Energy Reports 14 (2025) 3390–3402

Contents lists available at ScienceDirect

Energy Reports

journal homepage: www.elsevier.com/locate/egyr

When energy transitions are unjust: Examining actor strategies and household engagement in Ghana's clean energy shift

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ARTICLE INFO

JEL classifications:
D63
Q42
Q48
O13

Keywords:
Clean energy
Actor strategies
Household involvement
Sustainable transition
SDG7
Ghana

ABSTRACT

A transition to clean energy offers sub-Saharan Africa a solution to regional energy challenges. However, if not properly implemented, transition strategies risk marginalising vulnerable groups. This paper adds to existing literature by exploring how actors interact with one another, identifying areas of collaboration and conflicts. It provides new insights into household-actor interactions, analysing how these relationships influence household energy decisions. Drawing on the energy justice framework— specifically procedural and recognition justice — this study utilises primary data gathered through surveys and interviews conducted in rural communities in the Kwahu Afram Plains North and South Districts of Ghana between September 2022 and February 2023. Analysis conducted using the Statistical Package for Social Sciences (SPSS) and reflexive thematic techniques revealed limited collaboration among the key actors and competition among some non-state actors in energy transition. Procedural and recognition injustices are identified at multiple levels, including the exclusion of households from decision-making processes and the limited recognition of certain non-state actors at the national level. These findings underscore the importance of designing energy transition strategies that prioritise inclusive and multi-level stakeholder engagement. The study contributes to efforts to achieve SDG7 by highlighting pathways for inclusive energy transitions.

1. Introduction

Access to clean/modern/new energy services remains a major challenge in low- and middle-income countries (LMICs), where a substantial proportion of the population still lacks reliable electricity and clean cooking solutions (Murshed et al., 2022; Bamisile et al., 2023). Achieving Sustainable Development Goal (SDG) 7— which aims to ensure universal access to affordable, reliable, sustainable, and modern energy— hinges critically on progress in the region (Acheampong et al., 2021; Bhattacharyya and Palit, 2021). Rural-urban disparities further complicate efforts to meet SDG7 targets (Tamasiga et al., 2024; Abu Saim et al., 2025). In Ghana, these disparities have led to growing calls to expand clean energy access to rural areas through grid extension, mini-grids and off-grid renewable solutions (Gyimah et al., 2024; Nyarko et al., 2025).

In off-grid rural Ghana, simple technologies such as solar home systems, photovoltaic lamps and clean cookstoves have been introduced. These solutions are often promoted as appropriate for addressing the basic energy needs of rural households, primarily for lighting and cooking (Nuru et al., 2021a). However, as noted by Boateng et al. (2023a) and Nuru et al. (2021b), the availability of such technologies does not guarantee adoption. This prompts the need to critically reconsider what access means, particularly in contexts where availability of infrastructure does not necessarily translate into meaningful use.

Bloomer and Boateng (2024) argue for a shift beyond the conventional definitions of energy access, advocating for a framework that incorporates qualitative dimensions such as adequacy, reliability and affordability. Scholars like Twumasi et al. (2020), Ang'u et al. (2023) and Mosetlhe et al. (2025) emphasise that household-level adoption and sustained use of clean energy technologies are significantly influenced by socio-economic factors. This underscores the importance of context-specific solutions, which can be achieved through actor collaboration (Adenle, 2020; Francis et al., 2022; Nwokolo et al., 2023) and household participation (Akrofi et al., 2024; Opoku-Mensah et al., 2025) in the transition process.

This approach aligns with the principles of procedural justice, which emphasise inclusive and participatory decision-making (Jenkins et al., 2016), and recognition justice, which advocates for the acknowledgement of diverse identities, experiences and socio-cultural contexts of households (McCauley et al., 2013). Guided by these two dimensions of

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https://doi.org/10.1016/j.egyr.2025.10.009
Received 19 April 2025; Received in revised form 2 August 2025; Accepted 19 October 2025
Available online 30 October 2025

Nomenclature

LMICs	Low- and middle-income countries
SSA	sub-Saharan Africa
PCETPs	Private clean energy technology providers
DA	District Assembly
NGOs	non-governmental organisations
SDG	Sustainable Development Goal
SDGs 7	Access to clean and affordable energy
ESRI	Environmental Systems Research Institute
HHs	Household heads
SPSS	Statistical Package for Social Sciences
DCE	District Chief Executive
X2	chi square
N	sample size
K	Kendall's W
P	P-value.

energy justice, this study examines the roles and relationships of key multi-scalar actors[1] in attaining transition objectives. It addresses three critical, yet underexplored questions:

- Who are the key actors in energy transitions in off-grid rural Ghana, and how do they collaborate to advance transition goals?
- How do actor interactions and engagement strategies shape household participation in the energy transition process?
- In what ways do actor-household dynamics influence household energy decision-making in off-grid rural settings?

This study contributes to the energy literature by addressing a notable gap in existing research, which has largely prioritised large-scale technological solutions while overlooking the role of simpler and smaller technologies (Cantoni et al., 2022), and the importance of actor-household interactions in shaping transition outcomes in LMICs (Kizilcec and Parikh, 2020). It builds upon a gap identified by Kizilcec and Parikh (2020) and Müller et al. (2021), by providing context-specific insights from rural Ghana, and highlights procedural and recognition injustices – dimensions that have been insufficiently examined in sub-Saharan Africa's (SSA) energy transition (Girardeau et al., 2021). It responds directly to calls from scholars such as Sovacool (2021) for more inclusive research on mundane technologies in non-Western context.[2]

Drawing on survey and interview data from off-grid rural Ghana, the findings highlight the significant contributions of both state and non-state actors to Ghana's energy transition. However, a lack of coordination, particularly between DAs and NGOs, and limited household involvement point to persistent procedural and recognition injustices. Although many households emphasised the importance of active involvement, not all maintained constant communication with actors. These insights inform the design of more inclusive and sustainable energy transition strategies for rural Ghana and the broader SSA context, aligning with SDG7 (United Nations, 2023).

[1] At the local level, private clean energy technology providers (PCETPs) were involved; at the regional and national levels, District Assembly (DA) officers and non-governmental organisations (NGOs) were consulted. This ensured a more integrated and context-sensitive understanding of energy transitions (Sareen, 2021).

[2] According to Sovacool (2021, p.10), "five recommendations for future research: more inclusivity and diversity, more rigor and comparative analysis, focusing on more mundane technologies as well as non-Western case studies, more multi-scalar analysis, and more focus on policy and recommendations".

