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Leapfrogging inequality? Navigating a pathway to cleaner energy in rural Ghana

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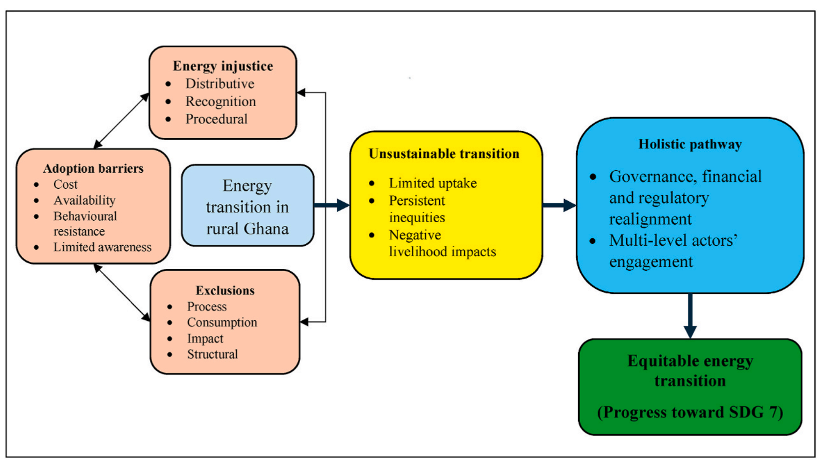
HIGHLIGHTS

- Context-specific strategies are vital for a sustainable energy transition in SSA.
- Technology-focused transitions risk reinforcing existing marginalisations
- Current transition efforts in rural Ghana are marked by injustices and exclusions.
- Governance, financial and regulatory realignments are vital for equitable transition.
- Multi-level actors play significant role in transition processes and outcomes.

GRAPHICAL ABSTRACT



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ABSTRACT

Despite progress toward SDG7, many people in sub-Saharan Africa (SSA) are projected to remain without access to clean energy by 2030 unless drastic measures are taken. Existing studies have largely focused on technological innovation in the Global North, producing a techno-centric bias that overlooks the complexities of energy access in non-Western contexts. This study addresses this gap by examining energy transitions in rural Ghana through the Political Ecology framework for Sustainable Energy Transition (PESET)—an integrated analytical model that synthesises energy justice, political ecology, and inclusive innovation. It provides novel empirical insights into how context-specific factors influence clean energy adoption and reinforce existing inequalities.

Through a reflexive thematic analysis of 43 qualitative key informant interviews, the study reveals the multidimensional nature of energy transitions and challenges dominant techno-centric paradigms by

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demonstrating how structural inequalities and power asymmetries shape participation, access, and outcomes in the transition process. The analysis identifies four adoption barriers (cost, availability, behavioural resistance, and limited awareness), four forms of exclusion (process, consumption, impact, and structural), and three dimensions of energy injustice (distributive, recognition, and procedural) that intersect to constrain a sustainable transition. Building on these insights, the study proposes a holistic pathway to support a more equitable and sustainable energy transition, offering actionable policy guidance and contributing to progress toward SDG7 in rural Ghana.

1. Introduction

Global efforts toward sustainable energy transitions aim to increase access to affordable and reliable low-carbon energy while minimising environmental impacts (Chirambo, 2018). Yet, investment in clean energy (SDG7[1]) is generally low (I.E.A., 2022), while sub-Saharan Africa (SSA) and other developing regions continue to bear the brunt of existing power inequalities (Lennon and Dunphy, 2023), casting doubt on their ability to achieve SDG7 (Avila et al., 2017; United Nations, 2023a). Indeed, many countries in SSA "… are not on track to achieve the Sustainable Development Goal (SDG) 7 …" (United Nations, 2023a, p. 27). Over the years, there have been growing calls to enhance energy access in the region (Hafner et al., 2018; SEforAll, 2019), with member states collaborating[2] to address the persistent clean energy access gap, particularly in rural communities (Alola, 2024).

Comparative studies across countries indicate that environmental sustainability is not determined by investment and technology alone; it also critically depends on the quality of institutions, political orientation, and governance contexts, with notable variations across regions (Barra and Falcone, 2024a, 2024b). Strong institutions and supportive political commitment are associated with higher environmental performance and more effective implementation of pollution-reduction technologies, highlighting the central role of governance in shaping sustainable outcomes. Therefore, a holistic approach that integrates economic, social, technological, and environmental considerations is essential for advancing a sustainable future (Giganti et al., 2025; Giganti and Falcone, 2025). In this context, Pellegrini-Masini et al. (2020), Nsafon et al. (2023), Sovacool et al. (2023), Falcone and Errichiello (2025) and Sica et al. (2026) emphasise the need for inclusive and just energy transitions that balance environmental objectives with social equity and broader systemic considerations.

However, much of the literature on energy transitions remains technocentric, focusing on technological advancements and production in the Global North (*e.g.*, Carley and Konisky, 2020; Overland and Sovacool, 2020; Hearn and Castaño-Rosa, 2021; Delina, 2022), while policy frameworks tend to prioritise technological deployment over social concerns (Boamah et al., 2021; McCauley et al., 2022; Apergi et al., 2024; Falcone and Errichiello, 2025). Some studies have explored aspects of political ecology (e.g., Lawhon and Murphy, 2012; Silver and Marvin, 2017), energy justice (e.g., (Akrofi et al., 2024; Apergi et al., 2024; Sen et al., 2024), and inclusivity (e.g., Burke and Stephens, 2017; Osunmuyiwa and Ahlborg, 2019) within energy transitions in isolation, while a few integrate two dimensions (e.g., Sovacool, 2016; Revez et al., 2020; Knuth et al., 2022). Boateng et al. (2023a) proposed the Political Ecology framework for Sustainable Energy Transition (PESET), integrating all three dimensions to show how even simple/mundane technologies can produce exclusions and injustices. These considerations are particularly critical in SSA, where rural communities continue to face persistent energy poverty, and where simple clean technologies have been deployed.

Ghana exemplifies this situation. Despite national initiatives (e.g. National Electrification Scheme (NES), Scaling Up Renewable Energy Programme (SREP) and Ghana Renewable Energy Master Plan (REMP)) to promote clean energy access nationwide (Bukari et al., 2021; Afful-Dadzie et al., 2022; Arthur et al., 2025), structural, economic and socio-cultural barriers continue to limit access, leaving rural communities disproportionately underserved (Bawakyillenuo et al., 2021; Energy Commission, 2025; Mawusi et al., 2025; Tettey et al., 2025). Even where clean energy solutions exist, these barriers can hinder effective utilisation (I.E.A., 2016; Bloomer and Boateng, 2024). This twofold conundrum — the lack of energy sources and the limited utilisation of available clean solutions — highlights the complex nature of energy access (Dioha and Kumar, 2020; Gafa et al., 2022; African Development Bank, 2023). Consequently, advancing clean energy access (energy transition) requires framing access not solely as the provision of technologies but also as a complex process shaped by social, economic and political factors (Singh and Ru, 2022).

Building on this background, the present study applies PESET as an interpretive framework to explore the perceptions of elite local actors on energy transition in rural Ghana. It draws on perspectives of local government and traditional authority actors. While these actors cannot provide direct household-level experiences, their insights illuminate governance, institutional, and socio-cultural factors shaping energy transitions (Abrefa Busia and Adjei, 2022; Adjei Baffour, 2025). This study addresses three key questions: What barriers hinder energy transition in off-grid rural communities? What forms of exclusion and injustice emerge in these transitions? What pathway can facilitate a sustainable and equitable energy transition? A reflexive thematic analysis of 43 key informant interviews (KIs) reveals barriers, injustices and exclusions (Nuru et al., 2021; Francis et al., 2022; Dokyi and Sharifi, 2024), showing how power asymmetries, capital flows, uneven planning, and historical neglect of rural infrastructure interact to produce marginalisation (Baker et al., 2021; Boateng et al., 2023b; Osório, 2023; Akrofi et al., 2024; Boateng, 2025). These dynamics underscore the need for transition strategies that address underlying political, economic, and social dynamics (Abe and Azubike, 2024; Sen et al., 2024)— a pathway advanced in this study.

The study makes three significant contributions. Empirically, it responds to calls for greater attention to mundane technologies and non-Western case studies (Sovacool, 2021). It contributes to knowledge that highlights the importance of local participation in energy transition, as shown in rural African contexts (Gebreslassie and Cuvilas, 2023), and supports the pursuit of a just and sustainable clean energy future in SSA— a gap highlighted by Sovacool (2021), Mulugetta et al. (2022) and Nsafon et al. (2023). It further provides context-specific insights, demonstrating that neglecting local conditions undermines effective transitions (Sovacool, 2021; United Nations, 2021; Sy and Mokaddem, 2022) and can reinforce existing power structures (O'Sullivan et al., 2020; Cellini et al., 2025). Theoretically, it advances understanding of the multidimensional nature of energy deprivation (Nussbaumer et al., 2012; Bouzarovski, 2014; Abbas et al., 2020) by operationalising the concepts of energy justice, inclusive innovation and political ecology. It challenges the dominant 'technological fix' paradigm (Stephens and Surprise, 2020), and demonstrates how exclusions and injustices are

[1] For more information on bridging the gap between funding requirements and implementation and for understanding the synergies between Climate and SDG Actions, see (Chatterjee, 2024).

[2] The African Union Development Agency (AUDA-NEPAD) and sub-regional bodies like the Economic Community of West African States (ECOWAS) and East African Community (EAC) have been instrumental in driving efforts to expand energy access.

embedded within transition processes (Axon and Morrissey, 2020; Sen et al., 2024). Finally, it provides a practical pathway to equitable and sustainable outcomes, illustrating how established concepts can guide sustainable transitions.

The rest of the study is organised as follows: Section 2, presents an overview of the energy landscape of SSA, while section 3 explains the interpretive framework (PESET). Section 4 highlights the materials and methods used to address the research questions. Next, the results are presented and discussed in section 5, and finally, the paper concludes (section 6) with a summary of the findings and recommendations for future works.

2. SSA's energy transition in view

Significant challenges continue to hinder progress toward achieving SDG7 and the African Union's Agenda 2063 (Nguyen and Su, 2022; I.E.A., 2022; Mperejekumana et al., 2024). Nyarko et al. (2023) identify economic constraints as the primary barrier to energy transition in SSA. Indeed, the region's low gross domestic savings rates tend to constrain the financial resources available for infrastructure investments (Falchetta et al., 2021; Evans, 2024). Without adequate domestic savings, governments have budgetary restrictions and rely heavily on foreign aid or investment. This reliance on external financing contributes to rising debt levels, leaving limited fiscal space to prioritise energy projects (Batinge et al., 2019). Moreover, the already limited financial resources are further compromised by corruption, which weakens investment capacity and undermines justice in energy transition (Amoah et al., 2020, 2022; Hamann et al., 2023).

Corruption also contributes to regulatory instability, heightening perceived risks and discouraging private sector investment (Opeyemi et al., 2019). This unfavourable investment climate has limited the development of energy infrastructure capable of meeting SSA's energy needs (Isihak, 2023). To address this, initiatives such as the Power Africa Program (2013) aim to stimulate private sector interest in the energy sector (Falchetta et al., 2021). The importance of both regional and international private sector investment is widely recognised in global efforts to expand energy access (Tadadjeu et al., 2020; Fotio et al., 2023). However, persistent challenges in cost recovery tend to discourage such investment and economic development (World Bank, 2018; Boamah et al., 2021; Garba and Bellingham, 2021).

These structural barriers underscore the need for strong policy support (Maswabi et al., 2021; Sen et al., 2025). However, the effectiveness of such policies often depends on the alignment between policy entrepreneurs and policymakers. Evidence indicates that when there is disunity of purpose or conflicting priorities among these actors, the intended outcomes of energy transition initiatives are unlikely to be realised, limiting their impact on overcoming financial, spatial, and institutional constraints (Tettey et al., 2025). Broader geopolitical dynamics, including international energy markets and donor priorities, can further shape policy implementation and resource allocation, highlighting the complex interplay between domestic governance and global political-economic forces in shaping energy transitions (Sefa-Nyarko, 2024).

While structural challenges shape the overall energy transition landscape of SSA, they also manifest at the household level, influencing the feasibility, adoption, and sustained use of low-carbon technologies. Household energy access is influenced by a complex interplay of economic and non-economic factors (Mperejekumana et al., 2024; Ukoba et al., 2024). Economic variables, such as income and affordability, influence households' capacity and willingness to adopt energy sources, while non-economic factors (e.g., education, household size, age structure and gender) also exert significant influence. Moreover, energy choices are shaped by the availability and reliability of technologies, alongside behavioural factors including cultural preferences, risk perceptions, awareness, and attitudes toward energy sources (Crentsil et al., 2019; Wassie et al., 2021a; Ngonda, 2022; Boateng et al., 2023b).

The situation where households are unable to access adequate energy services, often referred to as energy poverty, has been extensively studied (e.g., Monyei et al., 2022; Furszyfer Del Rio et al., 2023; Mukhtar et al., 2023; Wang et al., 2023). While some scholars frame energy poverty as specific to the Global South – marked by challenges of availability, affordability and quality, and distinct from fuel poverty linked to socio-economic factors (Li et al., 2014; Castaño-Rosa et al., 2019) – evidence from SSA indicates that energy access barriers are both structural and socio-economic (Boutabba et al., 2020; Adjei-Mantey et al., 2024; Tettey et al., 2025). This reinforces the view that energy poverty and fuel poverty are conceptually aligned (Bloomer and Boateng, 2024). Hence, the need for energy transition to move beyond mere availability toward sustainable and equitable solutions (Mperejekumana et al., 2024; Smarte Anekwe et al., 2024).

