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ENERGY TRANSITION KNOWLEDGE AND PERCEIVED BENEFITS AMONG HOUSEHOLDS IN KPONE-KATAMANSO MUNICIPALITY, GHANA

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ABSTRACT

Purpose: This research was conducted to find out people's satisfaction with the current energy situation in Kpone Katamanso Municipality and asses their willingness to transition to a more sustainable source of energy.
Design/Methodology/Approach: Stratified sampling was employed to categorise the entire municipality into strata, facilitating data collection. A sample size of (100) respondents answered questionnaires administered to them. A 5-point Likert scale questionnaire was administered to individual respondents during the data collection. Exploratory Factor analysis was done using both descriptive and bivariate analysis (the Pearson correlation method with a confidence level of 95% and a two-sided significance level of 5%).
Research Limitation: The sampled survey covered only a section of the study population in Ghana. As such, the results cannot be generalised for the entire population of Ghana.
Findings: It showed that awareness and knowledge, perceived benefits and costs, attitude, and motivation have a strong positive relationship with people's willingness to shift to sustainable energy. Additionally, Kpone Katamanso Municipality is dissatisfied with the current energy situation and looks forward to transitioning to more sustainable energy sources, provided they are cost-effective.
Practical Implication: This study on readiness for energy transition shows the willingness of the sampled population to accept energy transition. As such, if energy transition is implemented, it will enable Ghana to achieve a Net-Zero carbon economy by 2070.

Social Implication: The demonstrated willingness for energy transition reveals emerging social consensus around environmental priorities, potentially strengthening community cohesion around sustainability goals and creating foundations for collective action on climate issues.
Originality/ Value: The research identifies and categorises previously unexplored benefit perceptions unique to household contexts, including family security, domestic comfort, social status, and intergenerational considerations that influence energy transition decisions.

Keywords*: Benefits. energy. knowledge. society. transition*

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INTRODUCTION

Energy plays an integral role in the daily lives of people for purposes of industrialisation, urbanisation, and motorisation; however, the use of fossil fuels for energy is considered unsustainable (Onwe et al., 2024; Webber, 2015). Energy transition is defined as a global shift from fossil energy sources, such as crude oil, natural gas, and coal, to renewable energy sources, including wind, solar, and other Hydrothermal power sources (World Energy Outlook, 2023).

Ghana has made significant progress in expanding access to electricity, with an electrification rate of 86% as of 2018 (International Energy Agency, 2019). Despite increased access to electricity, 80% of the energy used is derived from fossil fuels, a source of energy that has negative health and environmental impacts (Nyasapoh, 2022). It is reported that fossil fuels cause household air pollution, which is responsible for over 3.5 million premature deaths worldwide (World Health Organzation, 2015).

Access to renewable energy sources, such as clean cooking fuels, remains a significant challenge, with only 14% of households using clean fuels like liquefied petroleum gas (LPG) or biogas for cooking (IEA, 2019). It is anticipated that renewable energy in the form of solar and wind will contribute 20% of the installed generation capacity by 2070 (World Energy Outlook, 2023).

In pursuit of sustainable energy development, technological advancements over the years have helped make progress from the use of fossil fuels and hydroelectric power supply systems to wind and solar energy systems (Lukashevych et al., 2024; Agoundedemba et al., 2023).

The concept of energy transition is relatively new in Ghana, and many people are uncertain about what it entails (Osei-Tutu et al., 2021). A primary goal of the energy transition is to achieve net zero carbon emissions. As such, 130 nations worldwide, including Germany and Sweden, have set a target of attaining zero carbon emissions by 2050 (World Economic Forum, 2023). According to the World Resources Institute (2019), there is a high level of support for the adoption of renewable energy sources in Ghana, with 94% of Ghanaians in favour of using renewable energy sources. Solar power is perceived as the most popular renewable energy source. Although there is support for the adoption of renewable energy, financial constraints and high upfront costs are barriers to the Energy transition among most households in Ghana (Addaney et al., 2019).