The rest of the paper is structured as follows: Section 2 reviews relevant literature on energy access, justice and actor collaboration. Section 3 highlights the theoretical framework guiding the study, while Section 4 details the methods for addressing the research questions. Section 5 presents and discusses the findings across three themes: key actors in energy transition, household engagement in energy transition, and actor-household interaction. Section 6 concludes and offers practical implications.

2. Literature review

Structural and socio-economic constraints are recognised as barriers to the adoption of clean energy solutions in LMICs (Acheampong et al., 2025). These barriers often manifest through specific challenges such as high costs, limited investment and unreliable supply (Adewuyi et al., 2020; Mugisha et al., 2021; Tamasiga et al., 2024). A transition to clean energy solutions offers a dual benefit in SSA: it addresses the persistent energy access challenges and contributes to the reduction of greenhouse gas emissions from the energy sector (Aemro et al., 2021). Yet, energy poverty, defined as the inability of households to access sufficient, reliable and modern energy services, persists in the region (Ballesteros-Arjona et al., 2022). Its manifestation varies across rural areas, indicating that barriers to energy access are context-specific (Gafa and Egbendewe, 2021). To promote a transition to clean energy, solutions have to be tailored to the specific needs of households (Casati et al., 2023). Uniform or top-down solutions risk excluding vulnerable populations, thereby perpetuating the marginalisation that energy transitions aim to address (Sanga et al., 2022). These concerns have led to a growing consensus that energy transition is inherently multidimensional (Tamasiga et al., 2024), with justice being a central pillar (Apergi et al., 2024).

2.1. Energy justice

Energy justice is closely linked to broader justice frameworks and has been widely applied across disciplines such as sociology, geography, and political ecology (Heffron and McCauley, 2017; Sovacool, 2021). It broadly centres on fairness in energy systems (Apergi et al., 2024). Sovacool et al. (2016) propose that an energy justice framework should be grounded in principles including availability, affordability, due process, transparency, accountability, sustainability, equity and responsibility. In the context of energy transitions, this implies ensuring equitable processes that prevent the marginalisation of any group during the shift to low-carbon energy sources (Heffron, 2022; Nsafon et al., 2023). Conceptually, energy justice is often framed through three core dimensions (distributive, procedural and recognition justices), each addressing distinct aspects of equity within energy systems (McCauley et al., 2013; Jenkins et al., 2016; Williams and Doyon, 2019).

Distributive justice concerns the fair allocation of the benefits and burdens associated with energy transitions across all segments of society (Jenkins et al., 2016). Procedural justice entails engaging communities in energy interventions in a non-discriminatory way (Jenkins et al., 2016; Hoesch et al., 2025a). It discourages the reliance on top-down approaches, where decisions are made by external actors without adequate local consultation. Recognition justice refers to the fair and meaningful representation and acknowledgment of stakeholders' contributions within the energy transition process, devoid of any threat. It respects and integrates the cultural values, social norms and lived realities of households (Jenkins et al., 2016; van Uffelen, 2022).

In addition to the three core dimensions, scholars have identified and explored emerging dimensions that reflect the evolving complexities of energy justice. Notable among these are restorative justice, which addresses historical energy-related harms and seeks remediation (Hazrati and Heffron, 2021; Heffron, 2022); cosmopolitan justice, which emphasises global equity in energy responsibility and access (Caney, 2005; Moellendorf, 2018); and intergenerational justice, which considers the

long-term impacts of present energy choices on future generations (Pellegrini-Masini et al., 2019). To mitigate unjust outcomes in energy transitions, inclusive decision-making and household engagement have been identified as pivotal (Sovacool and Dworkin, 2015; Sovacool et al., 2020).

2.2. Stakeholder engagements

While actors may pursue energy transitions for diverse reasons, interaction and collaboration is recognised as essential for promoting the adoption of new technologies (Adenle, 2020; Karanja et al., 2020; Francis et al., 2022; Nwokolo et al., 2023). Effective collaboration can prevent duplication of efforts and enhance the deployment of appropriate transition strategies (Dyner et al., 2005; Ambole et al., 2019; Sanderink and Nasiritousi, 2020; Sorman et al., 2020; Singh and Ru, 2022). LaBelle (2017) highlights the need to examine energy justice through multiple lenses, including institutions— arguing that "perceiving energy justice through a variety of prisms, whether global or local, universal or, and through institutions or societies' perspectives, enables energy justice as a discipline to develop and expose injustice" (LaBelle, 2017, p. 619).

Complementing this institutional lens, Sanga et al. (2022) advocate for active actor-household engagement by recommending approaches that integrate both top-down and bottom-up strategies. Similarly, Cloke et al. (2017), Baxter et al. (2020), Kaiser (2020), Sovacool (2021) and Boateng et al. (2023a) emphasise the important role household engagement plays in energy transition. Haque et al. (2021) argue that energy transitions should be understood as socio-cultural processes, reinforcing the importance of participatory design. Active actor-household engagement can enhance access to information, a tool to build trust and foster a sense of agency among households (Shoemaker et al., 2018; Cantarero, 2020; Goggins et al., 2022). However, Suboticki et al. (2023) caution that public engagement alone does not guarantee equitable outcomes. Participation can be superficial, unequally distributed or influenced by dominant actors, potentially exacerbating existing social inequalities. Based on insights drawn from the literature review, this study is guided by a framework drawn from the energy justice theory.

3. Theoretical framework

In many real-world contexts, the pursuit of transition objectives reveals a deep interconnection between procedural and recognition justice (Shejale et al., 2025; Shyu, 2025), often leading to their conflation in existing research (Ramasar et al., 2022). Accordingly, this study adopts a dual lens, procedural and recognition justice, to explore energy transition. As Suboticki et al. (2023, p. 9) emphasise, "to ensure good procedures for public engagement, recognising and giving a voice to a plurality of publics is necessary". This affirms the significant role of institutional actors and households in shaping energy transition.

The procedural and recognition justice dimensions of energy justice provided a lens to examine the nature of actor interactions, the extent of household participation, and the dynamics of decision-making, with a focus on inclusivity in processes and the recognition of diverse stakeholder voices. This framework informed the development of survey instruments and guided the coding of qualitative data, particularly in relation to engagement and inclusion. To situate this study, it is necessary to clearly define procedural and recognition justice.