This is particularly important in off-grid communities, where low energy demand, high grid-extension costs, and limited economic activity restrict the feasibility and adoption of energy resources (Longe et al., 2013). However, efforts to advance the energy transition may inadvertently cause harm or exacerbate marginalisation (Stock and Sovacool, 2024). Addressing this risk requires attention to justice and inclusion. Sen et al. (2024) emphasise the critical role of justice and inclusion in shaping energy transition processes, emphasising that equitable participation is essential for achieving sustainable outcomes. Similarly, Hosan et al. (2024) note that just energy transition is positively correlated with social equity, suggesting that efforts to promote fairness and inclusivity within energy systems can simultaneously advance broader social equity objectives.

Abe and Azubike (2024) contend that fostering equity in SSA's energy transition requires meaningful engagement with stakeholders at the local level, as traditional top-down approaches often overlook local contexts and have proven inadequate in addressing energy challenges (Cloke et al., 2017; Dagnachew et al., 2020; Batidzirai et al., 2021; Jodoin et al., 2024). A shift toward decentralised and participatory decision-making is therefore required to meet the region's future energy needs (Tsoeu-Ntokoane et al., 2024). Case studies from rural Ethiopia and Mozambique demonstrate how local participation can reduce injustices and exclusions, thereby enhancing local acceptance and adoption of renewable energy technologies (Gebreslassie and Cuvilas, 2023). While these examples affirm the benefits of local participation, they also underscore the need to contextualise energy transition (Nsafon et al., 2023). Building on this, the study employed an interpretive framework which integrates energy justice, political ecology and inclusive innovation—concepts central to achieving sustainable energy transitions.

3. Interpretive framework

Although scholars often apply political ecology, energy justice, and inclusive innovation in isolation, Boateng et al. (2023a) argue that a more holistic approach (referred to as PESET in their work)—one that integrates all three—is essential for effectively addressing the complex dynamics of energy transitions in rural SSA. This is particularly relevant in contexts where simple low-carbon technologies have been introduced. Accordingly, this study adopts PESET as an interpretive framework to examine energy transition. As noted by Tricarico and De Vidovich (2021) and Rótolo et al. (2022), interpretive frameworks are essential for understanding complex phenomena and informing research and policy.

Using PESET as an interpretive framework is appropriate because low-carbon transitions in rural Ghana unfold at the intersection of technological deployment, structural arrangements, and socio-economic dynamics (Boateng et al., 2023a). PESET conceptualises energy transitions as shaped by the interaction of power relations, justice considerations, and innovation processes. Rather than treating political ecology, energy justice, and inclusive innovation as discrete lenses, the framework emphasises how these dimensions are mutually constitutive. For instance, while inclusive innovation may prioritise scalability and technological diffusion, political ecology reveals how such processes are embedded within unequal power structures, and energy justice foregrounds their implications for equity, participation, and recognition. By linking these mechanisms, the framework highlights how pursuing one dimension can create trade-offs with others—for example, rapid technology deployment may exacerbate inequities—while simultaneously producing specific social outcomes in rural Ghana, including uneven access to energy technologies and exclusion from decision-making processes. To ground this analysis, it is important to define the key concepts that form the PESET.

Energy justice mainly focuses on fairness in energy systems (Heffron, 2022). It is commonly framed around three core dimensions— distributive justice, procedural justice and recognitional justice (McCauley et al., 2013; Jenkins et al., 2016). Distributive justice addresses the equitable sharing of energy transition benefits and burdens (Jenkins et al., 2016). Procedural justice emphasises inclusive and non-discriminatory stakeholder engagement, challenging top-down decision-making (Jenkins et al., 2016; Hoesch et al., 2025). Recognition justice ensures meaningful representation, valuing diverse cultural, social and lived experiences in the transition process (Jenkins et al., 2016; van Uffelen, 2022).

Political ecology offers a critical lens for understanding energy transitions by embedding them within wider socio-political and environmental structures. It examines how processes of energy change are not merely technical or economic but are shaped by entrenched power relations and modes of environmental governance (Walker, 2005). This perspective draws attention to how political and economic interests influence the design, implementation and outcomes of energy interventions, often to the detriment of marginalised communities (Sovacool, 2021). By highlighting the spatial, institutional and socio-political dimensions of energy systems, political ecology positions energy access as a contested issue, rather than a neutral or purely developmental challenge (Tornel, 2023).

The concept of inclusive innovation further broadens the interpretive lens by critically examining whether and how low-carbon innovations are meeting the needs of rural communities. This concept is central to the study because, while simple low-carbon technologies (e.g., solar home systems and clean energy technologies) may be operationally uncomplicated, their impact depends on accessibility, affordability, and cultural appropriateness, dimensions that inclusive innovation explicitly captures (Altenburg, 2009). Heeks et al. (2014) highlight that inclusive innovation involves analysing the intent, process, structure and outcomes of innovation to determine whose needs are being addressed, whose knowledge is valued, and who ultimately benefits. Foster and Heeks (2013) and Patiño-Valencia et al. (2022) further define inclusive innovation as both a process and a product aimed at meeting the specific needs of disadvantaged groups.

4. Materials and methods

This section details the methodological approach adopted in the study, encompassing the research design, data collection methods, sampling strategy, and analytical procedures.

4.1. Research design and scope

The study employed a qualitative methodological approach. As noted by Aspers and Corte (2019), qualitative inquiry provides nuanced insights into socio-cultural contexts and interpersonal dynamics. While such methods are often criticised for being resource-intensive and for offering limited generalisability (Queirós et al., 2017), they were particularly useful in this study, enabling a holistic examination of energy transition in rural Ghana.

For the purposes of this study, energy was defined in terms of its use for cooking and lighting—central to the aims of SDG7 (United Nations, 2023a, 2023b). This operational definition reflects the dominant patterns of residential energy use in SSA (Twerefou and Abeney, 2020; Bawakyillenuo et al., 2021; Wassie et al., 2021). Low-carbon technologies deployed in rural communities are considered innovations, as they aim to address energy access challenges and are designed to be accessible, affordable, and appropriate to local needs—what Christensen et al. (2006) describe as catalytic innovations. Consequently, references to low-carbon (or clean energy) technologies in this study are situated within the broader concept of innovation.

Primary data were collected from elite local actors (e.g., District Assembly (DA) officials, local government official, chiefs, elders and opinion leaders) residing in Ghana with relevant knowledge on energy transitions, regardless of nationality. As custodians of customary law and mediators in community affairs, these actors were selected for their central role in shaping local governance and influencing decisions on resource use and development. Within energy transition contexts, they function as intermediaries between external stakeholders and local populations, facilitating the introduction and acceptance of clean energy initiatives.

4.2. Case study

A case study approach was adopted to enable a context-specific and in-depth empirical investigation (Yin, 2009; Swanborn, 2010), as applied in prior scholarly works (Sovacool et al., 2020; Todd and McCauley, 2021; Tettey et al., 2025). Although case studies are often criticised for their limited generalisability, they are particularly relevant for exploring social, political, and contextual dynamics in complex phenomena (Flyvbjerg, 2011). Rural Ghana provided a suitable case for this study, since communities are disproportionately excluded from access to clean energy sources. With ongoing efforts to enhance energy uptake in rural Ghana, the case study offers valuable insights for advancing theory and informing policy on equitable energy transitions (Energy Commission, 2023).

Within Ghana, the Kwahu Afram Plains North (KAPN) and South (KAPS) districts were purposively selected as case study areas. In these districts, rural communities have limited access to the national electricity grid and hence, rely on unclean lighting (e.g., flashlights and kerosene lamps) and cooking sources (e.g., firewood and charcoal) (Ghana Statistical Service, 2023a; 2023b). The presence of simple low-carbon technologies in the districts further offered a valuable setting for investigating adoption, inclusion and equity within the transition. Traditional actors (local government officials, chiefs, elders and opinion leaders) participating in the study came from the following off-grid communities in the districts—Ayebeng, Aduonum, Adukrom, Abotanso Number 1, Asimpanyin, Mmradan, Kwasi Addae, Apesika, Sawua and Sodzikope (Fig. 1).

4.3. Data sampling and instruments

Participants were initially selected through purposive sampling informed by desk research to ensure inclusion of actors with relevant knowledge (Campbell et al., 2020). This was complemented by snowball sampling, whereby participants recommended additional actors. While the snowballing approach is criticised for its selection bias, it enabled the identification of other local actors who were not formally documented (Etikan, 2016; Parker et al., 2019). Initial interviews were conducted with DAs, the highest political authorities at the local level (Ayee, 2003), to capture their perspectives and identify key traditional actors. Based on the DAs' recommendations, traditional actors were recruited, who then suggested additional participants. The diverse sample, encompassing participants from different communities and institutional backgrounds, enabled the inclusion of varied perspectives that captured the complex dynamics shaping energy transitions.

Data collection continued until saturation was reached, an approach commonly applied in qualitative research. The data saturation model justifies sample size based on the point at which additional interviews no

Fig. 1. Map of Ghana showing the study districts and communities of KIs; based on Environmental Systems Research Institute (ESRI) shapefiles, using ArcGIS 10.8.

longer generate new insights or themes (Guest et al., 2006; Francis et al., 2010; Saunders et al., 2018). Data saturation was therefore approached as a gradual process of diminishing returns rather than a distinct point of completion. The adequacy and richness of the collected data were continually assessed to determine when saturation was achieved. A code frequency approach was employed, tracking the number of new codes identified after each round of data collection.

Saturation was considered reached after the 43rd interview, when no new codes emerged and redundancy was observed (Braun and Clarke, 2021). While small samples of 6–12 interviews may suffice for homogeneous populations or narrowly defined questions, larger samples are recommended for heterogeneous populations and complex, multidimensional phenomena, such as energy transitions (Guest et al., 2006). Malterud et al. (2016) emphasise that qualitative research should prioritise the informational contribution of participants rather than sheer numerical size. Similarly, Sovacool et al. (2018) emphasise that the nature and scope of the research question play a central role in determining an appropriate sample size. Accordingly, a total of 43 interviews was deemed sufficient to comprehensively examine energy transition in rural Ghana (Table 1).

A semi-structured interview format was used to gather information from interviewees. This ensured that interview questions aligned with the research focus, while providing flexibility for probing and follow-up questions to explore contextual nuances (Brinkmann, 2014; Husband, 2020). An interview guide was used to steer discussions around key themes, including energy access challenges, and exclusions and injustices within transitions. The guide provided a flexible structure that ensured consistency across interviews. Interviews were held in participants' homes or offices and conducted primarily in a local dialect (Twi[3]).

Table 1
Demographic characteristics of KIs.

Variables	Category	Number of participants (N = 43)
Gender	Male	27
	Female	16
Age	31-40 years	12
	41-50 years	22
	51-60 years	7
	>61 years	2
Status	District Assembly officials	5
	Local Government official	3
	Chiefs	8
	Elders and opinion leaders	27
Size of household	<3	4
	3-5	14
	6-8	25
Education	Never schooled	11
	Basic	20
	Secondary	6
	Tertiary	6

4.4. Research ethics

Ethical considerations were carefully addressed in consultation with the Mary Immaculate Research Ethics Committee (Reference number "A22-050"). Informed consent, either written or oral, was obtained from participants prior to interviews, confirming their voluntary participation and confidentiality (Denscombe, 2017). This was done after interviewees were introduced to the study using a Participant Information Sheet (PIS). The PIS outlined the purpose, scope and procedures of the research (Pacho, 2015). With the consent of participants, audio records and field notes were taken. Audio recordings were securely stored on a

[3] The first author is from Ghana and is fluent in the Twi Language.

password-protected laptop and field notes were kept securely to prevent unauthorised access. To ensure anonymity, identifier codes were used during data analysis.

4.5. Application of PESET framework and data analysis

All interviews were transcribed to ensure accuracy and completeness. Each 30-min recording required approximately 5 h for full transcription. The analysis proceeded through a reflexive thematic approach. This method was selected due to its flexibility and data-driven nature (Campbell et al., 2021). First, transcripts were subjected to initial inductive coding, during which recurring concepts were identified. Second, the PESET framework was operationalised to structure the analysis. Each code was explicitly mapped onto PESET's core concepts.

- Political ecology: Captured the barriers to adoption and underlying power asymmetries that shape energy transition.
- Inclusive innovation: Identified the extent of participation of local stakeholders in low-carbon transitions.
- Energy justice: Captured the costs of transition, and the forms of exclusion in the transition process.

Third, themes were developed through iterative refinement of framework-informed codes to capture clean energy transition in rural Ghana. Finally, validation was done through peer debriefing and cross-comparison across KI groups to enhance analytical rigor and credibility. This process ensured that the identified themes were grounded in the data and accurately reflected perspectives. All five authors collaboratively conducted the process, which involved familiarisation, coding, theme development, reviewing themes, defining and naming themes, and reporting (Braun and Clarke, 2022).

This study relies primarily on qualitative interviews, which capture local experiences shaped by broader structural conditions. The analysis therefore situates these micro-level narratives within macroeconomic trends—such as inflation, currency depreciation, and electricity tariff adjustments in Ghana—to show how such structural factors are experienced at the local level, without treating participants' accounts as direct evidence of macroeconomic dynamics. In reporting the findings, the results were compared with existing literature while some interview excerpts were included to provide contextual depth to the findings (Eldh et al., 2020; Olagoke et al., 2024). The selection of excerpts was informed by the authors' expert judgement regarding their relevance to the study's objectives and analytical focus (Hjeij et al., 2023). Fig. 2 illustrates the research procedure, providing a visual representation of the methodological flow.

4.6. Assumptions and limitations

The study focuses on rural Ghana and selected KIs, assuming they possess sufficient knowledge to reflect the dynamics of rural energy transitions. It further assumes that the PESET, as an interpretive framework, captures the primary barriers, forms of exclusion, and dimensions of energy injustice. KI interviews are also assumed to provide reliable and representative insights. While providing rich qualitative insights, the methodology is limited as the data collection is limited to the rural Ghanaian context. Interviewees' responses may also be influenced by recall and social desirability biases. PESET offers a comprehensive analytical lens; however, it may not encompass all factors shaping energy adoption. Finally, despite careful implementation of thematic analysis and validation procedures, interpretation of qualitative data inherently involved authors' reflexivity.