In pursuit of an energy transition, Ghana has developed a National Energy Transition Policy, taking into consideration existing energy policies and the current energy situation, to achieve a net-zero energy economy where carbon emissions are balanced by the total carbon removed from the atmosphere (International Monetary Fund, 2021). China is ranked as the world's top investor in renewable energy, primarily focusing on solar and wind energy, with the aim of achieving net-zero carbon emissions (Wood Mackenzie, 2023).

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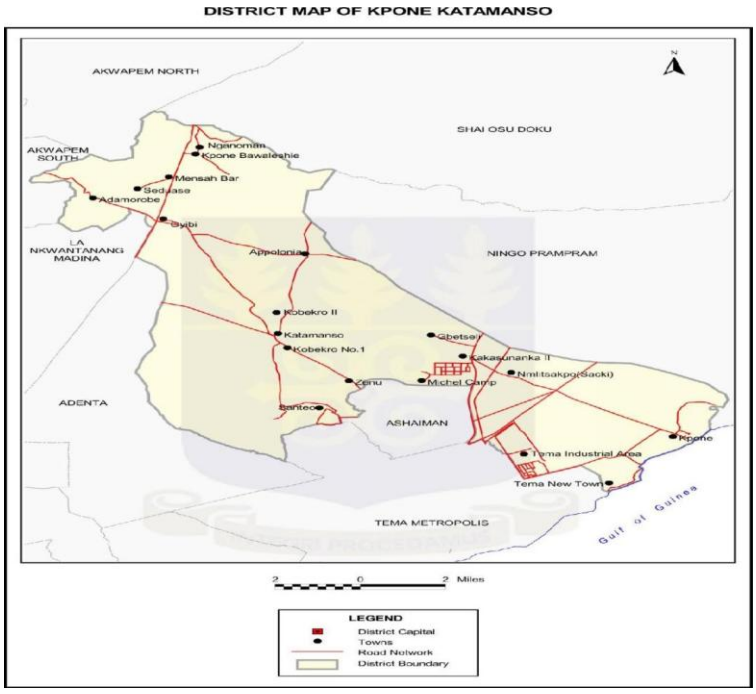
Kpone Katamanso Municipality, a hub of residential and industrial activities, use fossil and bioenergy. However, issues of frequent light-offs have compelled people to use generators, which are considered expensive and environmentally unfriendly. Given these challenges, this study was carried out to find their views on their preparedness for a transition to a more sustainable energy source.

Study Area

Kpone-Katamanso Municipality is made up of four (4) Area Councils, namely: KPONE (Afieye, Laloi, and Dingle); KAMSBEG (Kakasunanka, Nmlitsakpo, Sebrepor, Bethelhem and Gbetsile); ZEKAS (Zenu, Katamanso, Appolonia and Saasabi) and ONSBAC (Oyibi, Nanoman, Saduase, and Bawaleshie). The primary sources of lighting in dwelling units in the district are electricity (74.9%), kerosene lamps (13.4%) and flashlight/torch (7.5%),

As far as fuel for cooking is concerned, most households use charcoal (45.8%) (GSS, 2010).
The Kpone Katamanso Municipality is the site for the Asogli thermal plant that produces power that feeds into the national grid. The Municipality is also connected to the National grid (GSS, 2010).



Source: Ghana Statistical Service, 2021

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LITERATURE REVIEW

According to the International Renewable Energy Agency (2018), energy is a basic necessity of life that has undergone significant improvement in terms of technological development over the years, with shifts from the use of fossil fuels and hydroelectric power supply systems to wind and solar energy. This shift from fossil fuels to renewable energy sources, such as wind, solar, and other hydrothermal power sources, refers to the energy transition (United Nations Industrial Development Organisation, 2022). A transition from fossil fuel energy sources to clean energy requires the substitution of unsustainable fossil fuel energy for eco-friendly energy sources as their environmental impact is relatively very low compared to non-renewable sources (York & Bell, 2019).

Although solar PV systems are cost-effective and environmentally friendly, suitable for rural electrification in Ghana, challenges such as high upfront costs and limited financing options for households prevent their widespread adoption in rural settings (Adaramola et al., 2019). Further challenges to the energy transition in Ghana include the lack of a clear policy framework for renewable energy, inadequate funding for research and development, and a shortage of capacity building in the renewable energy sector (Ghana Energy Commission, 2017).

