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Gender Disparities in Clean Cooking Transitions: Evidence from Households in Urban Zambia

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Abstract

This study investigates gender disparities in access to and decision-making power over clean cooking energy in Mtendere, an urban settlement in Lusaka, Zambia. A convergent mixed-methods design was employed to triangulate quantitative associations with qualitative insights into household decision-making dynamics, drawing on structured questionnaires and in-depth interviews with 395 households selected through stratified random sampling across five zones to ensure socio-economic representation. Results reveal that despite women being the primary cooks in (87.8%) of households, only (34.7%) reported being involved in decisions regarding cooking fuel. Charcoal remains the dominant cooking fuel (92.4%), and power outages affect (78.0%) of households. Quantitative analysis showed a highly significant association between the gender of the household head and who makes the final decision on cooking energy ($\chi^2 = 257.76$, $p < 0.001$, Cramér's V = 0.81), indicating a very strong relationship. Female-headed households were more likely to use cleaner fuels and exercise autonomous decision-making. Education level and household income also significantly influenced clean fuel adoption. Crucially, while (79.2%) of respondents were aware of clean cooking options, adoption remained below (6%), underscoring that awareness alone is insufficient to drive transition. The findings underscore that in urban Zambian households, gendered power structures, not merely affordability or access, fundamentally constrain women's agency in energy choices, perpetuating reliance on polluting fuels. This study contributes to policy and scholarship by empirically demonstrating that achieving Sustainable Development Goals 5 (Gender Equality) and 7 (Affordable and Clean Energy) in Zambia requires gender-transformative interventions that address intra-household decision-making inequities and position women not merely as beneficiaries but as central actors in clean energy transitions.

Keywords: Clean cooking, energy poverty, gender and energy access, household energy decision-making, sustainable development goals.

INTRODUCTION

Access to clean cooking energy remains one of the most pressing yet under-addressed development challenges globally, with critical implications for public health, gender equity, and environmental sustainability. Despite global commitments, progress has lagged significantly behind electrification efforts. (World Bank, 2022; UNDP & FAO, 2025; IEA, 2025). Nearly 2.3 billion people globally still rely on traditional biomass fuels such as charcoal, firewood, and agricultural residues for cooking, with sub-Saharan Africa accounting for a significant share of this energy poverty (IEA, 2023; Khavari, Ramirez, Jeuland, et al, 2023; Malah-Kuet, 2025). The environmental pollution and health consequences associated with traditional cooking fuels are well documented. These fuels primarily consist of solid biomass, including firewood, charcoal, and animal dung, as well as fossil-fuel-derived coal. While biomass and coal are both solid fuels, they differ fundamentally in their sourcing, emissions profiles, and policy implications.

Biomass combustion, the dominant form of cooking energy in sub-Saharan Africa, contributes to respiratory illnesses, low birth weight, cardiovascular disease, and increased mortality among women and children (Sehgal, Rizwan, & Krishnan, 2014; Sigsgaard, Forsberg, Annesi-Maesano , et al, 2015; WHO, 2023). This burden disproportionately affects women, particularly in sub-Saharan Africa, where gendered divisions of labour predominantly assign women primary responsibility for cooking and household energy procurement (Totouom, 2024). The reliance on biomass fuels not only exposes women to harmful indoor air pollution but also exacerbates time poverty, limiting opportunities for education and income (Acheampong, Opoku, Amankwaa, & Dzator, 2024; WHO, 2024). While clean cooking initiatives have gained global attention, many interventions fail to address the deeply embedded social and gender-based barriers that hinder adoption.

In Zambia, the problem is particularly acute in urban low-income settlements. More than 90.0% of households rely on firewood or charcoal for cooking, contributing to severe indoor air pollution, deforestation, and greenhouse gas emissions (Zambia Statistics Agency, 2022; Ministry of Energy, 2020). These cooking fuels remain dominant despite the availability of cleaner alternatives such as liquefied petroleum gas (LPG) and electricity for cooking. However, electricity access for lighting does not guarantee its use for cooking, due to appliance costs, reliability issues, and cultural preferences. The persistence of traditional fuel use reflects not only affordability and infrastructural challenges but also entrenched gender inequalities in energy decision-making (Cellini et al., 2025). Although women are the primary users of household energy, they are often excluded from decisions regarding fuel type, technology adoption, and related expenditures.