5. Results and discussion

District-level data highlight rural–urban disparities in electricity and cooking fuel use in the KAPN and KAPS districts. In KAPN, 42% of

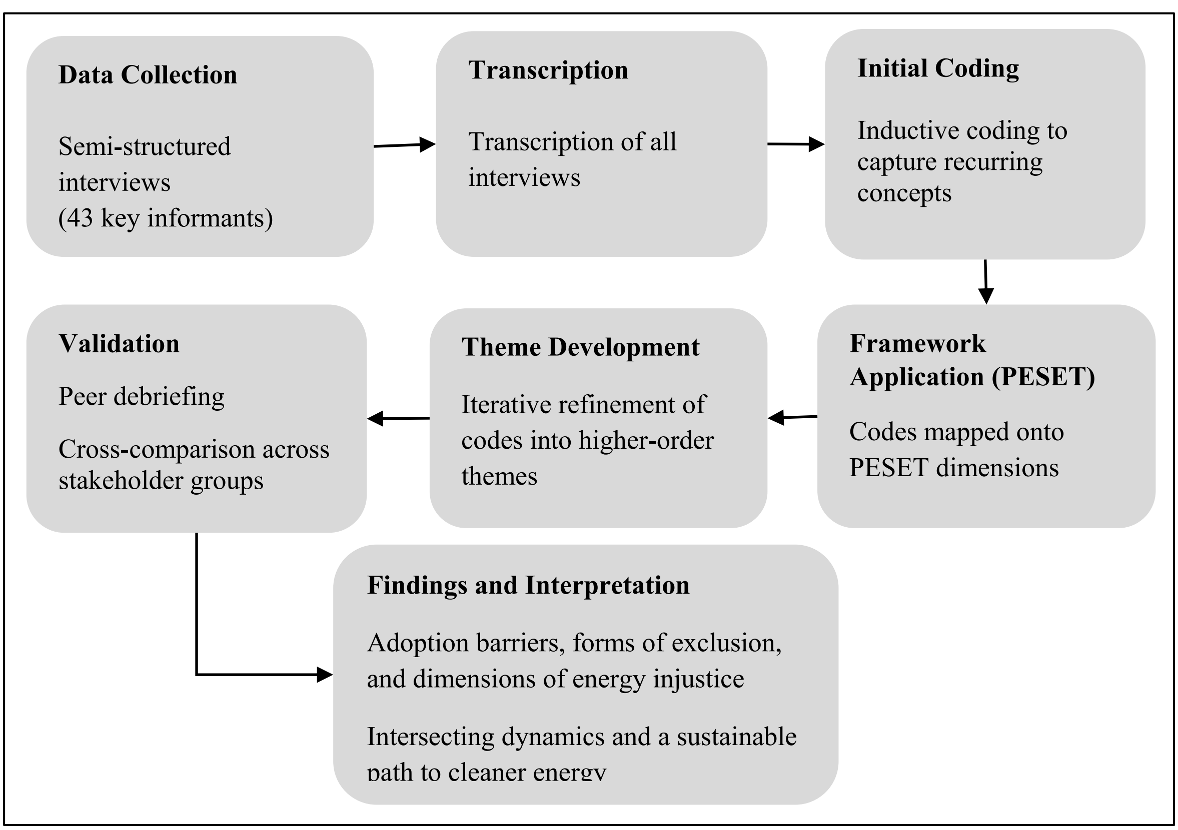

Fig. 2. Overview of the research process.

households rely on flashlights/torches and 28% on kerosene lamps, while urban households have 70% grid access compared to 18% in rural areas. In KAPS, flashlights/torches (46%) and kerosene lamps (27%) dominate, with grid access of 68% in urban areas versus 9% in rural areas (Ghana Statistical Service, 2023). Firewood is the principal cooking fuel in both districts, particularly in rural communities (85% in KAPN, 71% in KAPS), with LPG and electricity limited to a minority of urban households (Ghana Statistical Service, 2014a, 2014b). Qualitative interviews confirmed these disparities. KIs emphasised that limited grid access in rural areas compels households to rely heavily on unclean energy sources for lighting and cooking, despite the associated safety and health risks. These findings illustrate how structural inequalities, such as uneven infrastructure development, shape energy choices and contribute to disparities in access (Karakara and Osabuohien, 2020).

While interviewees acknowledged the introduction of clean energy technologies in their communities, they identified persistent challenges that need to be addressed to promote sustainable transition. Table 2 presents a summary of these challenges (key themes) emerging from interviews.

5.1. Barriers to clean energy adoption

In line with Sovacool and Brisbois (2019), Agyarko et al. (2020), Carley and Konisky (2020) and Chen et al. (2024), the findings affirm that energy transitions are not solely technological processes but are shaped by multiple interrelated factors. These dynamics manifest as practical barriers to the uptake of cleaner solutions. The key barriers to clean energy technology adoption identified in rural Ghana are discussed in this section.

Table 2
Challenges of the energy transition interpreted through PESET framework.

Challenges	Factors (Themes)	Empirical evidence	PESET implication
Adoption barriers	Cost	Limited income and high upfront costs	Economic exclusion and unequal distribution of capital between urban and rural areas
	Availability	Unavailability of clean technologies in rural areas	Political marginalisation due to urban-focused planning and investment
	Behavioural factors	Long-standing reliance on traditional energy sources	Historical neglect of rural energy infrastructure, reinforcing social and technological lock-in
	Limited awareness	Inadequate information on the full benefits of transition	Top-down outreach leading to uneven engagement and selective prioritisation of messages
Exclusions	Process	Limited household involvement in technology design	Constrained local agency resulting from centralised decision-making
	Consumption	Uneven adoption of clean energy technologies	Inequality driven by high upfront costs and profit-oriented delivery models
	Impact	Energy projects yield limited or uneven livelihood benefits	Social inequity reflected in uneven transition outcomes and limited local benefits
	Structure	Transition strategies insufficiently reflect local needs and practices	Technocratic planning coupled with weak institutional inclusion
Injustices	Distributive	Benefits and opportunities are unevenly allocated	Spatial and economic disparities in allocation of energy benefits and resources
	Recognition	Marginalised groups are overlooked in project engagement	Power asymmetries causing selective recognition
	Procedural	Limited meaningful participation in decision-making	Weak participatory governance resulting in limited local influence in decision-making

The findings reveal the critical role of location in shaping patterns of energy deprivation, reinforcing observations by Karakara and Osabuohien (2020) that spatial disparities significantly determine access to energy. As noted by Asante et al. (2018), limited access and inconsistent supply chains restrict technology availability and complicate investment planning. This reflects Ghana's distressed economic conditions (International Monetary Fund, 2025) that hinder the development of local renewable energy markets and the scaling of initiatives (Pueyo, 2018; Owusu-Manu et al., 2021). These infrastructural and economic barriers disproportionately affect rural and geographically remote communities, entrenching multidimensional energy poverty (Nuru et al., 2021; Sovacool et al., 2022). Consequently, this constrains households that are willing and able to invest in clean solutions. One opinion leader noted:

> *"Some households, like mine, would like to use LPG for cooking. However, there are no gas stations close to the community to fill gas cylinders. It will therefore inconvenience us to use LPG"* – (KI 35, December 2022).

Even when low-carbon technologies are available, cost was identified as a significant barrier to adoption, reflecting a persistent challenge across SSA (Twumasi et al., 2022; Adams et al., 2023). Limited incomes, high upfront costs, and unavailability of clean technologies—particularly solar systems—restrict accessibility, while some private providers prioritise profit, further exacerbating inequities (Osório, 2023; Boateng, 2025). To illustrate this, an opinion leader expressed that:

> *"Households will need to install a solar home system of high capacity to meet their lighting needs. However, many are unable to afford this kind of technology due to their low incomes. Hence, a significant number of households rely on non-rechargeable battery-powered torchlights"* – (KI 9, September 2022).

Underlying these micro-level constraints are structural economic pressures (Pueyo, 2018; Gill-Wiehl et al., 2021; Streimikiene, 2022). In an import-dependent economy like Ghana, currency volatility and debt pressures amplify exposure to global price fluctuations, directly influencing project viability (Omokaro et al., 2025). For example, the Ghana cedi depreciated by 29.9% against the US dollar in 2022, following a 4.1% depreciation in 2021, and by 27.8% in 2023 (Bank of Ghana, 2022, 2024). According to Yazdanie et al. (2024), this sustained depreciation has implications for local energy system planning, illustrating how local experiences reflect broader macroeconomic pressures. Import duties, VAT, and related statutory levies applied to clean technologies—including the National Health Insurance Levy and GETFund Levy—further increase financial burdens for investors and consumers, reducing the competitiveness of renewable energy relative to conventional alternatives (Sakah et al., 2017; Mahama et al., 2021; Nuhu and Bukari, 2021; Bruce, 2023; Yazdanie et al., 2024).

In line with Streimikiene et al. (2021), behavioural factors also emerged as a barrier to adoption. Interviews indicated that cultural and long-standing reliance on traditional energy sources influenced energy decisions. According to the KIs, such entrenched energy-use practices make it difficult for households to transition exclusively to clean energy solutions, even when these are available. This dependence reveals not merely a matter of preference but the embeddedness of energy practices within local livelihoods and social norms. For instance, the continued reliance on woodfuel—due to its reliability and accessibility—reinforces these practices and discourages a shift to cleaner energy alternatives (Boateng et al., 2023b). During interviews with a chief and DA officer, they stated that:

> *"Households prefer to use woodfuel for cooking. This is the energy source they have been exposed to for years. It is a very dependable energy source for cooking staple foods and gives good taste to certain kinds of food, compared to the use of LPG for cooking"* – (KI 38, December 2022).

"Many households are willing to shift to the use of clean energy technologies. However, the provided technologies should be readily available, reliable and adequate to enhance their exclusive use" – (KI 8, January 2023).

The preference for woodfuel reflects its reliability in meeting daily energy needs (Jodoin et al., 2024), indicating that continued use is not merely due to behavioural resistance but a pragmatic response to historical neglect within Ghana's energy system that restrict the adoption of cleaner alternatives (Kyere et al., 2024).

Limited environmental awareness and insufficient knowledge of clean energy technologies constituted significant barriers to adoption, corroborating earlier findings that link information deficits to low uptake of clean energy solutions (Hassan et al., 2014; Adjei-Mantey et al., 2024). Interviewees noted that communication strategies employed by clean technology providers often fail to reach remote communities or effectively convey their adoption benefits (Boateng et al., 2025a; Velasco-Herrejón and Bauwens, 2024). A local government officer and an opinion leader expressed how actors often focused on the socio-economic benefits of clean energy solutions, with little emphasis on the environmental benefits therewith:

"Clean energy technologies are deployed in this community to meet the energy needs of households, especially as we are marginalised in terms of access" – (KI 2, January 2023).

"Whenever clean energy technology providers visit the community to sell their products, they tell us the economic and health benefits of investing in them, with less emphasis on the environmental benefits" – (KI 27, December 2022).

The findings demonstrate that knowledge gaps in rural Ghana are not merely the result of individual-level awareness deficits but are produced through systemic inequities in information dissemination. The prevailing communication strategies that emphasise immediate economic savings and health benefits rather than environmental sustainability objectives narrow public understanding of clean energy to short-term gains, potentially limiting broader environmental engagement (Adjakloe et al., 2021a, 2021b; Boateng et al., 2025b). According to the KIs, households with limited access to comprehensive information, face greater barriers to engaging with clean energy initiatives, contributing to uneven participation in Ghana's energy transition.

5.2. Exclusions and injustices in energy transition

The study further explored issues of fairness in transitions, recognising justice and inclusion as central to its sustainability (Levidow and Papaioannou, 2018; Bishoge et al., 2020; Tarekegne, 2020; Antwi and Ley, 2021; Smith et al., 2023). The findings revealed that inclusion in energy interventions is uneven and often contingent on socio-political power, with some communities systematically overlooked due to their limited influence or representation (Fig. 3).

This pattern aligns with studies showing that energy decision-making frequently privileges actors and locations with greater political and economic leverage (Jenkins et al., 2016; van der Horst et al., 2021; Domegni and Azouma, 2022). In Ghana, electrification priorities and resource allocation are shaped through administrative discretion and political hierarchies, which determine which communities receive investment (Briggs, 2012; Abubakari, 2025). The exclusion of certain communities perceived as politically and economically weak constitutes recognition injustice, as their legitimacy and perspectives are undervalued, and simultaneously produces procedural injustice by excluding them from the decision-making processes.

Selective electrification also reflects macroeconomic constraints. Limited fiscal space encourages investment in politically visible or economically strategic areas, thereby reproducing spatial inequalities in energy access and constraining the implementation of programmes such as NES, SREP and REMP (Bukari et al., 2021; Arthur et al., 2025; Nyarko et al., 2025). Contrary to Brass et al. (2019), evidence from this study suggests that the exclusion of certain communities has contributed to electoral apathy, revealing how distributive injustice shapes not only energy access but also patterns of political participation. A DA officer and a chief noted:

"Generally, there are limited clean energy interventions being implemented in off-grid rural communities within the district. While stakeholders have made efforts to improve access, significant gaps persist" – (KI 6, November 2022).

Fig. 3. A local community shows its commitment to electrification by erecting an electric pole; however, it remains unconnected to the national grid.

> *"Community members have been made to erect electric poles but have yet been connected to the grid. Other communities have been connected within this period, but national actors have failed to fulfil their promise – to connect us to the grid"* – (KI 40, November 2022).

Certain transition strategies were found to be designed by and tend to favour dominant groups, reinforcing existing power imbalances (Ojong, 2021). Interviewees noted that their perspectives were rarely sought in the transition process, particularly in relation to the design of clean technologies. While direct involvement in technological design is often constrained by the fact that many technologies are imported (Mahama et al., 2021), their input remains crucial during implementation— as they serve as government representatives at the district level (DAs) and as representatives of rural communities (traditional actors) (Aasoglenang et al., 2025). Yet, their perspectives were seldom incorporated during the project implementation phase.