The acceptance of energy transition in many countries is a result of factors such as people with higher incomes who are willing to invest in renewable energy, thereby being willing to pay for its cost when the energy source is available (Von Borgstede et al., 2013). Furthermore, the social norms of communities influence the adoption of clean energy technologies (De Groot & Steg, 2010). Social norms refer to shared beliefs, values, and cultural practices that determine appropriate behaviour that influence the decision of households in communities to switch to renewable energy (De Groot & Steg, 2010). Additionally, policies aimed at increasing the affordability and accessibility of renewable energy, such as tax incentives, credits, grants, subsidies, net metering, and feed-in tariffs, encourage the acceptance of the energy transition (Hackbarth, 2017). The implementation of net-metering policies in the United States of America, Canada, and Australia has led to an increase in the adoption of solar energy systems by households (Krupa & Savoska, 2020).

METHODOLOGY

Stratified sampling was used to classify the entire municipality into starters to facilitate data collection. A sample size of (100) respondents answered questionnaires administered to them. A 5-point Likert scale questionnaire was administered to individual respondents during the data collection. Those who had difficulty understanding the questions were assisted by having the questions explained to them. Key questions on the questionnaire were three key variables: thus (Awareness and Knowledge, Perceived Benefits and Costs associated with energy transition, and Attitude and Motivation for energy transition). Attitude and Motivation served as the independent

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variables, and Household Energy Transition was the dependent variable. The test items were presented as statements, and participants were asked to rate their agreement on a 5-point Likert scale where one indicates "strongly disagree" and 5 indicating "strongly agree."

The collected data was analysed using SPSS software version 30.0 (IBM Corp., USA), and the results were presented in tables, charts, and figures. Exploratory Factor analysis was done using both descriptive and bivariate analysis (the Pearson correlation method with a confidence level of 95% and a two-sided significance level of 5%).

This approach helped to explore factors that influenced people's decision to transition to renewable energy sources. Moreover, these factors include economic factors, social norms and values, believes, government policies and incentives.

RESULTS

The majority of the respondents, 53%, were female, and a few were male; thus, 47% were mostly in their youthful ages, ranging from 18 to 30 years. The youngest age group constituted 42% of the study population, followed by respondents aged 31 -42 years, who made up 32% of the respondents. The least represented age group was 55 years and above, which accounted for 6% of the sampled population. In terms of education, those with the highest level of education were undergraduates, at 35%, followed by secondary school level education at 21%. The least educated group was those with basic education, at 14%, and non-formal education was also 14%. A reliability analysis of the data shown in Table 1 indicates a reliable result for discussion and decision-making.

Table 1 Reliability Statistics

Variable	Items in number	Cronbach's Alpha
Independent Variables	18	.835
Dependent Variables	4	.768
Overall	22	.852

Source: Field Data, June 2023

In Table 1, the Cronbach's Alpha coefficient for the independent variables (Awareness and Knowledge, Perceived Benefits and Costs, Attitude and Motivation) is 0.835, while the independent variable (Household Energy Transition) is 0.768. An overall Cronbach's Alpha value

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of 0.852, which exceeds the benchmark value of 0.7, shows a high level of reliability for the data collection instruments used for the study.

Analysis of data on awareness and knowledge of people in the municipality on primary sources of energy used (Table 2) show a mean value of (Mean = 4.21, SD = .95).

Table 2 Analysis of awareness and knowledge

Variables	Mean	Standard Deviation
Primary source of Energy (Awareness and Knowledge 1)	4.21	0.957
Willingness to switch to renewable energy (Awareness and Knowledge 4)	4.06	0.93
Awareness on energy transition (Awareness and Knowledge 3)	3.75	1.009
Knowledge on Government programmes (Awareness and Knowledge 5)	3.68	4.309
Level of satisfaction with energy situation (Awareness and Knowledge 2)	3.61	1.136
Environmental benefits of energy transition (Awareness and Knowledge 6)	3.55	1.114
	3.81	1.576

Field Data, 2023

This value shows those who agreed that Electricity and Biomass (wood and charcoal) are the primary sources of household energy. Among the two energy sources, biomass is the most dominant. Regarding the level of satisfaction with the current energy situation in the Municipality, the sampled population expressed dissatisfaction with the current energy situation, strongly disagreeing that energy is sustainable due to the unfavourable nature of the current energy situation. The study found dissatisfaction with the energy situation, with a mean value of 3.61 (SD = 1.13).