Procedural justice focuses on the equitable inclusion of all stakeholders in decision-making processes. It promotes non-discriminatory practices and stresses the importance of "local knowledge mobilisation, greater information disclosure, and better institutional representation" (Jenkins et al., 2016, p. 178). Mobilising local knowledge offers nuanced insights into social, environmental and economic conditions that external experts may overlook (Shejale et al., 2025). The disclosure of information fosters institutional accountability and trust, which can enhance household participation and reduce resistance (Hoesch et al., 2025a). Institutional representation plays a critical role in shaping perceived legitimacy; institutions regarded as inclusive and responsive are more likely to earn public trust—an essential prerequisite for a successful energy transition (Walker et al., 2010).

Recognition justice entails the fair treatment of stakeholders, acknowledging their rights and views. It calls for the respectful treatment of diverse perspectives and experiences in decision-making processes. Recognition injustices largely occur through cultural domination, non-recognition and disrespect (Fraser, 2008; Jenkins et al., 2016). Cultural domination involves the imposition of dominant cultural norms and values. Misrecognition involves the distortion or denial of a group's identity, often through stereotyping or mischaracterisation. Disrespect encompasses attitudes and practices that devalue or demean individuals or communities. Recognition justice plays a foundational role in ensuring a fair and equitable transition (Vega-Araújo and Heffron, 2022).

Table 1
Techniques for examining energy transition.

Data requirement	Technique	Information source
Key actors in off-grid rural communities	Qualitative	Members of DA
Activities undertaken by actors	Qualitative	Actors
Collaboration among actors	Qualitative	Actors
Actor and household collaborations	Quantitative	Household heads (HHs)
Impact of actors' communication on household current energy preferences	Quantitative	HHs
Methods of household engagement with actors	Quantitative and qualitative	HHs and actors
Household engagement and adoption of clean technologies	Quantitative	HHs

4. Materials and methods

The following section outlines the methodology employed in this study, including the research design, data collection strategies, sampling procedures, and analytical techniques used to examine energy transition dynamics in rural Ghana.

4.1. Research design

The study utilised a cross-sectional design that combined qualitative and quantitative research techniques. Quantitative research investigates social phenomena through statistical or numerical data. It is grounded in the assumption that such phenomena are measurable and seeks to identify patterns and validate findings, through empirical analysis for generalisation (Bloomfield and Fisher, 2019). It has been critiqued for its limited capacity to capture human emotions and subjective experiences (Queirós et al., 2017). In contrast, qualitative research involves close engagement with the subject of study, allowing for deeper insight into human emotions and social dynamics (Aspers and Corte, 2019). Despite its strengths, it is criticised for being time-consuming and lacking generalisability (Queirós et al., 2017). Combining both approaches in this study helped to offset the limitations inherent in using either method individually (Dawadi et al., 2021). This comprehensive approach allowed for an in-depth analysis of energy transition, and ensured the reliability and trustworthiness of the collected data (Clark et al., 2021) — refer to Table 1.

4.2. Research scope

To address the research questions within the given timeframe, the scope was narrowed to ensure a focused inquiry (Akànle et al., 2020). Given that household energy use in rural communities largely centres on cooking and lighting (Shahi et al., 2020; Twerefou and Abeney, 2020),

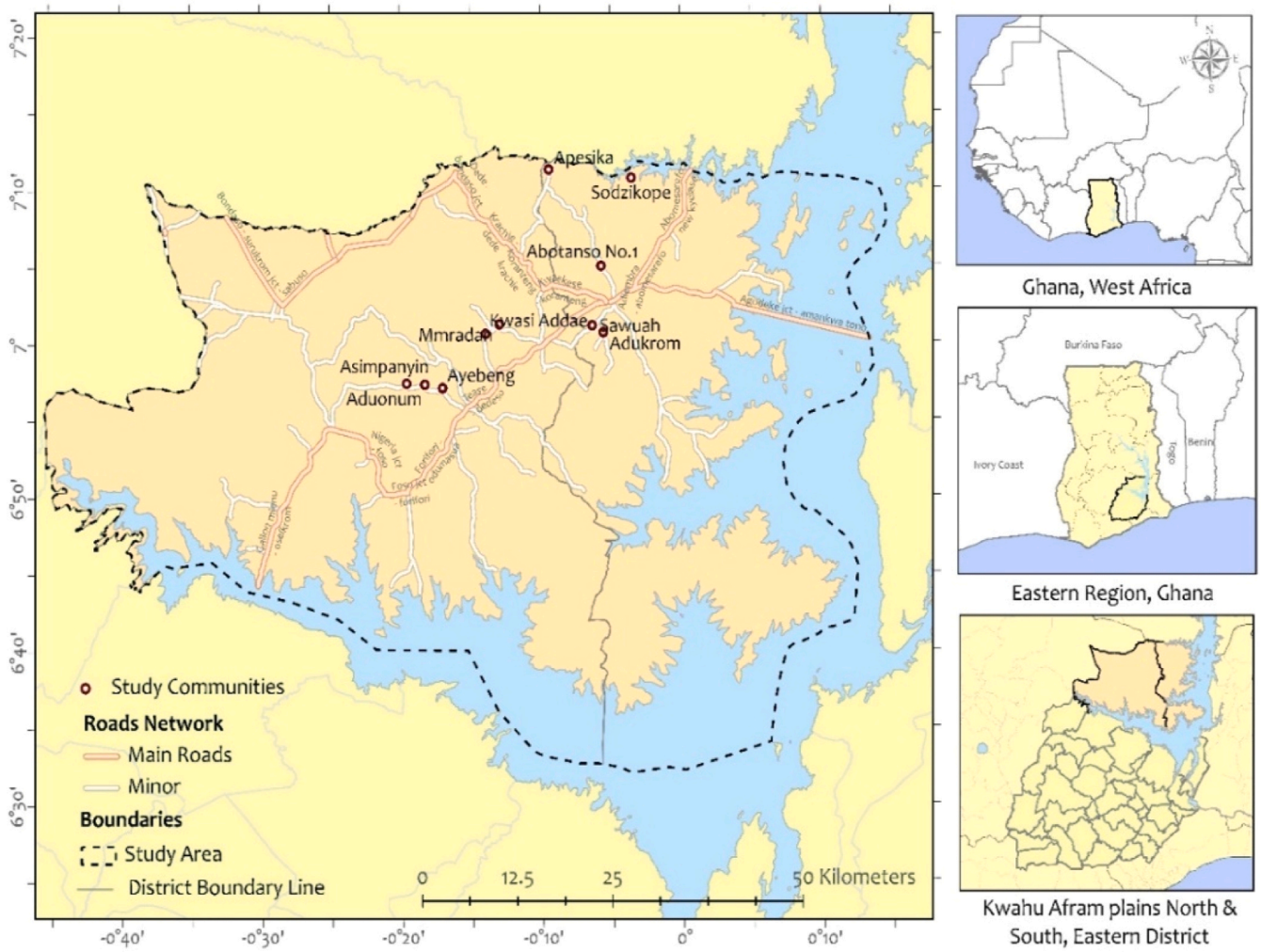

Fig. 1. A map of Ghana displaying the study districts and communities, created using Environmental Systems Research Institute (ESRI) shapefiles and ArcGIS 10.6.

this study limited its scope to the sources used for these specific functions. Although national-level actors, such as ministries and government departments, play a critical role in energy governance, they were not included in the study due to time constraints in the data collection process. However, the involvement of officers of DAs, the highest political authorities in the districts (Ayee, 2003), provided insights into governmental policies relevant to the research.