This implies a technocratic orientation in Ghana's energy transition, where decisions are driven primarily by technical expertise and externally developed technologies rather than by local knowledge and contextual needs. The limited engagement of local actors in the implementation phase further suggests that decision-making authority remains concentrated among influential actors at the national level, highlighting a top-down governance structure. As Owusu (2016) notes, such centralised decision-making is embedded in Ghana's planning culture and historical governance practices. This represents structural exclusion, as transition strategies fail to systematically incorporate local perspectives, rendering them largely invisible in shaping the design and discourse of transition initiatives (Sengupta, 2016; Lennon et al., 2019; Ikejemba and Schuur, 2020).

Some KIs noted how the distribution of free solar technologies in their communities privileged individuals with significant local power, as allocation decisions were often mediated through local authorities and networks rather than transparent eligibility criteria. This practice enabled politically connected actors to secure access ahead of more vulnerable households. As two opinion leaders explained:

> *"Some stakeholders have distributed solar home systems to some prominent members of the community, such as traditional and political leaders. I do not know the criteria they used in the selection of such beneficiaries"* – (KI 10, December 2022)

> *"The stakeholders that provided these clean energy solutions could not supply every household with the technologies. I did not ask why I was selected as a beneficiary, but I guess it is because of my status in the community"* – (KI 37, November 2022).

This suggests that once transition programmes reach communities, access may be mediated by local elites. Just as politics shape energy transition processes at the national level (Pedersen and Poncian, 2024; Tettey et al., 2025), political connections similarly influence the distribution of benefits at the local level. Such practices risk producing elite capture, whereby transition benefits are appropriated by politically connected individuals, reinforcing existing hierarchies and producing distributive injustice within communities.

Interviewees described a pattern of hybrid energy use, in which clean technologies are combined with long-standing traditional sources (Karakara and Osabuohien, 2020). They indicated that, where affordability challenges, supply unreliability, or limited system capacity persist, clean technologies are often integrated as complementary rather than substitutive solutions (Tsoeu-Ntokoane et al., 2025). In this context, reliance on multiple energy sources reflects an adaptive response to structural constraints within the energy system. This hybridisation indicates that the impacts of energy transitions— often portrayed as universally beneficial— are uneven in practice and may produce intended and unintended forms of marginalisation (Stock and Sovacool, 2024).

The findings further reveal that energy transitions disrupt local economies, leading to job losses (Bartiaux et al., 2019; Boateng et al., 2025a). In particular, individuals whose livelihoods depend on woodfuel production and trade face heightened economic vulnerability as demand shifts toward alternative energy sources. The KIs also noted that the initial acquisition cost of clean technologies and recurring fuel costs can strain already limited household resources and compete with other essential expenditures, such as food, healthcare and education. Some opinion leaders emphasised that:

> *"Even though a transition to liquefied petroleum gas (LPG) will be beneficial in meeting the cooking needs of households, it can result in a reduction of incomes as well. A significant number of households heavily rely on the production and sale of charcoal. A shift to clean alternatives will mean a reduction in incomes for such households"* – (KI 23, October 2022).

> *"The use of LPG entails significant financial implications. Beyond the initial acquisition cost, the expenses associated with its use can place additional strain on my household finances, potentially hindering the ability to meet other essential needs"* – (KI 22, October 2022).

Thus, while the benefits of energy transition accrue to specific actors, including technology providers and politically connected individuals, the associated costs are disproportionately borne by vulnerable populations. This reflects patterns of exclusion (consumption and impacts) and injustice (distributive) in the transition process. It illustrates how transition processes can reallocate economic risks downward, reinforcing rather than alleviating existing inequalities (Jodoin et al., 2024).

Overall, the findings indicate that energy transition in rural Ghana is associated with intersecting forms of injustices (distributive, recognition and procedural) and exclusions (in terms of process, consumption, impact and structure), consistent with Sovacool (2021) and Akrofi et al. (2024). This situation can cause distrust and disconnection from transition initiatives, potentially undermining Ghana's progress toward SDG 7. When communities perceive transition initiatives as externally imposed or politically mediated, their willingness to engage with and invest in new technologies declines (Brent and Rogers, 2010). These findings therefore underscore that achieving a just and inclusive energy transition requires confronting the structural foundations of exclusion, rather than focusing solely on expanding access to clean technologies (Ahlborg and Sjöstedt, 2015; Mulvaney, 2020; Velasco-Herrejón et al., 2023; Sodoke et al., 2026).

5.3. A sustainable path to energy transition in Ghana

In a debt-distressed economy undergoing macroeconomic stabilisation like Ghana (International Monetary Fund, 2025), leapfrogging to clean energy in rural communities can be most effectively achieved through the deployment of simple low-carbon technologies (e.g., solar home systems and clean cookstoves), rather than capital-intensive infrastructure. Extending the national grid to remote communities through initiatives such as REMP and NES entails substantial infrastructure costs, making it difficult to justify under constrained public finances (Kemausuor et al., 2014). By contrast, off-grid technologies require relatively modest investment, can be deployed incrementally, and avoid long-term state obligations related to transmission losses (Abdul-Salam and Phimister, 2016; Kumi, 2017).

Yet technological substitution alone is insufficient for a sustained and equitable transition. The analyses demonstrate how macroeconomic constraints create downstream effects across institutional arrangements and market dynamics to shape local participation and distributional outcomes. At the macro-economic level, fiscal constraints and sovereign debt pressures shape national energy priorities, concentrating decision-making authority within central institutions and directing investment toward commercially viable or politically strategic sectors. At the institutional and market level, administrative discretion in project siting and profit-oriented delivery models structure access, while political connections and personal relationships influence beneficiary selection.

At the local level, these dynamics produce uneven adoption, hybrid energy use, and differentiated access to transition benefits, often resulting in unstable transitions. Consequently, although some individuals adopt clean technologies despite existing constraints, such transitions are often unsustainable and prone to reversal to familiar but harmful energy sources (Herington and Malakar, 2016; Boateng et al., 2025a). An equitable pathway (Fig. 4.) therefore requires reforms that realign and integrate the interconnected systems of governance, finance, and regulation to support just transitions (Baker et al., 2021; Osório, 2023; Akrofi et al., 2024; Boateng, 2025; Bruku, 2025).

The empirical evidence shows that local actors are often overlooked in energy transitions, limiting the extent to which their decisions influence project design, allocation, and implementation. This reflects a broader structural problem of insufficient participation in governance processes. Addressing this requires decentralised and participatory governance mechanisms, where local input is actively integrated at all stages. This can ensure that diverse perspectives—especially those of marginalised groups—are considered, reducing the risk of elite capture and improving the alignment of transition strategies with local needs (Bazilian et al., 2014; Barra and Falcone, 2024b; Hosan et al., 2024b; Tettey et al., 2025).

The findings also indicate that the adoption of clean energy technologies is constrained by limited income, high costs and low availability of technologies, and potential livelihood losses associated with energy transitions. These barriers reduce the willingness or ability of rural households to shift from traditional energy sources, limiting uptake and impact. Affordability, access, and livelihood risk thus emerge as central obstacles shaped by household economic dependencies and decision-making. Effective responses involve financial strategies that lower costs, expand technology availability, and mitigate livelihood risks—through targeted subsidies, public–private partnerships, and support for those reliant on traditional energy (Maswabi et al., 2021; Awuku et al., 2022; IRENA, 2024).

The field evidence further shows that energy interventions often disproportionately benefit a small and well-positioned group, leaving marginalised actors underrepresented and reinforcing existing inequalities. This phenomenon—elite capture—is exacerbated by vague eligibility criteria and weak monitoring, allowing resources to be concentrated among a few. Mitigating this requires reforms that establish explicit beneficiary criteria, support community-based energy initiatives to broaden participation, and implement robust oversight mechanisms, thereby reducing elite capture and promoting a more equitable distribution of benefits (Antwi and Ley, 2021; Bloem et al., 2021; Coy et al., 2021; Rowan et al., 2024; Baldelli et al., 2025).

These realignments underscore the role of multi-level actors—from national institutions to local communities—in shaping transition outcomes. National governments establish the policy, regulatory, and financing frameworks that guide transition pathways, while subnational authorities facilitate decentralised planning, implementation, and beneficiary identification. Market actors, support supply chains, infrastructure deployment, and service delivery. At the community level, actors influence adoption decisions, enable participation, and sustain locally embedded ownership models. Coordinated interaction among these actors is therefore essential for achieving an equitable energy transition, particularly in contexts where structural conditions and local dynamics intersect to shape access and uptake (Evensen and Stedman, 2016; Caprotti et al., 2020; Irfan et al., 2021).

6. Conclusion

Using the PESET framework, this study examines how energy transition unfolds in rural Ghana. The findings reveal three interrelated mechanisms through which technological leapfrogging reproduces inequality. First, affordability constraints systematically exclude lower-income households, limiting access to those with greater purchasing power. Second, delivery models prioritise commercially viable locations and users, resulting in uneven spatial distribution of technologies. Third, discretionary beneficiary selection processes—often mediated by local authorities—favour socially and politically connected actors, reinforcing existing hierarchies (Domegni and Azouma, 2022; Adams et al., 2023). Achieving an equitable transition therefore requires addressing these embedded exclusions through multi-level actor engagement, rather than relying on technology provision alone (Caprotti et al., 2020; Irfan et al., 2021; Boateng et al., 2023b).

While the findings may offer insights for other SSA contexts, they should be interpreted with caution due to contextual dynamics (Tachega

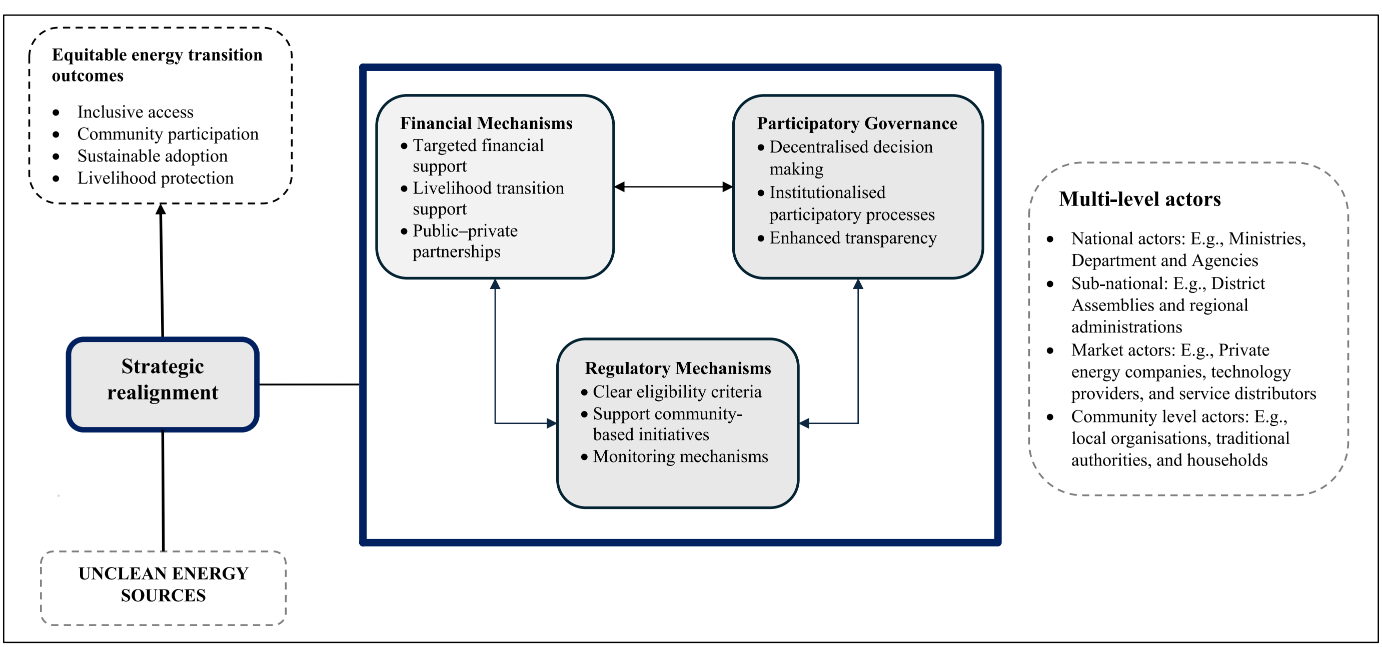

Fig. 4. An equitable path to sustainable energy transitions in rural Ghana.
Note: Elements within the grey "strategic alignment" box are drawn from interview data, whereas dashed boxes represent concepts informed by existing literature, notably Boateng et al. (2025a).

et al., 2025). This study is limited by its focus on Ghana and its reliance on qualitative interviews, which may not capture broader quantitative patterns or fully account for macroeconomic influences on energy transitions. Additionally, the sample is restricted to local government and traditional authority actors, excluding direct perspectives from community members and potentially limiting individual household-level experiences. Future research could address these limitations through comparative cross-country analyses, greater incorporation of macroeconomic factors, expanded community representation, and the integration of quantitative data to enhance empirical robustness.

CRediT authorship contribution statement

Dickson Boateng: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Breffní Lennon:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization. **Julian Bloomer:** Writing – review & editing, Supervision, Methodology, Conceptualization. **John Morrissey:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Niall P. Dunphy:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

References

Aasoglenang, T.A., Bonye, S.Z., Asante, W.K., 2025. Local governance enhancement mechanisms in Ghana: theoretical and practical reflection on representation, voice and information-flow within district assemblies in Ghana. SN Soc. Sci. 5 (8), 106. https://doi.org/10.1007/s43545-025-01135-4.