Zambia's 2019 National Energy Policy (Ministry of Energy, 2019) recognises clean energy adoption as a national priority. However, it falls short in addressing the gendered dynamics of energy access, which critically shape both adoption and sustained usage patterns. For instance, the 2019 National Energy Policy emphasises supply expansion and infrastructure investment but does not include gender-disaggregated targets or measurable indicators for women's participation in household energy governance. Sub-Saharan Africa has the highest Gender Inequality Index (GII) globally, with a score of 0.573, compared to 0.276 in Europe and Central Asia (UNDP, 2022). Zambia's GII stands at 0.540, reflecting substantial disparities in reproductive health, empowerment, and economic participation between men and women (UNDP, 2022). Despite growing global commitment to expanding access to clean cooking, energy interventions remain predominantly technology-centred and supply-oriented, with insufficient attention to the intra-household gender dynamics that fundamentally shape energy decision-making and exclusion (Zhang & Petrova, 2026).

Addressing these structural power relations is critical to designing equitable interventions that transcend conventional approaches, moving beyond the framing of women as passive beneficiaries to positioning them as central agents in just energy transitions. For Zambia to meet its obligations under Sustainable Development Goals 5 (Gender Equality) and 7 (Affordable and Clean Energy), the integration of gender-responsive strategies must be systematically embedded within national energy policies and implementation plans (United Nations, 2015; Ministry

of Energy, 2019; United Nations Development Programme, 2021).

A critical empirical gap persists in understanding how intra-household power dynamics shape clean cooking transitions in urban Zambia. While affordability and infrastructure constraints are frequently cited, limited research systematically examines how gendered decision-making structures mediate fuel adoption. This study addresses that gap by investigating gender disparities in cooking energy access and control in Mtendere, Lusaka. Grounded in Intra-household Bargaining Theory and the Energy Justice Framework, it examines the relationship between household headship and decision-making authority over cooking fuel, assesses how socio-economic factors intersect with gender to influence clean fuel adoption, and identifies barriers and norms sustaining biomass reliance despite widespread awareness.

LITERATURE REVIEW

Gender-Energy Nexus and the Sustainable Development Goals

The concept of the "energy-poverty-gender nexus" posits that gender roles, access to resources, and decision-making power within households critically determine both the experience of energy deprivation and the potential for adopting cleaner solutions. A robust body of literature underscores that energy poverty is intrinsically linked to gender inequality. The intersection of gender and energy is increasingly recognised in global discourse, as energy poverty disproportionately affects women due to entrenched socio-cultural norms, economic marginalisation, and policy gaps (ENERGIA, 2019; UNDP, 2021; Goldstein, Gonzalez, Kilic, Papineni, & Wollburg, 2024). While the disproportionate impacts of traditional cooking fuels on women are widely recognised, current literature shifts attention toward the structural and institutional factors that perpetuate these inequalities. Access to modern and clean energy is vital for achieving Sustainable Development.

The United Nations Sustainable Development Goals (SDGs), particularly SDG 5 (Gender Equality) and SDG 7 (Affordable and Clean Energy). Rather than focusing solely on exposure or burden, recent studies emphasise the limited agency women have in household energy decisions, especially in low-income urban settings(Acheampong, Opoku, Amankwaa, & Dzator, 2024; ENERGIA, 2019). This lack of decision-making power is compounded by systemic barriers such as restricted access to credit, information, and energy infrastructure, making the transition to clean cooking technologies more difficult. As such, addressing gender inequality in energy access requires not only technological solutions but also institutional reforms and inclusive policy design that actively empower women in energy governance. These disparities stem from complex structural barriers, including gendered decision-making power in households where men typically control energy expenditures(Pachauri & Rao, 2013), financial exclusion that results in higher loan rejection rates for women seeking clean energy products (World Bank, 2022), and cultural norms that rigidly assign cooking as women's responsibility (ENERGIA, 2019).