4.3. Study area

A case study approach, recognised for its effectiveness in conducting in-depth empirical investigation within a specific context (Yin, 2009; Swanborn, 2010), was employed (e.g. Christley et al., 2021; Simpson et al., 2021). The case study districts were the Kwahu Afram Plains North and Kwahu Afram Plains South Districts, located in the Eastern Region of Ghana. These districts were chosen as they exemplify rural environments where poverty and energy access challenges are prevalent (Ghana Statical Service, 2023a, 2023b). In consultation with officers from the DAs, off-grid rural communities were purposively chosen. This approach facilitated the targeted selection of communities most relevant to the study's focus (Sharma, 2017) – see Fig. 1 for a map showing the case study communities.

4.4. Data collection tools

Primary data were collected between September 2022 and February 2023. A semi-structured interview format, in English Language, was adopted for interviews. This format guided discussions according to the subject matter, while permitting the emergence of unanticipated insights (Sileyew, 2019; Husband, 2020). For surveys, questionnaires were used due to their efficiency and ability to yield a high response rate when well-designed (Parajuli, 2004). The questions, written in English, were mostly closed-ended and organised into sections to facilitate quick responses, and streamline coding and analysis (Rowley, 2014). Before commencing the actual data collection, all instruments were piloted to allow for adjustments and refinements, ensuring alignment with the study objectives (Taherdoost, 2021).

Using Chigbu et al. (2023) guidelines for conducting literature review, secondary data were obtained from peer-reviewed journals and reports. To retrieve more relevant articles, Boolean operators (AND, OR, NOT) and search modifiers such as 'intitle' and 'source' were applied to targeted keywords and search terms (Aliyu, 2017). Multiple search engines (Google, Google Scholar and Web of Science) were employed to optimise search results (Samadzadeh et al., 2013). The insights gained from the secondary data review shaped the development of data collection tools and informed the interpretation of the study findings (Brezina, 2012; Daas and Arends-Tóth, 2012).

4.5. Method of sampling

The study employed a two-tier sampling approach: institutional sampling and community sampling. Institutional level sampling

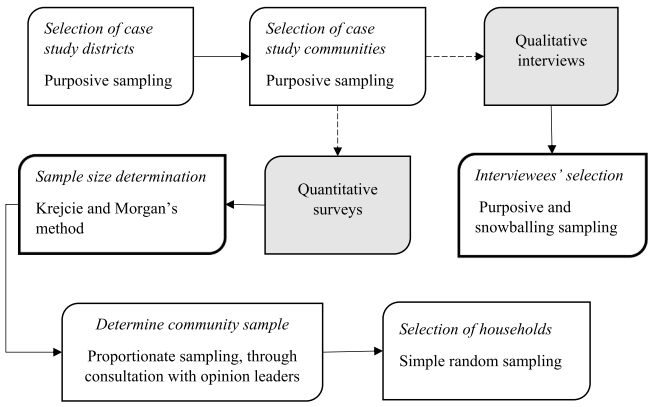

Fig. 2. Sampling process flowchart.

with Sovacool et al. (2018), who emphasised that appropriate sample size should be informed by the research question, available resources and accessibility of the target population.

A proportionate stratified random sampling was employed to recruit representative household for the community survey (see for instance, Pambudi et al. 2024). This method was selected to account for the varying population sizes across the chosen communities, with sample sizes for each stratum (community) determined proportionally to its population (Arnab, 2017; Iliyasu and Etikan, 2021). While exact population figures were not used for formal calculation,[4] community size estimates, obtained through consultation with opinion leaders, guided the allocation of sample sizes. This ensured that larger samples were drawn from more populous communities. Within each community, households were randomly selected. This approach proved useful following the homogenous nature of the communities, being predominantly rural and off-grid (Davis and Scott, 2007; Noor et al., 2022)

Table 2
Socio-demographic characteristics of HHs.

Variable	Category	Name of communities and frequencies										Total	%
		Ayebeng	Aduonum	Adukrom	Asimpanyin,	Mmradan	Kwasi Addae	Apesika	Sawua	Sodzikope	Abotanso1		
Sex	Male	3	18	18	17	36	38	15	14	47	39	245	58.5
	Female	1	10	10	10	21	17	22	4	29	50	174	41.5
	Total	*4*	*28*	*28*	*27*	*57*	*55*	*37*	*18*	*76*	*89*	*419*	*100*
Age	18–20	0	0	0	0	0	1	1	2	3	5	12	2.9
	21–30	1	2	7	7	11	4	7	0	16	14	69	16.5
	31–40	2	6	4	8	19	6	9	1	15	13	83	19.8
	41–50	1	9	6	3	9	14	8	4	26	21	101	24.1
	51–60	0	7	6	4	13	18	4	6	12	19	89	21.2
	> 61 years	0	4	5	5	5	12	8	5	4	17	65	15.5
	Total	*4*	*28*	*28*	*27*	*57*	*55*	*37*	*18*	*76*	*89*	*419*	*100*
Status	Native	3	11	13	18	41	40	24	13	57	58	278	66.3
	Migrant	1	17	15	9	16	15	13	5	19	31	141	33.7
	Total	*4*	*28*	*28*	*27*	*57*	*55*	*37*	*18*	*76*	*89*	*419*	*100*
Educational level	No School	2	15	3	8	14	21	12	6	23	12	116	27.7
	Basic	2	11	23	14	34	30	23	11	51	70	269	64.2
	Secondary	0	2	0	5	4	4	2	0	1	7	25	6.0
	Tertiary	0	0	2	0	5	0	0	1	1	0	9	2.1
	Total	*4*	*28*	*28*	*27*	*57*	*55*	*37*	*18*	*76*	*89*	*419*	*100*

comprised interviews with actors (PCETPs, DA officers and NGOs), while community level sampling included community surveys and key informant (chiefs and opinion leaders) interviews. In selecting interviewees, a non-probability sampling method, combining purposive and snowball sampling techniques was applied. Initially, participants were purposively selected based on their roles and expertise in energy transitions at the local level. Subsequently, snowball sampling was used, whereby initial participants referred additional relevant actors within their networks. This method was particularly effective for identifying actors who possess extensive knowledge of energy transition (Sharma, 2017; Mweshi and Sakyi, 2020). In total, 23 institutional and key informant interviews were carried out.