Regarding the level of awareness about energy transition, a mean value of 3.75 (SD = 1.00) was obtained (Table 2), indicating that most respondents are quite aware of energy transition and also knowledgeable about renewable energy sources in Ghana. In terms of willingness to switch to renewable energy sources (Table 2), a mean value of 4.06 (SD = 0.93) was obtained, indicating that the respondents strongly support switching to renewable sources of energy.

Regarding knowledge of government programs to support the energy transition, the majority of respondents had limited knowledge, as indicated by the Mean standard deviation value of (Mean

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= 3.68, SD = 4.30) recorded. This high standard deviation value indicates that the number of people with limited knowledge is substantial.

When it comes to the environmental benefits associated with the energy transition, Table 2 recorded a mean of 3.55 (SD = 1.11), indicating that the people of Kpone Katamanso are aware of the environmental benefits associated with this transition. Some benefits mentioned by the respondents include good air quality, reduced Greenhouse Gas Emissions, and high-water quality. Further questions on the extent to which knowledge and awareness influence people's willingness to transition to clean and renewable sources of energy show average mean and standard deviation values of (Table 2) (Mean = 3.81, SD = 1.57). This result shows that, indeed, awareness and knowledge have some level of influence on willingness to transition to renewable energy.

Table 3 Analysis of Perceived Benefits and Costs

Variables	Mean	Standard Deviation
Limited energy sources (Perceived Benefits and Costs 6)	4.13	0.884
Barriers to energy transition (Perceived Benefits and Costs 5)	4.09	0.842
Uncertainty about energy sources (Perceived Benefits and Costs 7)	4.08	0.849
Energy sufficiency and independence (Perceived Benefits and Costs 4)	3.84	0.992
Improvement in air quality (Perceived Benefits and Costs 3)	3.81	0.982
Cost benefits of transition to renewable energy (Perceived Benefits and Costs 1)	3.8	1.073
Reduce green house emissions (Perceived Benefits and Costs 2)	3.72	1.083
	3.92	0.958

Field Data, 2023

Results for perceived benefits and costs of energy transition (Table 3) showed a mean value of (Mean = 3.80, SD = 1.07), meaning there would be some form of positive gain.

The study results show a mean value of 3.72 (SD = 1.08) and 3.81 (SD = 0.98) for how the energy transition can help reduce greenhouse gas emissions and improve air quality, respectively (Table 3). These figures show that respondents strongly believe the energy transition will help reduce Greenhouse Gas levels and ensure better air quality. They explained that fumes from vehicles and other petroleum industries in the Kpone Katamanso Municipality are contributing to poor air quality and climate change.

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Furthermore, the mean and standard deviation values (Mean = 3.84, SD = 0.99) indicate that the energy transition will help respondents achieve energy sufficiency and independence in meeting their household energy needs. According to respondents, biomass energies such as charcoal and firewood do not last long when in use compared to solar energy. A food seller lamented that she uses a 50kg bag of charcoal in less than a week. She, however, believes that renewable sources of energy would last longer.

Despite the expected benefits, the municipality believes that there may be potential barriers to achieving an energy transition. This is quite evident in the mean and standard deviation values of (Mean = 4.09, SD = 0.84) as the high upfront cost of buying solar and other renewable energies can deter people interested in using them.

Results in Table 3, with a mean of 4.13 (SD = 0.88) and 4.08 (SD = 0.84), respectively, reveal that people in the municipality consider limited availability and accessibility of renewable energy sources, coupled with uncertainty, to be issues of concern to respondents. Such concerns are based on the belief that renewable energy sources are not as familiar as biomass, which is found everywhere. Accessibility concerns are also linked to challenges of importing renewable energy equipment, including import duties that raise their cost of purchase.