Abbas, K., Li, S., Xu, D., Baz, K., Rakhmetova, A., 2020. Do socioeconomic factors determine household multidimensional energy poverty? Empirical evidence from South Asia. Energy Policy 146, 111754. https://doi.org/10.1016/j.enpol.2020.111754.

Abdul-Salam, Y., Phimister, E., 2016. The politico-economics of electricity planning in developing countries: a case study of Ghana. Energy Policy 88, 299–309. https://doi.org/10.1016/j.enpol.2015.10.036.

Abe, O., Azubike, V., 2024. (Re) examining the intersection between energy justice and energy transition in Africa. J. Energy Nat. Resour. Law 42 (3), 279–299. https://doi.org/10.1080/02646811.2024.2356988.

Abrefa Busia, K., Adjei, P.O.-W., 2022. Changing role of traditional authorities in local governance and development in Ghana. In: Adjei, P.O.-W., Adu-Gyamfi, S. (Eds.), Democratic Decentralization, Local Governance and Sustainable Development: Ghana's Experiences for Policy and Practice in Developing Countries. Springer International Publishing, Cham, pp. 241–257. https://doi.org/10.1007/978-3-031-12378-8_14.

Abubakari, A.B., 2025. The political economy of mini-grids in Ghana. Policy Ambitions Versus the Realities of Implementation (No. 2025: 04). DIIS Working Paper.

Adams, A., Jumpah, E.T., Dramani, H.S., 2023. Dynamics of clean and sustainable households' energy technologies in developing countries: the case of improved cookstoves in Ghana. Sustain. Futures 5, 100108. https://doi.org/10.1016/j.sftr.2023.100108.

Adjakloe, Y.D., Boateng, E.N., Osei, S.A., Agyapong, F., 2021a. Gender and households' choice of clean energy: a case of the cape Coast Metropolis, Ghana. Soc. Sci. Humanit. Open 4 (1), 100227. https://doi.org/10.1016/j.ssaho.2021.100227.

Adjakloe, Y.D.A., Osei, S.A., Boateng, E.N.K., Agyapong, F., Koranteng, C., Baidoo, A.N.A., 2021b. Household's awareness and willingness to use renewable energy: a study of Cape Coast Metropolis, Ghana. Int. J. Sustain. Energy 40, 430–447. https://doi.org/10.1080/14786451.2020.1807551.

Adjei Baffour, A., 2025. Local government and climate literacy: exploring community perspectives in Ghana's coastal zones. Clim. Policy 1–14. https://doi.org/10.1080/14693062.2025.2566938, 0.

Adjei-Mantey, K., Inglesi-Lotz, R., Amoah, A., 2024. Environmental consciousness and household energy poverty in Ghana. Glob. Environ. Change 88, 102896. https://doi.org/10.1016/j.gloenvcha.2024.102896.

Afful-Dadzie, A., Mensah, S.K., Afful-Dadzie, E., 2022. Ghana renewable energy master plan: the benefits of private sector participation. Sci. Afr. 17, e01353. https://doi.org/10.1016/j.sciaf.2022.e01353.

African Development Bank, 2023. Annual Development Effectiveness Review 2023, Light up and Power Africa. African Development Bank.

Agyarko, K.A., Opoku, R., Van Buskirk, R., 2020. Removing barriers and promoting demand-side energy efficiency in households in Sub-Saharan Africa: a case study in Ghana. Energy Policy 137, 111149. https://doi.org/10.1016/j.enpol.2019.111149.

Ahlborg, H., Sjöstedt, M., 2015. Small-scale hydropower in Africa: socio-technical designs for renewable energy in Tanzanian villages. Energy Res. Social Sci. 5, 20–33. https://doi.org/10.1016/j.erss.2014.12.017.

Akrofi, M.M., McLellan, B.C., Okitasari, M., 2024. Characterizing 'injustices' in clean energy transitions in Africa. Energy Sustain. Dev. 83, 101546. https://doi.org/10.1016/j.esd.2024.101546.

Alola, A.A., 2024. Global urbanization and ruralization lessons of clean energy access gap. Energy Policy 188. https://doi.org/10.1016/j.enpol.2024.114101.

Altenburg, T., 2009. Building inclusive innovation systems in developing countries: challenges for IS research. In: Handbook of Innovation Systems and Developing Countries. Edward Elgar Publishing.

Amoah, A., Asiama, R.K., Korle, K., Kwablah, E., 2022. Corruption: is it a bane to renewable energy consumption in Africa? Energy Policy 163, 112854. https://doi.org/10.1016/j.enpol.2022.112854.

Amoah, A., Kwablah, E., Korle, K., Offei, D., 2020. Renewable energy consumption in Africa: the role of economic well-being and economic freedom. Energy, Sustainability and Society 10, 1–17. https://doi.org/10.1186/s13705-020-00264-3.

Antwi, S.H., Ley, D., 2021. Renewable energy project implementation in Africa: ensuring sustainability through community acceptability. Sci. Afr. 11, 00679. https://doi.org/10.1016/j.sciaf.2020.e00679.

Apergi, M., Eicke, L., Goldthau, A., Hashem, M., Huneeus, S., Oliveira, R.L., Otieno, M., Schuch, E., Veit, K., 2024. An energy justice index for the energy transition in the global South. Renew. Sustain. Energy Rev. 192, 114238. https://doi.org/10.1016/j.rser.2023.114238.

Arthur, J.L., Kporha, D.C.E., Arthur, S.D., 2025. Rural electrification as a catalyst for sustainable development. Discov. Environ. 3 (1), 1–22. https://doi.org/10.1007/s44274-025-00225-7.

Asante, K.P., Afari-Asiedu, S., Abdulai, M.A., Dalaba, M.A., Carrión, D., Dickinson, K.L., Abeka, A.N., Sarpong, K., Jack, D.W., 2018. Ghana's rural liquefied petroleum gas program scale up: a case study. Energy Sustain. Dev. 46, 94–102. https://doi.org/10.1016/j.esd.2018.06.010.

Aspers, P., Corte, U., 2019. What is qualitative in qualitative research. Qual. Sociol. 42, 139–160. https://doi.org/10.1007/s11133-019-9413-7.

Avila, N., Carvallo, J.P., Shaw, B., Kammen, D.M., 2017. The Energy Challenge in Sub-saharan Africa: a Guide for Advocates and Policy Makers: Generating Energy for Sustainable and Equitable Development. Oxfam, pp. 1–79.

Awuku, S.A., Bennadji, A., Muhammad-Sukki, F., Sellami, N., 2022. Public-private partnership in Ghana's solar energy industry: the history, current state, challenges, prospects and theoretical perspective. Energy Nexus 6, 100058. https://doi.org/10.1016/j.nexus.2022.100058.

Axon, S., Morrissey, J., 2020. Just energy transitions? Social inequities, vulnerabilities and unintended consequences. Build. Cities 1. https://doi.org/10.5334/bc.14.

Ayee, J.R.A., 2003. Local government, decentralization and state capacity in Ghana. In: Critical Perspectives on Politics and Socio-Economic Development in Ghana. Brill. https://doi.org/10.1163/9789047402169_008.

Baker, E., Nock, D., Levin, T., Atarah, S.A., Afful-Dadzie, A., Dodoo-Arhin, D., Ndikumana, L., Shittu, E., Muchapondwa, E., Sackey, C.V.H., 2021. Who is marginalized in energy justice? Amplifying community leader perspectives of energy transitions in Ghana. Energy Res. Social Sci. 73, 101933. https://doi.org/10.1016/j.erss.2021.101933.

Baldelli, M., Mattera, M., Renou-Wilson, F., 2025. From awareness to action: a study of capacity-building engagement techniques for fostering climate-adaptive behaviours in citizens. Eur. J. Educ. 60, e70056. https://doi.org/10.1111/ejed.70056.

Bank of Ghana, 2022. 2022 annual report & financial statements of the bank of Ghana. https://www.bog.gov.gh/news/2022-annual-report-financial-statements-of-the-bank-of-ghana/.

Bank of Ghana, 2024. Bank of Ghana monetary policy report. https://www.bog.gov.gh/wp-content/uploads/2024/03/Monetary-Policy-Report-January-2024.pdf.

Barra, C., Falcone, P.M., 2024a. Unraveling the impact of economic policy uncertainty on environmental efficiency: how do institutional quality and political orientation matter? Econ. Polit. 36, 1450–1490. https://doi.org/10.1111/ecpo.12297.

Barra, C., Falcone, P.M., 2024b. Environmental performance of countries. Examining the effect of diverse institutional factors in a metafrontier approach. Soc. Econ. Plann. Sci. 95, 101972. https://doi.org/10.1016/j.seps.2024.101972.

Bartiaux, F., Maretti, M., Cartone, A., Biermann, P., Krasteva, V., 2019. Sustainable energy transitions and social inequalities in energy access: a relational comparison of capabilities in three European countries. Global Trans. 1, 226–240. https://doi.org/10.1016/j.glt.2019.11.002.

Batidzirai, B., Trotter, P.A., Brophy, A., Stritzke, S., Moyo, A., Twesigye, P., Puranasamriddhi, A., Madhlopa, A., 2021. Towards people-private-public