Community surveys were conducted with households in the ten selected rural communities. The sample size for surveys was determined following Krejcie and Morgan's (1970) guidelines for determining sample size (see for e.g., Chiwaridzo, 2023; Bazgir et al., 2024; Chiwaridzo, 2024). Given that the household population in the two districts is close to 40000,[3] a sample size of 380, as recommended by Krejcie and Morgan (1970), was targeted. However, a total of 419 surveys were ultimately collected due to household availability. This decision aligns (Fig. 2).

In every selected household, preference was given to interviewing HHs, as they are generally considered to possess comprehensive knowledge of household decision-making processes, including those related to energy access (Bookwalter et al., 2006). In cases where the HH was unavailable or declined to participate, a mature and responsible household member was interviewed instead. No preference was given to any particular demographic group. Table 2 presents the socio-demographic characteristics of surveyed HHs.

4.6. Ethical considerations

Ethical considerations were addressed with the Mary Immaculate College Research Ethics Committee (MIREC), reference number 'A21–056'. This ensured that all aspects of the study, adhered to established ethical standards concerning informed consent, confidentiality and the protection of participants' rights (Fisher and Anushko, 2008; Arifin, 2018). Participants were provided with detailed information about the purpose, scope and procedures of the study. This emphasised the voluntary nature of their involvement and assured them of anonymity and confidentiality (Pacho, 2015). Informed consent was

[3] The two districts, predominantly made of rural populations, have a total of 37,054 households – 19,431 in Kwahu Afram Plains South and 17,623 in Kwahu Afram Plains North (Ghana Statistical Service, 2021).

[4] Due to the remoteness of the rural communities, official population statistics do not provide disaggregated data on community-level population sizes.

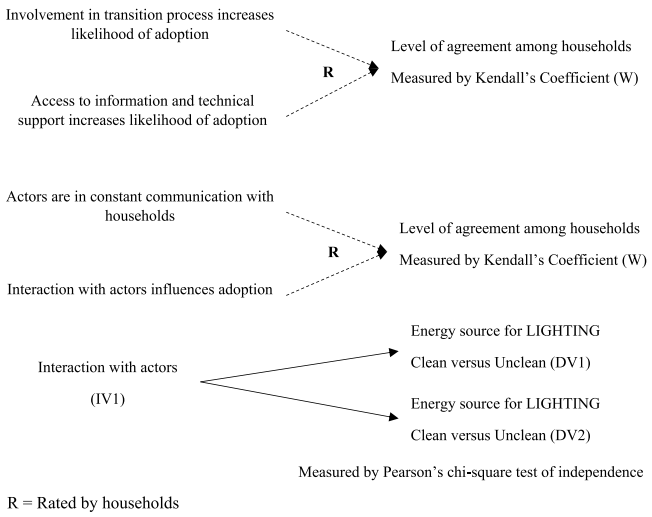

Fig. 3. Conceptual diagram of the quantitative analysis.

obtained from all participants, either in written form by signing a consent form or verbally. With participants' permission, audio recordings and field notes were taken (Denscombe, 2017). All data and research materials were securely stored in a password-protected digital folder to prevent unauthorised access.

4.7. Data analysis and management

Before quantitative analysis, data were screened for outliers and cleaned to ensure completeness and accuracy. No outliers were identified that would unduly influence the results, and missing values relevant to specific tests were excluded listwise (Gerber and Finn, 2005). Quantitative data from surveys were analysed using SPSS (version 28.0) and Microsoft Excel (e.g., Njenga et al., 2021; Alemu and Getie, 2024). To examine the level of agreement among households on ordinal-scale statements, Kendall's coefficient of concordance (W) test (1 indicating perfect agreement and 0 indicating no agreement) was employed (Cao et al., 2024). This non-parametric test is suitable for assessing consensus among multiple raters (Teles, 2012). Pearson's chi-square test of independence was used to explore associations between categorical variables (Ateba et al., 2019; Hussein et al., 2025). Descriptive statistics, including frequencies and percentages, were used to summarise results (Addis and Cheng, 2023; Tladi et al., 2024) — refer to Fig. 3 for a conceptual diagram of the quantitative analysis.

Diagnostic checks confirmed that the assumptions underlying both Kendall's W and Pearson's chi-square tests were met, including the use of ordinal Likert-scale data and categorical variables. Robustness checks were conducted by re-categorising responses and repeating analyses across demographic subgroups (e.g., gender and residential status). Results remained consistent across these specifications, reinforcing the stability and reliability of the findings.

The qualitative data on the other hand, were first transcribed. A reflexive thematic analysis was then performed to identify and develop themes, following Braun and Clarke's (2021) approach. This process began with familiarisation with the data through repeated reading of transcripts. Initial codes were generated which were then reviewed and collated into potential themes. These themes were iteratively refined to ensure coherence, and were named to reflect core meanings. The interview data were compared with quantitative data to identify points of convergence and divergence.

The qualitative and quantitative datasets were comprehensively synthesised to explore energy transition within the study communities. To produce a scholarly report, the findings were compared and contextualised with existing literature. Excerpts from some interviews were incorporated to reinforce the findings (Olagoke et al., 2024), with participants referred to by pseudonyms[5] to ensure confidentiality. The selection of excerpts was guided by the author's expert evaluation of relevance (Hjeij et al., 2023).

Table 3
Summary of themes from interviews.

