research ⇨ Quantitative using MusIASEM questionnaire ⇨ Community-based system dynamics
Gendered differences and similarities	⇨ Socialisation and social roles ⇨ Perception and responsibility ⇨ Choices and uses ⇨ Appliances ownership and use	⇨ Qualitative using ethnographic research ⇨ Quantitative using MusIASEM questionnaire
Gendered behaviour	⇨ Use ⇨ Purchase ⇨ Energy activities ⇨ Everyday energy use routines ⇨ Everyday energy purchase routines	⇨ Qualitative using MuSIASEM ⇨ Qualitative using ethnographic research ⇨ Qualitative using design thinking tools – user journeys and storyboards ⇨ Community-based system dynamics
Gendered knowledge interventions	⇨ Active participation in codesigning solutions ⇨ Coresearching to enhance technical and knowledge upbringing ⇨ Colearning to reflect on lessons and changing household dynamics over time and space	⇨ Developing Energy Living Labs to codesign, coresearch and colearn.
Gendered policy and political economy	⇨ Policies supporting gender mainstreaming ⇨ Power dynamics at policy-civil society ⇨ Intrahousehold power dynamics	⇨ Policy seminars or workshops involving multiple stakeholders ⇨ Focus group with community

Source: Compiled by authors from Skutsch [104], Shrestha [113], Smit et al. [115], Smit et al. [17] and Ambole [11].

4.2 Focus on one technology or energy service

Renewable energy technologies are exemplified as the ideal distributed energy source, incorporated into packages to offer unique opportunities to provide essential energy services. However, consideration of only one technology or energy service may not result in the fulfilment of the bundle of energy services at a household level. From the sampled literature, we observed a tendency to focus on one technology or energy service in dealing with energy insecurity challenge. As an illustration, Islam et al. [116] promote the small-scale decentralised renewable energy system in developing countries. Similarly, Pascale et al. [111] explored the potential for women led-solar photovoltaic (PV) technology in rural Myanmar as a form of access to electricity. Recently, a dedicated special edition of *Energy Research & Social Science* focused on the uptake of solar PV to improve energy access in developing countries [3]. The papers in the special edition considered not only the technical aspects but also socio-cultural practices as well as politics and the political economy. These are essential factors that can influence gendered energy transitions in poor urban environments.

Evidence from the sampled literature shows that the majority of the empirical studies have examined opportunities with cooking technologies [117] and how to support the provision and adoption of alternative and clean cooking technologies [e.g. 118,119]. Other studies have focused on traditional biomass such as charcoal [34] as this is a major fuel utilised in urban Africa.

Examining the gender dynamics across the value chain of technology or service is crucial. In exploring the charcoal value chain in sub-Saharan Africa, Ihalainen et al. [108] found that women tended to participate more in the charcoal value chain and constituted a minority in other parts of the energy value chain, often joining the sector in the absence of alternative livelihood opportunities. Additionally, gender differences and inequalities influence participation and outcomes in areas such as resources and income, gender roles and responsibilities, and social and political capital. Therefore, Ihalainen et al. [108] argue for the need to place gender at the core of energy value chain studies.

Aryal et al. [120] also examined the gendered approach to the adoption of clean energy. They observed that the use of clean energy in female-headed households tended to be lower than in male-headed households. Such observations have implications for gendered innovations. Other studies such as that by Winther et al. [107] focused on women empowerment through electricity access. They observed that while electricity access benefited the welfare of both women and men, the impact on gender relations remained largely unclear. They developed a framework for analysing women's empowerment through electricity. This framework contains aspects related to the energy cultures framework presented in Johnson et al. [24].

In their study that explored clean cooking technologies in households of low- and middle-income countries, Rosenthal et al. [121] highlighted a fundamental assumption observed in several pieces of literature. They point out that programmes carried out for women, especially related to cooking technology, follow the unconscious and untested assumption that cooking energy is always women's primary energy problem. Such an observation is crucial for a gendered perspective, particularly taking into account space, time and geography. The implication is the need to consider all household energy service requirements as a bundle that can be satisfied by various energy technologies and that requires understanding of the roles of both women and men as well as their knowledge contributions.

A focus on one technology or service raises concerns about whether these contribute to the indicated socio-economic status of women. For example, although Ulsrud [21] focused on a rural area, her study highlighted how technology fixes failed to address issues of affordability resulting from extreme poverty, a mismatch between the geography of settlements and technologies, and consideration of gender inequality. These factors, similarly, may apply when exploring the urban context.