partnerships: an integrated community engagement model for capturing energy access needs. Energy Res. Social Sci. 74, 101975. https://doi.org/10.1016/j.erss.2021.101975.
Batinge, B., Musango, J.K., Brent, A.C., 2019. Perpetuating energy poverty: assessing roadmaps for universal energy access in unmet African electricity markets. Energy Res. Social Sci. 55, 1–13. https://doi.org/10.1016/j.erss.2019.05.004.
Bawakyillenuo, S., Crentsil, A.O., Agbelie, I.K., Danquah, S., Boakye-Danquah, E.B., Menyeh, B.O., 2021. The landscape of energy for cooking in Ghana - a review. Modern Energy Cooking Services (MECS).
Bazilian, M., Nakhooda, S., Van de Graaf, T., 2014. Energy governance and poverty. Energy Res. Social Sci. 1, 217–225. https://doi.org/10.1016/j.erss.2014.03.006.
Bishoge, O.K., Kombe, G.G., Mvile, B.N., 2020. Community participation in the renewable energy sector in Tanzania: community participation in the renewable energy sector. Int. J. Sustain. Energy Plan. Manage. 28, 121–134. https://doi.org/10.5278/ijsepm.4477.
Bloem, S., Swilling, M., Koranteng, K., 2021. Taking energy democracy to the streets: socio-technical learning, institutional dynamism, and integration in South African community energy projects. Energy Res. Social Sci. 72, 101906. https://doi.org/10.1016/j.erss.2020.101906.
Bloomer, J., Boateng, D., 2024. Prepaid into poverty? Exploring energy poverty and access to alternative electricity sources among urban poor households in Ghana. Energy Res. Social Sci. 112, 103510. https://doi.org/10.1016/j.erss.2024.103510.
Boamah, F., Williams, D.A., Afful, J., 2021. Justifiable energy injustices? Exploring institutionalised corruption and electricity sector “problem-solving” in Ghana and Kenya. Energy Res. Social Sci. 73, 101914. https://doi.org/10.1016/j.erss.2021.101914.
Boateng, D., 2025. When energy transitions are unjust: examining actor strategies and household engagement in Ghana's clean energy shift. Energy Rep. 14, 3390–3402. https://doi.org/10.1016/j.egyr.2025.10.009.
Boateng, D., Bloomer, J., Morrissey, J., 2023a. Where the power lies: developing a political ecology framework for just energy transition. Geogr. Compass, e12689. https://doi.org/10.1111/gec3.12689.
Boateng, D., Bloomer, J., Morrissey, J., 2023b. A burning desire: trying to achieve SDG 7 and improving access to cleaner cooking fuels in rural Ghana. In: Dunphy, P. (Ed.), Living with Energy Poverty (Paola Velasco Herrejón, Breffní Lennon and Niall. Routledge, pp. 255–272.
Boateng, D., Bloomer, J., Morrissey, J., 2025a. Dilemmas and decision-making: exploring households' perspectives on the energy-environment-livelihoods nexus in off-grid rural Ghana. Energy Sustain. Dev. 85. https://doi.org/10.1016/j.esd.2024.101604.
Boateng, D., Bloomer, J., Morrissey, J., 2025b. Fueling homes and lighting lives: understanding household energy decisions in off-grid rural Ghana. Energy Res. Social Sci. 125, 104105. https://doi.org/10.1016/j.erss.2025.104105.
Boutabba, M.A., Diaw, D., Laré, A., Lessoua, A., 2020. The impact of microfinance on energy access: a case study from peripheral districts of Lomé, Togo. Appl. Econ. 52, 4927–4951. https://doi.org/10.1080/00036846.2020.1751800.
Bouzarovski, S., 2014. Energy poverty in the European Union: landscapes of vulnerability. WIREs Energy Environ. 3, 276–289. https://doi.org/10.1002/wene.89.
Brass, J.N., Harris, K., MacLean, L.M., 2019. Is there an Anti-politics of Electricity? Access to the Grid and Reduced Political Participation in Africa, 182. Afro Barometer. https://www.afrobarometer.org/wp-content/uploads/2022/02/afropaperno182_antipolitics_of_electricity.pdf.
Braun, V., Clarke, V., 2022. Conceptual and design thinking for thematic analysis. Qual. Psychol. 9, 3–26. https://doi.org/10.1037/qup0000196.
Braun, V., Clarke, V., 2021. To saturate or not to saturate? Questioning data saturation as a useful concept for thematic analysis and sample-size rationales. Qualitatt. Res. Sport, Exercise Health 13, 201–216. https://doi.org/10.1080/2159676X.2019.1704846.
Brent, A.C., Rogers, D.E., 2010. Renewable rural electrification: sustainability assessment of mini-hybrid off-grid technological systems in the African context. Renew. Energy 35, 257–265. https://doi.org/10.1016/j.renene.2009.03.028.
Briggs, R.C., 2012. Electrifying the base? Aid and incumbent advantage in Ghana. J. Mod. Afr. Stud. 50, 603–624. https://doi.org/10.1017/S0022278X12000365.
Brinkmann, S., 2014. Unstructured and semi-structured interviewing. In: Leavy, P. (Ed.), The Oxford Handbook of Qualitative Research. Oxford University Press, pp. 277–299.
Bruce, E., 2023. Taxes on Imported Equipment Threatens Energy Transition Agenda. Graphic Online. https://www.graphic.com.gh/business/business-news/taxes-on-imported-equipment-threatens-energy-transition-agenda.html.
Bruku, C.E., 2025. Climate-energy justice intersections: critical perspectives on mini-grids transition in Ghana's island communities. Clim. Dev. 1–15. https://doi.org/10.1080/17565529.2025.2577258.
Bukari, D., Kemausuor, F., Quansah, D.A., Adaramola, M.S., 2021. Towards accelerating the deployment of decentralised renewable energy mini-grids in Ghana: review and analysis of barriers. Renew. Sustain. Energy Rev. 135, 110408. https://doi.org/10.1016/j.rser.2020.110408.
Burke, M.J., Stephens, J.C., 2017. Energy democracy: goals and policy instruments for sociotechnical transitions. Energy Res. Soc. Sci., Pol. Mixes Energy Trans. 33, 35–48. https://doi.org/10.1016/j.erss.2017.09.024.
Campbell, K.A., Orr, E., Durepos, P., Nguyen, L., Li, L., Whitmore, C., Gehrke, P., Graham, L., Jack, S.M., 2021. Reflexive thematic analysis for applied qualitative health research. Qual. Rep. 26, 2011–2028. https://doi.org/10.46743/2160-3715/2021.5010.
Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., Bywaters, D., Walker, K., 2020. Purposive sampling: complex or simple? Research case examples. J. Res. Nurs. 25, 652–661. https://doi.org/10.1177/1744987120927206.
Caprotti, F., Essex, S., Phillips, J., de Groot, J., Baker, L., 2020. Scales of governance: translating multiscalar transitional pathways in South Africa's energy landscape. Energy Res. Social Sci. 70, 101700. https://doi.org/10.1016/j.erss.2020.101700.
Carley, S., Konisky, D.M., 2020. The justice and equity implications of the clean energy transition. Nat. Energy 5, 569–577. https://doi.org/10.1038/s41560-020-0641-6.
Castaño-Rosa, R., Solís-Guzmán, J., Rubio-Bellido, C., Marrero, M., 2019. Towards a multiple-indicator approach to energy poverty in the European Union: a review. Energy Build. 193, 36–48. https://doi.org/10.1016/j.enbuild.2019.03.039.
Cellini, M., Loos, S., Mirenda, C., Pisacane, L., Striebing, C., Tagliacozzo, S., 2025. Exploring the nexus of gender and energy transitions: a systematic literature review. Energy Res. Social Sci. 119. https://doi.org/10.1016/j.erss.2024.103887.
Chatterjee, S., 2024. Synergy Solutions for Climate and SDG Action: Bridging the Ambition Gap for the Future we Want. Faculty of Science and Engineering at PEARL, School of Geography, Earth and Environmental Sciences, New York.
Chen, H., Jang, S.-G., Zhang, Y., Liu, Y., 2024. Clean energy for all? Mapping inequity potential in the clean energy transition in the United States. Energy Res. Social Sci. 108, 103400. https://doi.org/10.1016/j.erss.2023.103400.
Chirambo, D., 2018. Towards the achievement of SDG 7 in Sub-Saharan Africa: creating synergies between power Africa, sustainable energy for all and climate finance in-order to achieve universal energy access before 2030. Renew. Sustain. Energy Rev. 94, 600–608. https://doi.org/10.1016/j.rser.2018.06.025.
Christensen, C.M., Baumann, H., Ruggles, R., Sadtler, T.M., 2006. Disruptive innovation for social change. Harv. Bus. Rev. 84, 94–101, 163.
Cloke, J., Mohr, A., Brown, E., 2017. Imagining renewable energy: towards a social energy systems approach to community renewable energy projects in the global south. Energy Res. Social Sci. 31, 263–272. https://doi.org/10.1016/j.erss.2017.06.023.
Coy, D., Malekpour, S., Saeri, A.K., Dargaville, R., 2021. Rethinking community empowerment in the energy transformation: a critical review of the definitions, drivers and outcomes. Energy Res. Social Sci. 72, 101871. https://doi.org/10.1016/j.erss.2020.101871.
Crentsil, A.O., Asuman, D., Fenny, A.P., 2019. Assessing the determinants and drivers of multidimensional energy poverty in Ghana. Energy Policy 133. https://doi.org/10.1016/j.enpol.2019.110884.
Dagnachew, A.G., Poblete-Cazenave, M., Pachauri, S., Hof, A.F., Ruijven, B., Vuuren, D. P., 2020. Integrating energy access, efficiency and renewable energy policies in Sub-Saharan Africa: a model-based analysis. Environ. Res. Lett. 15, 125010. https://doi.org/10.1088/1748-9326/abcbb9.
Delina, L.L., 2022. Co-producing just energy transition in everyday practices: sociotechnical innovation and sustainable development in the Thailand-Myanmar border. Local Environ. 27, 16–31. https://doi.org/10.1080/13549839.2021.1997964.
Denscombe, M., 2017. EBOOK: the Good Research Guide: for small-scale Social Research Projects. McGraw-Hill Education, UK.
Dioha, M.O., Kumar, A., 2020. Exploring sustainable energy transitions in Sub-Saharan Africa residential sector: the case of Nigeria. Renew. Sustain. Energy Rev. 117, 109510. https://doi.org/10.1016/j.rser.2019.109510.
Dokyi, K.A.N., Sharifi, A., 2024. Identification and analysis of barriers to the implementation of utility-scale solar photovoltaic technology in Ghana. Energy Sustain. Dev. 83, 101547. https://doi.org/10.1016/j.esd.2024.101547.
Domegni, K.M.S., Azouma, Y.O., 2022. Productive uses of energy: a solution for promoting energy justice in rural areas in West Africa. Renew. Sustain. Energy Rev. 160, 112298. https://doi.org/10.1016/j.rser.2022.112298.
Eldh, A.C., Årestedt, L., Berterö, C., 2020. Quotations in qualitative studies: reflections on constituents, custom, and purpose. Int. J. Qual. Methods 19, 1609406920969268. https://doi.org/10.1177/1609406920969268.
Energy Commission, 2025. National Energy Statistical Bulletin 2025. Energy Commission, Ghana, Accra, Ghana.
Energy Commission, 2023. National energy statistical bulletin; energy statistics and balances. Energy Commis. Ghana. Accra, Ghana.
Etikan, I., 2016. Comparision of snowball sampling and sequential sampling technique. Biom. Biostat. Int. J. 3 (1), 55. https://doi.org/10.15406/bbij.2016.03.00055.
Evans, O., 2024. The investment dynamics in renewable energy transition in Africa: the asymmetric role of oil prices, economic growth and ICT. Int. J. Energy Sect. Manag. 18, 229–247. https://doi.org/10.1108/IJESM-03-2022-0002.
Evensen, D., Stedman, R., 2016. Scale matters: variation in perceptions of shale gas development across national, state, and local levels. Energy Res. Social Sci. 20, 14–21. https://doi.org/10.1016/j.erss.2016.06.010.
Falchetta, G., Dagnachew, A.G., Hof, A.F., Milne, D.J., 2021. The role of regulatory, market and governance risk for electricity access investment in Sub-Saharan Africa. Energy Sustain. Dev. 62, 136–150. https://doi.org/10.1016/j.esd.2021.04.002.
Falcone, P.M., Errichiello, G., 2025. Energy justice in the 21st century: policy interventions and advocacy for a fair energy transition. AIMSES 12, 594–614. https://doi.org/10.3934/environsci.2025027.
Flyvbjerg, B., 2011. What is a case study?. In: The SAGE Handbook of Qualitative Research. SAGE.
Foster, C., Heeks, R., 2013. Conceptualising inclusive innovation: modifying systems of innovation frameworks to understand diffusion of new technology to low-income consumers. Eur. J. Dev. Res. 25, 333–355. https://doi.org/10.1057/ejdr.2013.7.
Fotio, H.K., Adams, S., Nkengfack, H., Poumie, B., 2023. Achieving sustainable development goal 7 in Africa: does globalization matter for electricity access, renewable energy consumption, and energy efficiency? Util. Policy 82, 101545. https://doi.org/10.1016/j.jup.2023.101545.
Francis, J.J., Johnston, M., Robertson, C., Glidewell, L., Entwistle, V., Eccles, M.P., Grimshaw, J.M., 2010. What is an adequate sample size? Operationalising data