Variable	Main themes
Key actors	State/Government NGOs PCETPs
Main activities	Provision of clean technologies Provision of information on clean energy Provision of technical assistance
Actor collaborations	Improved collaboration among NGOs Limited collaboration and competition among PCETPs Minimal collaboration between NGOs and DAs
Household participation in transition process	Limited engagement in identification and design of technologies High level of engagement at implementation stage Minimal post-adoption engagement

5. Results and discussion

Out of the 419 HHs surveyed, males constituted 58 %. The majority fell within the 41–50 age group (24 %), followed by those aged 51–60 (21 %) and 31–40 (20 %). Respondents over 60 years made up 16 %, while only 3 % were aged 18–20. Approximately 34 % of participants were migrants. Educational attainment was highest at the basic level (64 %), with 28 % having no formal education (refer to Table 2). Only a small proportion had secondary (6 %) or tertiary (2 %) education. The main themes from the interviews are summarised in Table 3.

5.1. Key actors in energy transition

The findings identified both state and non-state actors as actively involved in clean energy transition. The key actors included the state/government (through DAs), PCETPs and NGOs. DAs were the closest actors to rural communities. Being representatives of the central government, all state-led activities went through the DAs. They therefore serve as a conduit to disseminate information on national energy policies and plans to rural communities. This was affirmed by a DA officer:

> *"The District Assembly is informed about every government intervention aimed at providing communities with clean energy. Once we get this information, we pass it on to the community representatives for dissemination. At times, we go to the communities ourselves to disseminate information"* – (Kofi, January 2023).

NGOs and PCETPs were also recognised for their significant contributions. NGOs were primarily involved in facilitating community engagement and supporting sustainable development initiatives. PCETPs were small-scale companies and retailers who sold products from house-to-house. Many of them engaged directly with households without prior notification to the DAs. The door-to-door sales approach by PCETPs made it challenging for DAs to effectively monitor their activities. As one DA officer explained:

> *"It is difficult to track the activities of private clean technology providers since they do not alert the District Assembly of their entry to communities. At times, the local representatives are not even aware of their operations in the communities"* – (Kwaku, December 2022).

[5] Common local names were used to ensure anonymity and to give the study a more familiar and local feel

The findings reinforce the importance of multi-actor engagement in energy transitions, consistent with Agyarko et al. (2020) and Dagnachew et al. (2020). Ghana's case is relatively unique within the SSA context, with PCETPs playing a notably prominent role (Wassie and Adaramola, 2021). The active involvement of DAs further underscores the significance of decentralisation in advancing national energy transition goals (Institute of Local Government Studies and Friedrich-Ebert-Stiftung Ghana, 2010; Fairholm et al., 2018; Obeng-Darko, 2019). Decentralisation, by devolving power and decision-making authority to local government bodies, allows for more context-specific, responsive, and inclusive policy implementation. DAs, being closer to local communities, are well positioned to understand the unique energy needs, social dynamics, and development priorities of their constituencies. Despite being decentralised extensions of the central government, the role of DAs in shaping national energy policy remains unclear (Akrofi and Akanbang, 2021).

5.1.1. Actors in action

An analysis of actors' activities revealed that interventions focus on provision of technologies. Government and NGO-led initiatives were typically offered at free or low-cost and tended to involve large-scale technological solutions. In contrast, PCETP interventions incurred costs for recipients and predominantly involved simpler technologies.

In promoting transition, actors also disseminated information on clean energy. However, this was typically limited to occasions when actors had a technology to introduce to households. Many actors stated that their messaging generally focused on socio-economic benefits, downplaying environmental advantages. They attributed this limited environmental focus to the perceived low literacy levels among households, suggesting that households may find it difficult to understand the environmental benefits. Actors who previously highlighted environmental advantages reported a general lack of interest from households, and have started to prioritise tangible and short-term gains. Explaining the reasons for this strategic decision, some actors explained that:

> *"While clean energy technologies offer environmental benefits, it is essential to prioritise the cost and quality of the products, as these are the primary factors households evaluate when deciding the energy source to use" – (Yaw, October 2022).*

> *"The environmental benefits associated with clean energy technologies are less emphasised during the implementation of clean energy projects. This is because rural households are indifferent toward such benefits. As a marketer, I have to tell potential buyers the things they find relevant, rather than highlighting the things they consider 'irrelevant', such as the environmental benefits" – (Kwadwo, November 2022).*

Additionally, actors provided technical assistance to households in forms such as installation support and maintenance. Some actors had offices in district capitals, allowing households to visit for technical support. Others also made visits to communities to address the technical issues. An officer of the DA acknowledged that:

> *"Actors primarily engage in the provision of clean energy technologies and the delivery of technical support to households. Specifically, NGOs that provide households with clean energy technologies conduct monitoring visits to evaluate the efficacy of the technologies and repair any malfunctioning units" – (Ama, October 2022).*

The findings align with previous works (Hassan et al., 2014; Steel et al., 2016; Lakatos and Arsenopoulos, 2019; Daoudi, 2024) which highlight that transition efforts involve technology provision, information dissemination and technical support. While such efforts may enhance adoption (Acharya and Marhold, 2019; Agyarko et al., 2020; Qadir et al., 2021), their impact is often limited without accompanying financial assistance — an aspect identified as critical by Guta (2020), Twumasi et al. (2021) and Wassie et al. (2021). Yet, largely absent in current interventions is the provision of financial assistance. Moreover, consistent with Adenle (2020) and Baker et al. (2021), the limited attention to environmental impacts reflects a narrow conceptualisation of energy transition. This implies that the current efforts by actors may be insufficient to facilitate households' shift to clean energy technologies.

5.1.2. Interactions for a sustainable energy transition

Some actors who engaged with state institutions, such as the Ministry of Energy and the Energy Commission of Ghana, expressed concerns about the perceived political polarisation of these bodies. This perception created a barrier to effectively influence national policy design and implementation. Consequently, some reported declining interest to engage with state institutions. On the contrary, the study found stronger collaboration among NGOs, many of which organised and participated in seminars and conferences to share knowledge.