Table 4: Analysis of Attitude and Motivation

Variables	Mean	Standard Deviation
Household energy sustainability (Attitude and Motivation1)	4.26	0.691
Peer influence (Attitude and Motivation 4)	4.22	0.86
Community acceptance (Attitude and Motivation 5)	4.22	0.917
Incentives for energy transition (Attitude and Motivation 2)	4.21	0.902
Environmental impacts (Attitude and Motivation 3)	4.14	0.841
	4.21	0.842

Field Data, 2023

On Attitudes and Motivation as one of the factors that influence willingness to accept energy transition, people interviewed on whether household energy transition is necessary for the sustainable future showed mean and standard deviation values (Table 4) (Mean = 4.26, SD = 0.69) that strongly agreed to the fact that household energy will help them to achieve future energy sustainability. They further believe that to achieve an energy transition, they need to adopt positive mindsets towards it. It was also an objective of the study to gather views on whether financial

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incentives and government subsidies would be sufficient incentives for adopting an energy transition (Table 4). Findings show mean and standard deviation values of (Mean = 4.21, SD = 0.90) that give strong approval or agreement that incentives and government subsidies will help reduce the costs of purchasing renewable energy, and this will motivate people to use them. Concerning the positive environmental impacts of renewable energy, which serve as a basis for its use, the mean and standard deviation values (Mean = 4.14, SD = 0.84) indicate that respondents strongly agreed that using renewable sources of energy is eco-friendly, as it would have positive environmental impacts in terms of peer influence or community.

Table 5: Analysis of Energy Transition

Variables	Mean	Standard Deviation
Willingness to abandon biofuels (Energy Transition 3)	4.01	0.798
Additional knowledge on energy transition (Energy Transition1)	3.99	0.916
Support campaign on energy transition (Energy Transition 2)	3.97	0.846
Adoption of renewable technologies (Energy Transition 4)	3.96	0.84
	3.98	0.85

Acceptance as motivation for accepting energy transition a mean value of (Mean = 4.22, SD = 0.86) show that community support will be a strong motivation for communities to accept energy transition as community networks are believed to motivate inhabitants of the community to embrace energy transition.

To determine whether respondents are interested in learning more about energy transition and adopting it at the household level and whether they will support any campaigns or programs related to household energy transition. The results in Table 5 (Mean =3.99, SD = 0.91) and (Mean =3.97, SD = 0.84) respectively indicate that the respondents strongly agreed that they would like to have further knowledge on household energy transition and are willing to support any campaign or programs that aim at improving household energy transition information to the public. Almost all the respondents were willing to have more practically oriented knowledge of energy transition. Some even suggested that stakeholders in the energy sector in Ghana should organise periodic awareness to deepen public knowledge on renewable energy technologies as far as precise questions on whether they will be willing to abandon charcoal, fuelwood and other biofuels and adopt solar lamps, natural gas and other forms of renewable energies. The results in Table 5, with a mean of 4.01 (SD = 0.79) and 3.96 (SD = 0.84), respectively, indicate that they were prepared to adopt the use of renewable energy technologies in their household energy systems. Almost all the responses strongly agreed to use renewable energy going forward.

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Correlational Analysis

To establish how strong or weak a relationship exists between the independent variables (awareness and knowledge, perceived benefits and cost, attitude and motivation and the dependent variable energy transition a bivariate analysis using Spearman's Correlation hierarchical models was calculated at a confidence level of 95% based on a two-sided significance level of 5% (Table 6) showed a positive correlation of 0.502 between Perceived Benefits and Household Energy.

Table 6: Correlation Results of the bivariate analysis

	ET	PBC	AM	AK
ET	1.00			
PBC	.502**	1.00		
AM	.552**	.489**	1.00	
AK	.733**	.506**	.382**	1.00

***** Correlation is significant at the 0.01 level (2-tailed).***

Source: Field Survey (2023)

Note: ET=Energy Transition, PBC=Perceived Benefits and Costs, AM=Attitude and Motivation, AK= Awareness and Knowledge

Transition (r=.502, P<.01). There is also a positive correlation of 0.552 between Attitude and Motivation and Household Energy Transition (r=.552, P<.01). Furthermore, there is a positive correlation of 0.733 between Awareness and Knowledge and Household Energy Transition (r=.733, P<.01).