saturation for theory-based interview studies. Psychol. Health 25, 1229–1245. https://doi.org/10.1080/08870440903194015.
Francis, K., Dongying, S., Dennis, A., Edmund, N.N.K., Kumah, N.Y.G., 2022. Network governance and renewable energy transition in Sub-Saharan Africa: contextual evidence from Ghana. Energy Sustain. Dev. 69, 202–210. https://doi.org/10.1016/j.esd.2022.06.009.
Furszyfer Del Rio, J., Furszyfer Del Rio, D.D., Sovacool, B.K., Griffiths, S., 2023. The demographics of energy and mobility poverty: assessing equity and justice in Ireland, Mexico, and the United Arab Emirates. Glob. Environ. Change 81, 102703. https://doi.org/10.1016/j.gloenvcha.2023.102703.
Gafa, D.W., Egbendewe, A.Y., Jodoin, L., 2022. Operationalizing affordability criterion in energy justice: evidence from rural West Africa. Energy Econ. 109, 105953. https://doi.org/10.1016/j.eneco.2022.105953.
Garba, I., Bellingham, R., 2021. Energy poverty: estimating the impact of solid cooking fuels on GDP per capita in developing countries - case of Sub-Saharan Africa. Energy 221. https://doi.org/10.1016/j.energy.2021.119770.
Gebreslassie, M.G., Cuvilas, C., 2023. The role of community energy systems to facilitate energy transitions in Ethiopia and Mozambique. Energy Sys. 1–15. https://doi.org/10.1007/s12667-023-00640-w.
Ghana Statical Service, 2023a. Kwahu Afram Pains South District Multidimensional Poverty Fact Sheet. Accra, Ghana. https://statsghana.gov.gh/gssmain/fileUpload/pressrelease/Kwahu%20Afram%20Plains%20South.pdf.
Ghana Statical Service, 2023b. Kwahu Afram Pains North District Multidimensional Poverty Fact Sheet. Ghana Statical Service, Accra, Ghana. https://statsghana.gov.gh/gssmain/fileUpload/pressrelease/Kwahu%20Afram%20Plains%20North.pdf.
Ghana Statistical Service, 2014a. 2010 population and housing census. District analytical report. Kwahu Afram Plains South. https://www2.statsghana.gov.gh/docfiles/2010_District_Report/Eastern/KWAHU%20AFRAM%20PLAINS%20SOUTH.pdf.
Ghana Statistical Service, 2014b. 2010 Population and Housing Census. District Analytical Report. Kwahu Afram Plains North. https://www2.statsghana.gov.gh/docfiles/2010_District_Report/Eastern/KWAHU%20AFRAM%20PLAINS%20NORTH.pdf.
Giganti, P., Barra, C., Falcone, P.M., 2025. Unveiling the nexus of institutional quality and renewable energy utilizing a topic modelling approach. Renew. Sustain. Energy Rev. 214, 115516. https://doi.org/10.1016/j.rser.2025.115516.
Giganti, P., Falcone, P.M., 2025. Unveiling latent topics in the interplay of circular economy and energy transition: a topic modelling approach. Resour. Conserv. Recycl. 219, 108318. https://doi.org/10.1016/j.resconrec.2025.108318.
Gill-Wiehl, A., Ray, I., Kammen, D., 2021. Is clean cooking affordable? A review. Renew. Sustain. Energy Rev. 151, 111537. https://doi.org/10.1016/j.rser.2021.111537.
Guest, G., Bunce, A., Johnson, L., 2006. How many interviews are enough? An experiment with data saturation and variability. Field Methods 18, 59–82. https://doi.org/10.1177/1525822X05279903.
Hafner, M., Tagliapietra, S., De Strasser, L., 2018. Energy in Africa: Challenges and Opportunities. Springer nature.
Hamann, R., Rennkamp, B., Kruger, W., Musango, J.K., 2023. Corruption undermines justice in clean energy transitions. Environment 65, 5–9. https://doi.org/10.1080/00139157.2023.2205345.
Hassan, M.K., Pelkonen, P., Pappinen, A., 2014. Rural households' knowledge and perceptions of renewables with special attention on bioenergy resources development – results from a field study in Bangladesh. Appl. Energy 136, 454–464. https://doi.org/10.1016/j.apenergy.2014.09.049.
Hearn, A.X., Castaño-Rosa, R., 2021. Towards a just energy transition, barriers and opportunities for positive energy district creation in Spain. Sustainability 13, 8698. https://doi.org/10.3390/su13168698.
Heeks, R., Foster, C., Nugroho, R., 2014. New models of inclusive innovation for development. Innov. Dev. 4, 175–185. https://doi.org/10.1080/2157930X.2014.928982.
Heffron, R.J., 2022. Applying energy justice into the energy transition. Renew. Sustain. Energy Rev. 156, 111936. https://doi.org/10.1016/j.rser.2021.111936.
Herington, M.J., Malakar, Y., 2016. Who is energy poor? Revisiting energy (in) security in the case of Nepal. Energy Res. Social Sci. 21, 49–53. https://doi.org/10.1016/j.erss.2016.06.025.
Hjeij, D., Bicer, Y., Al-Sada, M. bin S., Koç, M., 2023. Hydrogen export competitiveness index for a sustainable hydrogen economy. Energy Rep. 9, 5843–5856. https://doi.org/10.1016/j.egyr.2023.05.024.
Hoesch, K.W., Mills, S.B., Rand, J., Nilson, R., Bessette, D.L., White, J., Hoen, B., 2025. What to expect when you're expecting engagement: delivering procedural justice in large-scale solar energy deployment. Energy Res. Social Sci. 120, 103893. https://doi.org/10.1016/j.erss.2024.103893.
Hosan, S., Sen, K.K., Rahman, M.M., Chapman, A.J., Karmaker, S.C., Alam, M.J., Saha, B. B., 2024a. Energy innovation funding and social equity: mediating role of just energy transition. Renew. Sustain. Energy Rev. 197, 114405. https://doi.org/10.1016/j.rser.2024.114405.
Hosan, S., Sen, K.K., Rahman, M.M., Karmaker, S.C., Chapman, A.J., Saha, B.B., 2024b. Mitigating energy poverty: a panel analysis of energy policy interventions in emerging economies of the Asia-Pacific region. Energy 291, 130367. https://doi.org/10.1016/j.energy.2024.130367.
Husband, G., 2020. Ethical data collection and recognizing the impact of semi-structured interviews on research respondents. Educ. Sci. 10, 206. https://doi.org/10.3390/educsci10080206.
I.E.A., 2022. Africa Energy Outlook 2022: World Energy Outlook Special Report. Paris.
I.E.A., 2016. World Energy Outlook 2016. IEA, Paris. https://www.iea.org/reports/world-energy-outlook-2016.
Ikejemba, E.C., Schuur, P.C., 2020. The empirical failures of attaining the societal benefits of renewable energy development projects in Sub-Saharan Africa. Renew. Energy 162, 1490–1498. https://doi.org/10.1016/j.renene.2020.08.052.
International Monetary Fund, 2025. How ghana's central bank is helping the economy recover. https://www.imf.org/en/news/articles/2025/12/04/how-ghanas-central-bank-is-helping-the-economy-recover.
IRENA, 2024. Sub-Saharan Africa: Policies and Finance for Renewable Energy Deployment. International Renewable Energy Agency, Abu Dhabi.
Irfan, M., Hao, Y., Ikram, M., Wu, H., Akram, R., Rauf, A., 2021. Assessment of the public acceptance and utilization of renewable energy in Pakistan. Sustain. Prod. Consum. 27, 312–324. https://doi.org/10.1016/j.spc.2020.10.031.
Isihak, S., 2023. Achieving universal electricity access in line with SDG7 using GIS-Based model: an application of OnSSET for rural electrification planning in Nigeria. Energy Strategy Rev. 45. https://doi.org/10.1016/j.esr.2022.101021.
Jenkins, K., McCauley, D., Heffron, R., Stephan, H., Rehner, R., 2016. Energy justice: a conceptual review. Energy Res. Social Sci. 11, 174–182. https://doi.org/10.1016/j.erss.2015.10.004.
Jodoin, L., Gafa, D.W., Egbendewe, A., Domegni, L.K., Gaye, I.D., Ague, V.J., Lo, K., Ouendo, E.M., Fagbémi, L., Diop, M., 2024. Making energy justice work for women in rural Sub-Saharan Africa: a quantitative diagnostic from Benin, Senegal, and Togo. Energy Res. Social Sci. 118, 103754. https://doi.org/10.1016/j.erss.2024.103754.
Karakara, A.A., Osabuohien, E.S., 2020. Clean versus dirty energy: empirical evidence from fuel adoption and usage by households in Ghana. Afr. J. Sci., Technol. Innov. Dev. 13, 785–795. https://doi.org/10.1080/20421338.2020.1816266.
Kemausuor, F., Adkins, E., Adu-Poku, I., Brew-Hammond, A., Modi, V., 2014. Electrification planning using network planner tool: the case of Ghana. Energy Sustain. Dev. 19, 92–101. https://doi.org/10.1016/j.esd.2013.12.009.
Knuth, S., Behrsin, I., Levenda, A., McCarthy, J., 2022. New political ecologies of renewable energy. Environ. Plan. E Nat. Space 5, 997–1013. https://doi.org/10.1177/25148486221108164.
Kumi, E., 2017. The Electricity Situation in Ghana: Challenges and Opportunities (Working Paper No. 109), Policy Papers. Center for Global Development.
Kyere, F., Dongying, S., Bampoe, G.D., Kumah, N.Y.G., Asante, D., 2024. Decoding the shift: assessing household energy transition and unravelling the reasons for resistance or adoption of solar photovoltaic. Technol. Forecast. Soc. Change 198, 123030. https://doi.org/10.1016/j.techfore.2023.123030.
Lawhon, M., Murphy, J.T., 2012. Socio-technical regimes and sustainability transitions: insights from political ecology. Prog. Hum. Geogr. 36, 354–378. https://doi.org/10.1177/0309132511427960.
Lennon, B., Dunphy, N.P., 2023. Energy and citizenship in a time of transition and socio-technical change. The Palgrave Handbook of Global Social Change. Springer International Publishing, Cham. https://doi.org/10.1007/978-3-030-87624-1_223-1.
Lennon, B., Dunphy, N.P., Sanvicente, E., 2019. Community acceptability and the energy transition: a citizens' perspective. Energy, Sustainability and Society 9, 1–18. https://doi.org/10.1186/s13705-019-0218-z.
Levidow, L., Papaioannou, T., 2018. Which inclusive innovation? Competing normative assumptions around social justice. Innov. Dev. 8, 209–226. https://doi.org/10.1080/2157930X.2017.1351605.
Li, K., Lloyd, B., Liang, X.-J., Wei, Y.-M., 2014. Energy poor or fuel poor: what are the differences? Energy Policy 68, 476–481. https://doi.org/10.1016/j.enpol.2013.11.012.
Longe, O.M., Oluwajobi, F.I., Omowole, F., 2013. Electricity access in Sub-Saharan Africa — case for renewable energy sources microgrid. In: 2013 IEEE International Conference on Emerging & Sustainable Technologies for Power & ICT in a Developing Society (NIGERCON), pp. 253–257. https://doi.org/10.1109/NIGERCON.2013.6715664.
Mahama, M., Derkyi, N.S.A., Nwabue, C.M., 2021. Challenges of renewable energy development and deployment in Ghana: perspectives from developers. Geojournal 86, 1425–1439. https://doi.org/10.1007/s10708-019-10132-z.
Malterud, K., Siersma, V.D., Guassora, A.D., 2016. Sample size in qualitative interview studies: guided by information power. Qual. Health Res. 26, 1753–1760. https://doi.org/10.1177/1049732315617444.
Maswabi, M.G., Chun, J., Chung, S.-Y., 2021. Barriers to energy transition: a case of Botswana. Energy Policy 158, 112514. https://doi.org/10.1016/j.enpol.2021.112514.
Mawusi, S., Shrestha, P., Nukpezah, D., Kemausuor, F., 2025. Clean cooking transition in Ghana: challenges, opportunities, and strategic pathways for sustainable development. Energy Sustain. Dev. 87, 101727. https://doi.org/10.1016/j.esd.2025.101727.
McCauley, D., Grant, R., Mwathunga, E., 2022. Achieving energy justice in Malawi: from key challenges to policy recommendations. Clim. Change 170, 28. https://doi.org/10.1007/s10584-022-03314-1.
McCauley, D.A., Heffron, R.J., Stephan, H., Jenkins, K., 2013. Advancing energy justice: the triumvirate of tenets. Int. Energy Law Rev. 32, 107–110.
Monyei, C.G., Akpeji, K.O., Oladeji, O., Babatunde, O.M., Aholu, O.C., Adegoke, D., Imafidon, J.O., 2022. Regional cooperation for mitigating energy poverty in Sub-Saharan Africa: a context-based approach through the tripartite lenses of access, sufficiency, and mobility. Renew. Sustain. Energy Rev. 159, 112209. https://doi.org/10.1016/j.rser.2022.112209.
Mperejekumana, P., Shen, L., Gaballah, M.S., Zhong, S., 2024. Exploring the potential and challenges of energy transition and household cooking sustainability in Sub-Saharan Africa. Renew. Sustain. Energy Rev. 199, 114534. https://doi.org/10.1016/j.rser.2024.114534.