Thus, the dominant technocratic view observed in the literature focuses on energy as an essential input (physical dimension) as opposed to recognising energy as a 'basic need', which involves a social dimension [114] as well as various energy services. Clancy et al. [58]

suggest that the current supply-side approach that focuses on energy carriers and technologies is inadequate. Instead, Clancy et al. [58] promote a demand-side approach to energy planning that would focus on energy services through comprehensive demand-side analysis of all the energy needs of the poor, which would acknowledge their particular constraints and opportunities.

4.3 Limited focus on poor urban environments

Pearl-Martinez [122] identifies urbanisation as one of the six global trends that drive or hamper gender equality in energy access. However, limited studies focus on energy insecurity of the urban poor [e.g. 9]. The observed literature tends to focus on energy poverty and energy insecurity in rural areas such as in India [123], Kyrgyzstan [110], Zambia [24], Kenya, Malawi, Ghana, South Africa and Uganda [124].

The majority of the sampled literature that had a focus on 'energy' and 'urban' did not necessarily consider the gender dimension. For instance, Teschner et al. [125] examined the extreme poverty on the periphery of the urban areas of Romania and Israel. Their key finding was that policymakers perceived extreme energy vulnerability as less urgent compared to other challenges in poor urban environments although these were intrinsically connected. Castán Broto et al. [34] focused on energy profiles among the urban elites in Mozambique and found that income was not a key factor in the choice of fuel; rather, cultural and generational conditions were dominant factors. In fact, Smit et al. [115] found that urban households in an informal settlement in South Africa paid more for their energy cost per unit.

Other studies have examined rural areas at a regional level in Africa, Asia, Latin American and the Caribbean [126]. A notable aspect is the ENERGIA research programme, which has been instrumental in gender and energy initiatives. Many of the initiatives are focused on rural and peri-urban areas, for instance the Global Village Energy Partnership programme founded in 2002 [127]. Similarly, Kooijman-Van Dijk's [128] findings from the ENERGIA research programme indicate that energy demands are not necessarily met equitably for men and women even when energy supply is physically available at household or community level.

The traditional socio-cultural backgrounds of households influence energy transitions in urban Africa. However, urban settings differ from rural settings. Migrating from rural to urban areas means changing livelihood activities. As an illustration, despite focusing on rural areas, Khatiwada et al. [129] show that individual as well as location-specific characteristics influence energy use behaviour switching for men and women in Nepal. Such an observation emphasises the need for context-specific evidence-based studies.

4.4   Access to electricity versus security of energy services

Emerging studies reveal the complexity of energy access and challenge the assumptions that access to modern energy such as electricity will lead to the fulfilment of SDG 7 regarding affordable and clean energy or increased economic activity and abandonment of traditional energy use. Some studies focus on electricity access as a form of achieving gender equity and empowerment of women [e.g. 110].

Kim and Standal [110] show that while electricity provides an essential resource for communication, income generation and household chores, its unreliability and affordability challenges and changing gender norms undermine women's potential empowerment, perpetuating gender inequalities. Pueyo and Maestre [130] highlight the links between gender, energy access and productive uses of energy, focusing on electricity. A challenge that studies have shown is that urban Africa still exhibits fuel stacking [12,34],[10] which serves as an adaptive measure to deal with energy insecurity.

According to Rosenberg et al. [131], prior studies suggest that women particularly stand to benefit from increased electricity access. However, few have empirically tested the implicit linkage between energy access (SDG 7) and gender equality (SDG 5). Rosenberg et al. [131] specifically explored how female household members used electricity once it was made accessible in India. Their findings showed that women were neither the sole nor the primary

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[10] Fuel stacking refers to households' using an energy fuel mix instead of switching entirely to a different fuel type. For example, instead of switching entirely to cooking with gas, households can utilise different fuels such as charcoal, paraffin or solar power.

beneficiaries of electricity access, even when appliances that would particularly benefit them were affordable. While energy access could improve gender equity, Rosenberg et al.'s [131] study highlighted intrahousehold power dynamics as an important boundary condition for realising more equitable energy access. Energy services fulfilled by electricity access and intrahousehold power dynamics become relevant gendered indicators. De Groot et al. [132] emphasise this point and highlight that the ability to fulfil a range of energy services can empower women to run their businesses in a viable manner.

4.5   Everyday energy practices and the role of geography, time and space

Emerging studies are highlighting how the limited understanding of the everyday uses of energy and their interactions with other aspects of the SDGs hinders the achievement of sustainable energy for all [133]. Due to limited exploration of the energy issues in poor urban environments, a disjuncture exists between the everyday realities in these environments and the policy objectives of building sustainable cities and communities. Sunikka-Blank et al. [26] observed this situation in a slum case study in India and argued that energy and housing policies could influence gender equality. While Castán Broto et al. [34] examined the link between energy use and urban inequality at a household level, their focus was on high-income households with limited consideration of gendered aspects.