Collaboration among PCETPs remained limited. Some deliberately refrained from collaborating with peers out of concerns that their strategies might be copied. This protective stance reflects the competitive dynamics within the sector, where knowledge-sharing is often perceived as a risk rather than a collective benefit — as recounted by a respondent:

> *"I do not share the approach I use to distribute solar technologies with other providers, neither do they share their methods with me. If I happen to come across an approach that I believe is effective, I adopt and apply it" – (Kwame, January 2023).*

While NGOs collaborated with DAs, they rarely involved them during project conceptualisation. DAs typically became aware of energy projects only after funding had been secured or during implementation. According to some NGO representatives, this was partly due to the personal and political ambitions of certain DA officials (e.g. District Chief Executives (DCE)).[6] The lack of early engagement often results in weak support from DAs, as noted by an officer:

> *"Some NGOs involve the District Assembly during the implementation of their projects. However, the Assembly can contribute much more if involved from the ideation stage of projects" – (Yaw, February 2023).*

The lack of unified purpose, identified by Tettey et al. (2025), emerges as a significant barrier to energy transition. Consistent with Francis et al. (2022), the findings reveal limited collaboration among key actors, which undermines transition efforts (Akwei et al., 2020; Sanderink and Nasiritousi, 2020). The political affiliations of some DA and national level officers inhibit collaboration, especially with NGOs (Debrah, 2016), constraining their ability to influence policies at higher levels (Akwei et al., 2020). Interestingly, NGOs demonstrate relatively stronger collaboration levels, possibly due to their development-oriented and non-profit mandates (Kwao and Amoak, 2022). In contrast, PCETPs appear less cooperative – likely influenced by profit-maximisation motives within a perfectly competitive market (Osório, 2023). These dynamics underscore the need for enhanced collaboration (Abe and Azubike, 2024), particularly as elements of procedural and recognition injustices persist at the institutional level (Jenkins et al., 2016; LaBelle, 2017). For instance, the dominance of state actors and the marginalisation of non-state actors (e.g., NGOs), reflect limited recognition of diverse stakeholder roles. Competition among PCETPs, along with the political affiliations of certain high-ranking, poses a challenge to procedural and recognition justice.

5.2. Household engagement in energy transition

Actors often import clean energy technologies and typically engaged

[6] The DCE is the head of the DA and is appointed by the president (Institute of Local Government Studies and Friedrich-Ebert-Stiftung Ghana, 2010). This renders the DCE primarily accountable to the central government rather than the local people.

Table 4
Households' likelihood to adopt clean energy technologies.

Variables	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Mean	Kendall's W
Households are likely to adopt clean technologies if involved in the transition process	43.2 %	39.6 %	10.5 %	6.2 %	0.5 %	1.811	0.055
Households are likely to adopt clean energy technologies if there is adequate information and technical support	24.1 %	53.0 %	20.3 %	2.6 %	0 %	2.014	

households only after selecting and importing these technologies—limiting household participation to the implementation stage of the transition process. At this point, households are introduced to the products and their purported benefits, typically through promotional campaigns aimed at encouraging household adoption. Although some actors recognise the value of post-implementation visits, such visits were inconsistently conducted. A PCETP noted:

> *"I am constantly on the move from one off-grid community to the other. While I agree that it is necessary to get feedback from buyers, I rarely visit the communities after selling the products. I, however, give my number to households so that they can contact me if they encounter any problem" – (Kwaku, January 2023).*

The findings reflect a trend across SSA, where clean technologies are frequently imported (Jackson et al., 2021). Reliance on imported solutions constrains the contextualisation of energy solutions, which poses a challenge to adoption of clean technologies (Broto et al., 2018; Heffron and McCauley, 2018; Heiskanen et al., 2022). The limited involvement of households in the design and selection of technologies reinforces their role as passive consumers, a practice often criticised as being unjust (Bartiaux et al., 2018; McCauley et al., 2019; Droubi et al., 2022). This reveals a top-down approach to energy transition that limits meaningful participation from end-users during critical stages of the process. By selecting and importing technologies before engaging households, actors effectively exclude them from decision-making processes that could shape the suitability, accessibility and cultural acceptance of the technologies introduced.

5.2.1. Methods of household engagement with actors

Analysis of responses to a multiple-choice question on communication methods revealed that the majority of HHs (82 %) reached actors by visiting their offices, while 77 % interacted with them during community visits. In contrast, only 5 % contacted actors through telephone calls. Office visits occurred both before and after technology adoption—initially to explore available options and assess feasibility, and later to resolve issues and optimise usage. These offices were typically located outside the communities, and community visits by actors were irregular.

The findings indicate a degree of engagement between HHs and actors. The presence of offices (Nuru et al., 2021b) and community visits by actors (Shoemaker et al., 2018) can play a pivotal role in facilitating energy transitions. However, the location of actors' offices outside of rural communities poses potential barriers to timely and frequent access—especially for households with limited mobility or financial means. The inconsistency of community visits limits their effectiveness in fostering sustained communication and support. This irregularity, coupled with the geographical distance of actor offices, may hinder equitable access to information and support for households.

From a procedural justice perspective, these limitations reduce opportunities for meaningful and consistent household participation in decision-making and support system (Akrofi et al., 2024). Although some solar technologies can charge mobile phones, their high cost remains a barrier for low-income households (Baurzhan and Jenkins, 2016). These logistical, technological and financial barriers reflect a form of recognition injustice, wherein the socio-economic constraints of households are overlooked in the design and implementation of transition strategies (Jenkins et al., 2016; Alford-Jones, 2022; Akrofi et al., 2024).

5.2.2. Households' likelihood to adopt clean technologies

A significant number of HHs (83 %) indicated a greater likelihood of adopting clean technologies if actively involved in the transition process. Moreover, 77 % of HHs recognised the importance of information and technical support in adopting clean technologies, indicating that they would be more likely to adopt if such support were available. However, a Kendall's W test assessing the level of agreement among respondents (x^2 (1, N = 419) = 23.211, K= 0.055), showed minimal level of consensus (Table 4).

Consistent with prior studies, many HHs are likely to adopt clean energy technologies when actively involved in the transition process (Ruiz-Mercado and Masera, 2015; Cloke et al., 2017; Agyarko et al., 2020; Boateng et al., 2023a) and when provided with adequate information and technical support (Mfune and Boon, 2008; Hellmuth et al., 2019). However, the findings highlight a missed opportunity to improve adoption outcomes through a more meaningful household engagement. Active participation of households enables actors to gather requisite information to contextualise initiatives, as transitions "play out in different ways across contexts and scales" (Sareen and Haarstad, 2018, p. 630).

A more participatory approach could significantly improve outcomes by fostering household trust, increasing perceived legitimacy of the process, and enhancing the relevance and acceptability of clean energy technologies. As suggested by Cantarero (2020) and Zulu et al. (2022), such approaches can promote deeper inclusion and ultimately lead to higher adoption rates, reinforcing the need for frameworks that prioritise household engagement as a core component of energy transition strategies.

5.3. Actor-household interaction for a sustained transition

To assess the interaction between actors and rural households and its influence on the adoption of clean energy technologies, HHs were asked to rank their agreement with two statements: "Actors are in constant communication with you" and "Interaction with actors has influenced your adoption of clean energy technologies," using a 5-point Likert scale (1 = strongly agree; 5 = strongly disagree). Thirty-seven percent of HHs disagreed that actors are in constant communication, while 30 % agreed. Regarding influence on adoption, 34 % agreed that interaction with actors had shaped their decision to adopt clean technologies,

Table 5
Households' interaction with actors.