Mukhtar, M., Adun, H., Cai, D., Obiora, S., Taiwo, M., Ni, T., Ozsahin, D.U., Bamisile, O., 2023. Juxtaposing sub-sahara Africa's energy poverty and renewable energy potential. Sci. Rep. 13, 11643. https://doi.org/10.1038/s41598-023-38642-4.
Mulugetta, Y., Sokona, Y., Trotter, P.A., Fankhauser, S., Omukuti, J., Somavilla Croxatto, L., Steffen, B., Tesfamichael, M., Abraham, E., Adam, J.P., Agbemabiese, L., 2022. Africa needs context-relevant evidence to shape its clean energy future. Nat. Energy 7, 1015–1022. https://doi.org/10.1038/s41560-022-01152-0.
Mulvaney, D., 2020. Sustainable Energy Transitions: Socio-Ecological Dimensions of Decarbonization. Springer International Publishing.
Ngonda, T., 2022. A scoping review of adopter attributes, motivations, and barriers of solar home systems adoption: lessons for Sub-Saharan Africa. Renew. Energy Sustain. Dev. 8. https://doi.org/10.21622/RESD.2022.08.1.001.
Nguyen, C.P., Su, T.D., 2022. The influences of government spending on energy poverty: evidence from developing countries. Energy 238, 121785. https://doi.org/10.1016/j.energy.2021.121785.
Nsafon, B.E.K., Same, N.N., Yakub, A.O., Chaulagain, D., Kumar, N.M., Huh, J.S., 2023. The justice and policy implications of clean energy transition in Africa. Front. Environ. Sci. 11, 1089391. https://doi.org/10.3389/fenvs.2023.1089391.
Nuhu, P., Bukari, D., 2021. An analysis of export, import and exchange rate oscillation in Ghana. Int. J. Econom. Pol. Stud. 15, 301–327. https://doi.org/10.1007/s42495-021-00060-7.
Nuru, J.T., Rhoades, J.L., Gruber, J.S., 2021. The socio-technical barriers and strategies for overcoming the barriers to deploying solar mini-grids in rural islands: evidence from Ghana. Technol. Soc. 65, 101586. https://doi.org/10.1016/j.techsoc.2021.101586.
Nussbaumer, P., Bazilian, M., Modi, V., 2012. Measuring energy poverty: focusing on what matters. Renew. Sustain. Energy Rev. 16, 231–243. https://doi.org/10.1016/j.rser.2011.07.150.
Nyarko, K., Urmee, T., Whale, J., Simsek, Y., Haigh, Y., 2025. Assessing the effectiveness of energy policies in accelerating renewable energy-based mini-grid deployment: a case study. Energy Sustain. Dev. 85, 101631. https://doi.org/10.1016/j.esd.2024.101631.
Nyarko, K., Whale, J., Urmee, T., 2023. Drivers and challenges of off-grid renewable energy-based projects in West Africa: a review. Heliyon 9, e16710. https://doi.org/10.1016/j.heliyon.2023.e16710.
Ojong, N., 2021. The rise of solar home systems in Sub-Saharan Africa: examining gender, class, and sustainability. Energy Res. Social Sci. 75, 102011. https://doi.org/10.1016/j.erss.2021.102011.
Olagoke, U., Daly, S.R., Syal, S.M., 2024. Unpacking travel needs and experiences: insights from qualitative interviews with affordable housing residents in California. Energy Res. Social Sci. 118, 103723. https://doi.org/10.1016/j.erss.2024.103723.
Omokaro, G.O., Nafula, Z.S., Iloabuchi, N.E., Efeni, O.S., Adeyanju, O.I., Janet, O.O., Idiong, O.U., 2025. Energy sanctions in the global economy: geopolitical disruptions, market fragmentation, innovation and green transition. Int. J. Innov. Stud. 9, 246–261. https://doi.org/10.1016/j.ijis.2025.07.003.
Opeyemi, A., Uchenna, E., Simplice, A., Evans, O., 2019. Renewable energy, trade performance and the conditional role of finance and institutional capacity in sub-sahara African countries. Energy Policy 132, 490–498. https://doi.org/10.1016/j.enpol.2019.06.012.
Osório, A., 2023. Not everything is green in the green transition: theoretical considerations on market structure, prices and competition. J. Clean. Prod. 427, 139300. https://doi.org/10.1016/j.jclepro.2023.139300.
O'Sullivan, K., Golubchikov, O., Mehmood, A., 2020. Uneven energy transitions: understanding continued energy peripheralization in rural communities. Energy Policy 138. https://doi.org/10.1016/j.enpol.2020.111288.
Osunmuyiwa, O., Ahlborg, H., 2019. Inclusiveness by design? Reviewing sustainable electricity access and entrepreneurship from a gender perspective. Energy Res. Social Sci. 53, 145–158. https://doi.org/10.1016/j.erss.2019.03.010.
Overland, I., Sovacool, B.K., 2020. The misallocation of climate research funding. Energy Res. Social Sci. 62, 101349. https://doi.org/10.1016/j.erss.2019.101349.
Owusu-Manu, D.G., Mankata, L.M., Debrah, C., Edwards, D.J., Martek, I., 2021. Mechanisms and challenges in financing renewable energy projects in Sub-Saharan Africa: a Ghanaian perspective. J. Finan. Manage. Proper. Construct. 26 (3), 319–336. https://doi.org/10.1108/JFMPC-03-2020-0014.
Pacho, T., 2015. Exploring participants' experiences using case study. Int. J. Humanit. Soc. Sci. 5, 44–53.
Parker, C., Scott, S., Geddes, A., 2019. Snowball Sampling. SAGE Publications Ltd, London. https://doi.org/10.4135/9781526421036831710.
Patiño-Valencia, B., Villalba-Morales, M.L., Acosta-Amaya, M., Villegas-Arboleda, C., Calderón-Sanín, E., 2022. Towards the conceptual understanding of social innovation and inclusive innovation: a literature review. Innov. Dev. 12, 437–458. https://doi.org/10.1080/2157930X.2020.1859215.
Pedersen, R.H., Poncian, J., 2024. The political economy of energy transitions in Africa: coalitions, politics and power in Tanzania. Energy Res. Social Sci. 117, 103712. https://doi.org/10.1016/j.erss.2024.103712.
Pellegrini-Masini, G., Pirni, A., Maran, S., 2020. Energy justice revisited: a critical review on the philosophical and political origins of equality. Energy Res. Social Sci. 59, 101310. https://doi.org/10.1016/j.erss.2019.101310.
Pueyo, A., 2018. What constrains renewable energy investment in Sub-Saharan Africa? A comparison of Kenya and Ghana. World Dev. 109, 85–100. https://doi.org/10.1016/j.worlddev.2018.04.008.
Queirós, A., Faria, D., Almeida, F., 2017. Strengths and limitations of qualitative and quantitative research methods. European J. Edu. Stud.
Revez, A., Dunphy, N., Harris, C., Mullally, G., Lennon, B., Gaffney, C., 2020. Beyond forecasting: using a modified Delphi method to build upon participatory action research in developing principles for a just and inclusive energy transition. Int. J. Qual. Methods 19, 1609406920903218. https://doi.org/10.1177/1609406920903218.
Rótolo, G.C., Vassillo, C., Rodriguez, A.A., Magnano, L., Milo Vaccaro, M., Civit, B.M., Covacevich, M.S., Arena, A.P., Ulgiati, S., 2022. Perception and awareness of circular economy options within sectors related to agriculture in Argentina. J. Clean. Prod. 373, 133805. https://doi.org/10.1016/j.jclepro.2022.133805.
Rowan, W., McCarthy, S., Mebrahtu, S., Ertiö, T., Dimova, A., Asenova, D., Moraitis, N., Revez, A., 2024. Promoting active citizen engagement in sustainable energy transitions: a co-creation approach. J. Decis. Syst. 33, 234–245. https://doi.org/10.1080/12460125.2024.2344872.
Sakah, M., Diawuo, F.A., Katzenbach, R., Gyamfi, S., 2017. Towards a sustainable electrification in Ghana: a review of renewable energy deployment policies. Renew. Sustain. Energy Rev. 79, 544–557. https://doi.org/10.1016/j.rser.2017.05.090.
Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Burroughs, H., Jinks, C., 2018. Saturation in qualitative research: exploring its conceptualization and operationalization. Qual. Quantity 52, 1893–1907. https://doi.org/10.1007/s11135-017-0574-8.
Sefa-Nyarko, C., 2024. Ghana's national energy transition framework: domestic aspirations and mistrust in international relations complicate 'justice and equity. Energy Res. Social Sci. 110, 103465. https://doi.org/10.1016/j.erss.2024.103465.
SEforAll, 2019. Energizing finance: understanding the landscape 2019. https://www.seforall.org/publications/energizing-finance-understanding-the-landscape-2019.
Sen, K.K., Hosan, S., Karmaker, S.C., Chapman, A.J., Saha, B.B., 2024. Clarifying the linkage between renewable energy deployment and energy justice: toward equitable sustainability. Sustain. Futures 8, 100236. https://doi.org/10.1016/j.sftr.2024.100236.
Sen, K.K., Karmaker, S.C., Chapman, A.J., Saha, B.B., 2025. How does environmental policy shape the impact of energy innovation funding on renewable energy generation? Evidence from econometric and machine learning approaches. Energy Econ. 150, 108833. https://doi.org/10.1016/j.eneco.2025.108833.
Sengupta, P., 2016. How effective is inclusive innovation without participation? Geoforum 75, 12–15. https://doi.org/10.1016/j.geoforum.2016.06.016.
Sica, E., Falcone, P.M., Lopolito, A., 2026. Uncovering network changes in the evolution of an innovation niche. Soc. Netw. 84, 87–100.
Silver, J., Marvin, S., 2017. Powering sub-Saharan Africa's urban revolution: an energy transitions approach. Urban Stud. 54, 847–861. https://doi.org/10.1177/0042098016668105.
Singh, S., Ru, J., 2022. Accessibility, affordability, and efficiency of clean energy: a review and research agenda. Environ. Sci. Pollut. Control Ser. 29, 18333–18347. https://doi.org/10.1007/s11356-022-18565-9.
Smarte Anekwe, I.M., Akpasi, S.O., Mkhize, M.M., Zhou, H., Moyo, R.T., Gaza, L., 2024. Renewable energy investments in South Africa: potentials and challenges for a sustainable transition - a review. Sci. Prog. 107, 00368504241237347. https://doi.org/10.1177/00368504241237347.
Smith, A., Contreras, G.A.T., Brisbois, M.C., Lacey-Barnacle, M., Sovacool, B.K., 2023. Inclusive innovation in just transitions: the case of smart local energy systems in the UK. Environ. Innov. Soc. Transit. 47, 100719. https://doi.org/10.1016/j.eist.2023.100719.
Sodoke, S., Ermolin, I., Boateng, D., Amoah, E.G., 2026. Beyond grid connection: a Q-methodology study of stakeholder perspectives on energy poverty in urban Ghana. Energy Res. Social Sci. 131, 104471. https://doi.org/10.1016/j.erss.2025.104471.
Sovacool, B.K., 2021. Who are the victims of low-carbon transitions? Towards a political ecology of climate change mitigation. Energy Res. Social Sci. 73, 101916. https://doi.org/10.1016/j.erss.2021.101916.
Sovacool, B.K., 2016. The political ecology and justice of energy. In: Van de Graaf, T., Sovacool, B.K., Ghosh, A., Kern, F., Klare, M.T. (Eds.), The Palgrave Handbook of the International Political Economy of Energy. Palgrave Macmillan UK, London, pp. 529–558. https://doi.org/10.1057/978-1-137-55631-8_22.
Sovacool, B.K., Axsen, J., Sorrell, S., 2018. Promoting novelty, rigor, and style in energy social science: towards codes of practice for appropriate methods and research design. Energy Res. Social Sci. 45, 12–42. https://doi.org/10.1016/j.erss.2018.07.007.
Sovacool, B.K., Bell, S.E., Daggett, C., Labuski, C., Lennon, M., Naylor, L., Klinger, J., Leonard, K., Firestone, J., 2023. Pluralizing energy justice: incorporating feminist, anti-racist, Indigenous, and postcolonial perspectives. Energy Res. Social Sci. 97, 102996. https://doi.org/10.1016/j.erss.2023.102996.
Sovacool, B.K., Brisbois, M.-C., 2019. Elite power in low-carbon transitions: a critical and interdisciplinary review. Energy Res. Social Sci. 57, 101242. https://doi.org/10.1016/j.erss.2019.101242.
Sovacool, B.K., Hook, A., Martiskainen, M., Brock, A., Turnheim, B., 2020. The decarbonisation divide: contextualizing landscapes of low-carbon exploitation and toxicity in Africa. Glob. Environ. Change 60, 102028.
Sovacool, B.K., Newell, P., Sanya, C., Jessica, F., 2022. Equity, technological innovation and sustainable behaviour in a low-carbon future. Nat. Hum. Behav. 6, 326–337. https://doi.org/10.1038/s41562-021-01257-8.
Stephens, J.C., Surprise, K., 2020. The hidden injustices of advancing solar geoengineering research. Glob. Sustain. 3, e2. https://doi.org/10.1017/sus.2019.28.
Stock, R., Sovacool, B.K., 2024. Blinded by sunspots: revealing the multidimensional and intersectional inequities of solar energy in India. Glob. Environ. Change 84, 102796. https://doi.org/10.1016/j.gloenvcha.2023.102796.
Streimikiene, D., 2022. Renewable energy technologies in households: challenges and low carbon energy transition justice. Econom. Sociol. 15, 108–120. https://doi.org/10.14254/2071789X.2022/15-3/6.

Streimikiene, D., Baležentis, T., Volkov, A., Morkūnas, M., Žičkienė, A., Streimikis, J., 2021. Barriers and drivers of renewable energy penetration in rural areas. Energies 14, 6452. https://doi.org/10.3390/en14206452.

Swanborn, P., 2010. Case Study Research: what, Why and How? SAGE.

Sy, S.A., Mokaddem, L., 2022. Energy poverty in developing countries: a review of the concept and its measurements'. Energy Res. Social Sci. 89, 102562. https://doi.org/10.1016/j.erss.2022.102562.

Tachega, M.A., Chen, Y., Wang, J., Yang, P., 2025. Regional disparities in Africa's renewable energy transition: patterns and drivers. J. Clean. Prod. 503, 145396. https://doi.org/10.1016/j.jclepro.2025.145396.

Tadadjeu, S., Njangang, H., Ningaye, P., Nourou, M., 2020. Linking natural resource dependence and access to water and sanitation in African countries. Resour. Policy 69, 101880. https://doi.org/10.1016/j.resourpol.2020.101880.

Tarekegne, B., 2020. Just electrification: imagining the justice dimensions of energy access and addressing energy poverty. Energy Res. Social Sci. 70, 101639. https://doi.org/10.1016/j.erss.2020.101639.

Tettey, G., Ansah, E.A., Asante, W., 2025. The politics of renewable energy transition in Ghana: issues, obstacles and prospects. Energy Res. Social Sci. 120, 103939. https://doi.org/10.1016/j.erss.2025.103939.

Todd, I., McCauley, D., 2021. Assessing policy barriers to the energy transition in South Africa. Energy Policy 158, 112529. https://doi.org/10.1016/j.enpol.2021.112529.

Tornel, C., 2023. Decolonizing energy justice from the ground up: political ecology, ontology, and energy landscapes. Prog. Hum. Geogr. 47, 43–65. https://doi.org/10.1177/03091325221132561.

Tricarico, L., De Vidovich, L., 2021. Proximity and post-COVID-19 urban development: reflections from Milan, Italy. J. Urban Manage. 10, 302–310. https://doi.org/10.1016/j.jum.2021.03.005.

Tsoeu-Ntokoane, S., Kali, M., Lemaire, X., 2025. Transitioning to cleaner solutions and moving away from precautionary energy stacking in Lesotho households. Discov. Energy 5 (1), 24. https://doi.org/10.1007/s43937-025-00080-w.

Tsoeu-Ntokoane, S., Mosabala, T.D., Kali, M., Lemaire, X., 2024. Community imaginaries, participation and acceptance of renewable energy projects–substituting the quicksand of development with rocky fundamentals. Cogent Soc. Sci. 10, 2292755. https://doi.org/10.1080/23311886.2023.2292755.

Twerefou, D.K., Abeney, J.O., 2020. Efficiency of household electricity consumption in Ghana. Energy Policy 144, 111661. https://doi.org/10.1016/j.enpol.2020.111661.

Twumasi, M.A., Asante, D., Fosu, P., Essilfie, G., Jiang, Y., 2022. Residential renewable energy adoption. Does financial literacy matter? J. Clean. Prod. 361, 132210. https://doi.org/10.1016/j.jclepro.2022.132210.

Ukoba, K., Yoro, K.O., Eterigho-Ikelegbe, O., Ibegbulam, C., Jen, T.C., 2024. Adaptation of solar power in the global south: prospects, challenges and opportunities. Heliyon 10, 28009. https://doi.org/10.1016/j.heliyon.2024.e28009.

United Nations, 2021. Theme Report on Energy Transition. Towards the Achievement of SDG 7 and net-zero Emissions. United Nations.

United Nations, 2023a. The Sustainable Development Goals Report 2023 (Special Edition), Special Edition Report. United Nations. https://unstats.un.org/sdgs/report/2023/.

United Nations, 2023b. Advancing SDG7 in Africa. https://sdgs.un.org/sites/default/files/2023-06/2023%20Advancing%20SDG7%20in%20the%20Africa-062923.pdf.

van der Horst, D., Grant, R., Montero, A.M., Garneviciene, A., 2021. Energy justice and social acceptance of renewable energy projects in the global south. In: A Critical Approach to the Social Acceptance of Renewable Energy Infrastructures. Palgrave Macmillan, Cham, pp. 217–234. https://doi.org/10.1007/978-3-030-73699-6_12.

van Uffelen, N., 2022. Revisiting recognition in energy justice. Energy Res. Social Sci. 92, 102764. https://doi.org/10.1016/j.erss.2022.102764.

Velasco-Herrejón, P., Lennon, B., Dunphy, N.P., 2023. Living with Energy Poverty. Routledge, London. https://doi.org/10.4324/9781003408536.

Velasco-Herrejón, P., Bauwens, T., 2024. Are energy transitions reproducing inequalities? Power, social stigma and distributive (in)justice in Mexico. Glob. Environ. Change 87, 102883. https://doi.org/10.1016/j.gloenvcha.2024.102883.

Walker, P.A., 2005. Political ecology: where is the ecology? Prog. Hum. Geogr. 29, 73–82. https://doi.org/10.1191/0309132505ph530pr.

Wang, H., Zafar, M.W., Abbas, S., Destek, M.A., 2023. An assessment of energy poverty in Sub-Saharan Africa: the role of financial inclusion and education. Econ. Change Restruct. 56, 4689–4711. https://doi.org/10.1007/s10644-023-09568-8.

Wassie, Y.T., Rannestad, M.M., Adaramola, M.S., 2021. Determinants of household energy choices in rural Sub-Saharan Africa: an example from southern Ethiopia. Energy 221, 119785. https://doi.org/10.1016/j.energy.2021.119785.

World Bank, 2018. Nigeria - Power Sector Recovery Program (English) (Program Information Document No. 124328). World Bank Group, Nigeria.

Yazdanie, M., Frimpong, P.B., Dramani, J.B., Orehounig, K., 2024. Depreciating currency impacts on local-scale energy system planning: the case study of Accra, Ghana. Energy Strategy Rev. 53, 101362. https://doi.org/10.1016/j.esr.2024.101362.

Yin, R.K., 2009. Case Study Research: Design and Methods. SAGE.