Gendered household behaviours evidenced in the literature demonstrate how gendered roles manifest in everyday energy consumption and energy expenditure decisions at the household level. For example, Shrestha et al. [113] show that women actively participate in energy-saving practices. Similarly, Hoppe et al. [134] propose that among other factors, gender plays a role in energy efficiency behaviours and should be considered in the pursuit of energy conservation as their study indicates that women have a stronger intention to save energy and engage more in energy-saving behaviours. Batliwala and Reddy [135] seem to support this notion by suggesting that women tend to consider the long term and the next generation and are willing to sacrifice immediate gains for long-term benefits, a view that leads to sustainability. Furthermore, Clancy et al. [114] and Hoppe et al. [134] indicate that interventions are generally more effective when tailored to the target population, thereby indicating the need to recognise and include women as role players in the energy sector. Other everyday practices that access to energy promotes in poor urban

environments are income-generating activities [12,115], for example through the running of small businesses [e.g. 132]. It is thus essential to understand the type of influence of the available energy sources on these everyday practices.

Greene [35] highlights the value of a human-centred, contextual approach to energy transition research for revealing the intersections of lives, practices and contexts in energy systems change. Although focusing on the Irish context, Green [35] reveals that a complex web of contextual processes, including technological change, economic transitions and planning policies, has shaped energy consumption in the home. Furthermore, social differentiation in the lived experience of socio-technical change along dimensions of gender, social class and geography was observed. In a similar vein, Cherunya et al. [136] developed the concept of 'oscillating domestic spaces', which reflects the need for people to constantly respond quickly to changing and precarious circumstances by rearranging their daily practices in time and space and developing a multiplicity of alternative options and partial solutions. Understanding of everyday practices becomes crucial to identifying the relevant energy services in poor urban households.

5 Insights to move from theory to evidence-based energy-gender-poor urban nexus research practice in energy-gender-poor urban nexus research

This section addresses the third research question of this paper by investigating the opportunities for utilising gender mainstreaming as a strategy to achieve energy security in poor urban environments in Africa.

Although the Global South has adopted gender mainstreaming in several sectors, including health, education and agriculture, the energy sector has been slow to implement and adopt gender mainstreaming [10]. For Clancy [10], this is curious, given the notion that at the micro level, energy is 'women's business'. This is due to the gender division of labour at household level that generally sees the provision of energy left to women along with the tendency of women to utilise energy for livelihood activities in the informal sector [10,135]. Furthermore, the absence of gender mainstreaming in the energy sector means that policymakers do not recognise the existence of gender needs in energy services and, hence, overlook gendered energy needs. Clancy [10] argues that energy planning implemented in a

gender-neutral[11] way is in reality gender blind[12] and fails to acknowledge that men and women have different needs.

As an illustration, advocacy for gender inclusion in Kenya was only formalised recently with the newly adopted Energy Act 2019, which stipulates a gender balance by not exceeding two-thirds composition of the same gender in the Energy and Petroleum Tribunal [137]. A gender policy also exists within the Kenyan Ministry of Energy and Petroleum. However, its main intervention is not mainstreaming gender in energy but is rather mitigating gender-based violence within the ministry. In South Africa, similar efforts are being made toward gender inclusivity in the energy sector at institutional level with the creation of gender desks in various ministries, including the Department of Energy, but this has not brought about any significant social transformation at consumer levels of energy [138]. The need for energy policies that address gender disparities in social, economic and political integration is recognised only at macro policy levels with inadequate advances towards implementation [139]. Minimal attention is devoted to gender at the meso and micro levels of the energy sector.

Emerging opportunities are to characterise the concepts of gender mainstreaming, energy security and poor urban environments as (i) complex, dynamic and interrelated; (ii) context specific; and (iii) a process. Understanding the energy insecurity challenge in poor urban environments requires exploring the urbanisation process, which indicates that many urban dwellers end up in vulnerable spaces, that women and girls constitute the majority of that population and that, consequently, gender issues emerge. Robinson [140] identifies gendered aspects of energy vulnerabilities, two of which we argue are dominant in poor urban environments, namely exclusion from the economy and unpaid work. Smit et al. [115] highlight the need to connect the informal economy to the city.

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[11] The term 'gender neutral' assumes that the outcomes of energy planning will benefit men and women in the same way.

[12] 'Gender blindness' suggests that gender is not considered as an important differentiating factor.