Variables	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Mean	Kendall's W
Actors are in constant communication with you	2.4 %	27.9 %	32.9 %	32.0 %	4.8 %	3.089	0.134
Interaction with actors has positively influenced your adoption of clean energy technologies	2.1 %	32.0 %	49.4 %	16.0 %	0.5 %	2.807	

Table 6
Association between communication with actors and households' choice of energy sources (clean and unclean).

Variable	Actors in constant communication	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total (N = Sample)	P-value
Light	Clean	5	66	75	83	11	240	0.698
	Unclean	5	51	63	50	9	178	
	Total	*10*	*117*	*138*	*133*	*20*	*418*	
Cooking	Clean	0	1	1	0	0	2	0.859
	Unclean	10	116	137	134	20	417	
	Total	*10*	*117*	*138*	*134*	*20*	*419*	

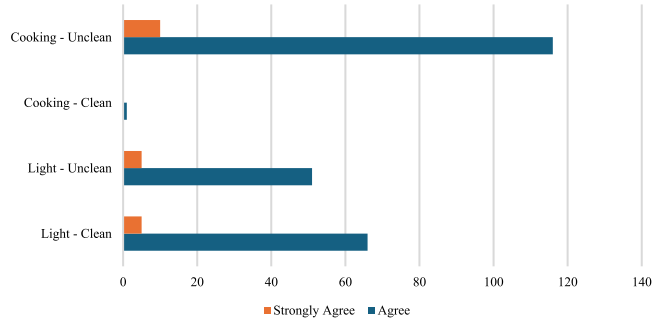

Fig. 4. Actors interaction with households and energy decision.

whereas 17 % disagreed. A Kendall's W test revealed a low level of agreement among HHs (x^2 (1, N = 419) = 56.178, K= 0.134) (Table 5).

The absence of constant communication between households and key actors – whether through verbal, non-verbal or mass media channels – suggests that some households may lack adequate information on clean energy transition (e.g. technologies, policies, laws and regulations) – as highlighted by Bishoge et al. (2020). This reflects procedural injustice as limited access to information restricts households' ability to participate meaningfully in decisions that directly impact their energy futures (Apergi et al., 2024). The noticeable disagreement among HHs regarding the level of communication with actors and its impact on their adoption of clean energy technologies indicates that, while some HHs reported regular interaction that positively influenced their adoption, a substantial proportion disagreed. This divergence underscores the need for more structured and tailored communication strategies (Lindgren, 2020; Haque et al., 2021).

5.3.1. *Impact on household current energy preferences*

A chi-square analysis showed no significant relationship between communication with actors and households' choice of energy for cooking (X^2 (4, N = 419) = 1.315, p > .05) and for lighting (X^2 (4, N = 418) = 2.207, p > .05) (Table 6). Based on HHs who reported frequent communication with actors (agree or strongly agree), adoption patterns varied notably between energy uses. A majority relied on unclean fuels for cooking, with minimal uptake of clean alternatives, while lighting showed a more balanced distribution (Fig. 4).

The results suggest that communication with actors influences household energy choices unevenly. While some households translate this engagement into the adoption of clean technologies, others continue to rely on unclean sources, indicating variations in the quality and content of interactions (Lindgren, 2020). Even when communication is perceived as regular, the findings suggest that it may not be sufficient to drive meaningful behavioural change — as other factors, such as cost, availability, reliability and accumulated knowledge play significant roles (Adenle, 2020; Hansen and Xydis, 2020; Wassie et al., 2021; Boateng et al., 2023b). The persistence of unclean energy sources, particularly for cooking, reflects a broader failure to consider the diverse socio-economic and cultural realities influencing household energy practices (Boateng et al., 2023b).

6. Conclusions and practical implications

Drawing on primary data from key actors and households in the Kwahu Afram Plains North and South districts, this study examined energy transition through a procedural and recognition justice lens. The findings reveal notable injustices across both dimensions. Although state and non-state actors are actively involved in the process (Agyarko et al., 2020; Dagnachew et al., 2020), a lack of collaboration constrains a smooth transition (Sanderink and Nasiritousi, 2020; Singh and Ru, 2022). Despite household engagement being recognised as critical for adoption (Ruiz-Mercado and Masera, 2015; Boateng et al., 2023a), limited HH engagement reflects procedural injustice. Infrastructural and financial barriers to digital communication continue to hinder participation, exacerbating recognition injustice (Baurzhan and Jenkins, 2016; Alford-Jones, 2022). The study provides empirical support that affirms the need for more inclusive and context-specific strategies in transition (Cantarero, 2020; Zulu et al., 2022).

In the rural Ghanaian context, the limited collaboration among key actors and the competitive dynamics among some non-state actors highlight the need for institutional reforms that promote structured coordination and shared responsibility in energy transition (Agyarko et al., 2020; Francis et al., 2022). Formal mechanisms such as district-level multi-stakeholder energy platforms could be established to facilitate inclusive dialogue and harmonise efforts by actors. To ensure equity, transition policies must embed procedural and recognition justice by actively involving rural and marginalised communities in decision-making processes (Baker et al., 2021; McCauley et al., 2022). These measures can ensure that energy transition policies are not only technically effective but also fair and equitable. This is particularly relevant for Ghana and other SSA contexts, where similar structural and socio-economic challenges shape the energy transition landscape.

This study has limitations that offer opportunities for future inquiry. It focused exclusively on local-level actors, which may not capture the full spectrum of institutional dynamics; future research could examine national-level stakeholders to understand how broader governance structures shape energy transition efforts. The study did not assess the role of national policies and the dynamics of power relations among actors in the clean energy transition. Investigating this would offer valuable insights into multi-scalar power and justice dynamics. By concentrating on off-grid rural communities, the findings of the study are context-specific; further studies in other contexts would enhance generalisability and allow for comparative analysis across diverse settings. Despite these limitations, the study contributes to the energy literature by providing empirical evidence on the justice dimensions of transitions in Ghana.

CRediT authorship contribution statement

Dickson Boateng: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization.

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.

Acknowledgment

This research was supported by the Department of Geography, Mary Immaculate College, University of Limerick. I gratefully acknowledge the guidance of my supervisors, Dr. Julian Bloomer and Dr. John Morrissey.

Data availability

The data that has been used is confidential.

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