DISCUSSION

The study participants comprised a majority of females 53% and a minority of males 47% who are primarily in their youthful ages of 18 - 30 years and form 42% of the study population, followed by 31 - 42 years who constitute 32% of the respondents and the least age group was 55 years and above that was 6% of the sampled population. Other studies also included a higher proportion of women and a significant number of youth (Lawson et al., 2019). The inclusion of more women is based on the fact that the Energy Transition will significantly impact women and children more, as they are primarily responsible for gathering firewood for cooking (Elias et al., 2005). On the

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contrary, gender roles in household energy transition vary depending on who heads the household, as there are male-headed households (Vigolo et al., 2021).

The educational background of the sampled population showed high literacy among the respondents, considering that 35% of them are undergraduates, followed by 21% secondary school leavers. The least educated group was those with basic education, at 14%, and non-formal education, also at 14%. The levels of education may influence their decision-making ability to opt for renewable energy over bioenergy (Chen et al., 2006; Wang et al., 2012).
The primary sources of energy used in the Municipality are electricity and biomass (wood, charcoal). This agrees with a study by the Ghana Statistical Service, which reports that the main source of fuel for cooking in most households in Kpone Katamanso is charcoal (45.8%) (GSS, 2021).

There is a high level of dissatisfaction with the current energy situation in the municipality, as such, the desire for energy transition. This study's results align with those of Afful et al. (2020), who expressed similar dissatisfaction with Ghana's unsustainable energy situation, which is perceived to have potential health and environmental consequences.

It is not only the unsatisfactory energy situation that is luring the people of the municipality to pursue energy transition but also the awareness of the environmental benefits associated with it, such as improved air quality and reduced Greenhouse Gas Emissions. When Ghana transitions to renewable energy, the 80% of fossil fuels used in the country that have a negative impact on health and the environment will be averted (Nyasapoh, 2022).

Although there is considerable expectation for an energy transition, knowledge of government programmes that support this transition, such as the energy transition policy framework, is limited among many.

Despite the expected benefits of the energy transition, the municipality believes that there are potential barriers to achieving it, such as the high upfront cost of purchasing solar and other renewable energy sources. In an attempt to address identified barriers, lessons from the United States of America, where 26% tax relief was provided to citizens as an incentive to use solar energy, can be emulated (Kim & Yoo, 2018).

On Attitudes and Motivation as one of the factors that influence willingness to accept energy transition, people interviewed on whether household energy transition is necessary for the sustainable future showed mean and standard deviation values (Table 4) (Mean = 4.26, SD = 0.69) that strongly agreed to the fact that household energy will help them to achieve future energy sustainability.

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The study revealed that households are interested in learning more about energy transition and are likely to support any campaign or program focused on household energy transition. This concords with Koyunbaba et al. (2017), who stated that education and awareness raising cannot be overstated in the campaign for household energy transition. Limited knowledge of government energy transition policy explains why a public policy is perceived as a novelty (Osei-Tutu et al., (2021).

According to the World Resource Institute (2019), 94% of Ghanaians support the use of renewable energy sources; however, some doubts persist among the population regarding the feasibility and cost of renewable energy. These findings directly align with Addaney et al. (2019), who suggest that financial constraints, high upfront costs, and limited availability of renewable energy sources are barriers to the Energy transition among most households in Ghana.

CONCLUSION

The study comprised a majority female and youthful population with high levels of education, which influenced their understanding of the relevance of the energy transition about choices of sustainable energy options. Although there is an overwhelming readiness to transition to renewable energy, concerns were expressed over the cost of renewable energy sources, which could deter people from using them despite being aware of their benefits. Many people in the municipality, however, are not aware of Government policies or initiatives to advance the energy transition, as such education is needed. Awareness creation needs to be intensified to enhance the knowledge base of people regarding energy transition and the perceived costs and benefits associated with it.

The research identifies and categorises previously unexplored benefit perceptions unique to household contexts, including family security, domestic comfort, social status, and intergenerational considerations that influence energy transition decisions.

The demonstrated willingness for energy transition reveals an emerging social consensus around environmental priorities, potentially strengthening community cohesion around sustainability goals and laying the foundations for collective action on climate issues.

This study on readiness for energy transition shows the willingness of the sampled population to accept energy transition. As such, if energy transition is implemented, it will enable Ghana to achieve a Net-Zero carbon economy by 2070.

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