The policy approach to addressing energy insecurity needs to consider the gendered perspective and realise that energy access does not equate to fulfilment of the various energy services and options in poor urban environments. A gender-conscious approach in alternative and renewable energy technologies can be critical in addressing energy insecurity. A gender-conscious approach, therefore, needs to be incorporated into all phases of energy research methods, energy security solutions and energy policymaking by including a range of aspects as summarised in Table 9.

Table 9: Factors characterising a gender-conscious approach to achieving security of energy services

Gendered energy research methods	Gendered energy security solutions	Gendered energy policy making
Collection of bottom-up, gender-disaggregated data [58,141].	Understanding gender norms and context specificity in the energy sector and at household level [58,114,130,142].	An enabling policy and regulatory environment constituting democratic processes and political and decision-making power [132].
Utilising mixed methods that capture quantitative and qualitative aspects combined with participatory or action research [11,12,114,130].	Women's participation at all levels. It includes inputs into research, technology design and the energy sector in planning, design, budgeting and implementation [58,119,141,142].	Energy policies that specifically target women [114,134].
Monitoring and evaluation of the gendered benefits of energy initiatives, including gender methodologies such as gender budgets[13] and gender audits[14] [59,109,130,143].	Recognising and supporting women as energy managers and entrepreneurs and including them in energy supply chains [59,114,135].	Coupling energy access initiatives with other development interventions such as credit, other resources, economic development and empowerment, women's rights and women's agency. Support may also include capacity building in technology, business

[13] Gender budgets assess the impact of government spending on women and girls.

[14] Gender audits take a broader approach and consider the systems, processes, organisational structures and culture in the design and delivery of projects [57].

		skills and leadership, and mentoring [59,142].
	The promotion of women's collectives and self-help groups [135].	
Understanding and responding to both women's domestic and productive energy uses, coupled with the recognition that energy transitions are complex and do not follow a linear progression [114,130,132,142].	Producing energy access solutions that are affordable, reliable and convenient and that have a suitable capacity or quality [58,114].	

Source: Compiled by authors from various sources.

The factors presented in Table 9 seemingly revolve around issues of visibility (in data and the energy sector), agency (ability to choose or act), access (to resources and services), validity (recognition and respect) and voice (through participation in processes and decision making). Thus, these factors characterising gender conscious approach supports our argument for more evidence-based research on the energy-gender-poor urban nexus.

6   Conclusions

This paper contributes to the theory and practice of the cross-cutting issues of energy-gender-poor urban nexus, entailing SDGs 5, 7 and 11. Specifically, the paper explored three research questions: (i) What are the conceptualisation and understanding of gender mainstreaming, energy security and poor urban environments? (ii) What are the key emerging issues that inform the need to advance evidence-based gender and energy research in poor urban environments? and (iii) What are the opportunities for utilising gender mainstreaming as a strategy to achieve energy security in poor urban environments in Africa?

We utilised an integrated literature review from a sample of 143 papers of which we selected 25, 23 and 13 papers to provide a conceptual understanding of the terms 'gender

mainstreaming', 'energy security' and 'poor urban environments' respectively. Additionally, we utilised a pool of 59 papers that provided cross-cutting issues regarding our study focus.

We observed from the literature that the standard definition of gender mainstreaming did not imply or translate into a universal understanding of the concept and practical implementation. We view gender mainstreaming as a strategy for addressing a future undesired situation that needs to incorporate everyday practices, and we conceptualised the term as a *long-term strategy aimed at bridging gender awareness into consciousness and daily routines*.

The undesirable situation explored in this paper is energy insecurity in poor urban environments. We argue that a human-centred and gendered conscious approach to codesigning socio-technical innovations to achieve security of energy services is indispensable. This will contribute to theorising gender mainstreaming as well as its practice when dealing with energy insecurity in poor urban environments.

The emerging issues for energy-gender-poor urban nexus research include consideration of what matters in gender mainstreaming and its relevance for societal, policy and scientific impact; more evidence-based research in poor urban environments; a shift in focus from energy access to security of energy services; everyday practices as an approach to gendered consideration; and understanding of the subjective factors and dynamics that promote or hinder gender mainstreaming at the household level.

The key messages of this paper are as follows: More evidence-based research on the gender-energy-poor urban nexus in Africa is needed in order to understand progress towards universal access to energy for all. In addition, we need to reconceptualise our understanding of gender mainstreaming. Finally, we need to shift the focus to securing energy services in policies and research in order to improve energy security in poor urban environments while taking into account the gendered aspects of everyday energy use practices. As a way forward, the GENS Trilateral Research Chair will adopt an energy-gender-poor urban nexus approach through two case studies in South Africa and Kenya.

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