The relationship between energy access and the SDGs reveals important gendered dimensions. SDG 7 aims for universal energy access by 2030, yet progress remains uneven, with profound implications for gender equality. While (92.0%) of the global population has electricity, sub-Saharan Africa lags behind, with (85.0%) of those still without access, and the majority lacking clean cooking(IEA, IRENA, UN, World Bank, & WHO, 2025). These deficits are not gender-neutral: because women bear primary responsibility for cooking across the region, the lack of clean cooking energy disproportionately affects their socioeconomic well-being. Sub-Saharan Africa continues to reflect the most pronounced disparities in energy access, with only (7.0%) of rural populations having access to clean cooking compared to (42.0%) in urban areas(IEA, IRENA, UN, World Bank, & WHO, 2025).

This urban-rural gap has clear gendered consequences, as women in rural areas where patriarchal norms more rigidly confine them to domestic roles face compounded barriers, including greater time spent collecting fuelwood, higher exposure to indoor air pollution, and limited access to information and credit for clean energy alternatives. These regional disparities significantly influence global averages, where urban access is approximately (89.0%) and rural access is around (55.0%). When Sub-Saharan Africa is excluded, the global access rates improve markedly to (94.5%) in urban areas and (67.3%) in rural areas,

underscoring the region's disproportionate impact on global progress toward achieving SDG 7 targets(IEA, IRENA, UN, World Bank, & WHO, 2025).

For women in sub-Saharan Africa, slow progress in clean cooking access perpetuates exclusion from its health, educational, and economic benefits, undermining progress toward SDG 5. Limited access to modern energy intensifies household labour burdens, with documented impacts on educational outcomes (Mukanema, Simate, & Mbimbi, 2026). A study in Sudan concluded that for each additional hour spent on household tasks, the likelihood of school attendance decreases by (22.0%) for boys and (10.0%) for girls(Mohammed, James, & Bahaj, 2025) and clean cooking technologies can reduce women's unpaid labour, enabling greater economic participation(Su & Azam, 2023). Furthermore, these energy transitions support other SDGs, including improved health outcomes (SDG 3), enhanced economic opportunities (SDG 8), and climate resilience (SDG 13), demonstrating the multiplier effect of gender-responsive energy policies.

The Gendered Dimensions of Energy Poverty

The relationship between gender and energy poverty has emerged as a critical area of scholarly inquiry, with mounting evidence demonstrating that energy access deficits are systematically patterned along gendered lines. Seraj et al. (2025) found that a (1.0%) increase in gender inequality leads to a (0.14%) rise in energy poverty in Sub-Saharan Africa, confirming that gender disparities remain a critical determinant of energy access outcomes. Van der Merwe et al. (2020) argue that energy inequalities disproportionately affect women in developing contexts, particularly in urban poor environments where female-headed households are prevalent. However, Musango & Chicomb (2025) reveal that most sub-Saharan African energy frameworks lack clearly defined, measurable gendered indicators, undermining the ability to track progress towards gender-equitable energy outcomes. Empirical evidence consistently demonstrates that women shoulder a disproportionate burden of energy poverty across multiple dimensions. World Bank (2025) reports that women spend an average of two to four hours daily collecting fuel, with indoor air pollution accounting for over 400,000 premature deaths annually in Africa, the majority among women and children. Critically, ethnographic research in rural Tanzania revealed that cooking fuel falls firmly within the female financial domain, meaning women must choose between daily necessities and refilling LPG cylinders (Gill-Wiehl, Ogoya, Dowdy-Arnold, & Ray, 2025).

The economic case for gender-responsive energy access is increasingly well-established. Evidence suggests that women tend to allocate a greater proportion of their income toward household welfare, including health, nutrition, and education, compared to men (FAO, 2011). Building on this, Dinkelman's (2011) seminal study on South Africa's mass electrification rollout found that access to electricity significantly increased female employment by reducing time-intensive home production and enabling microenterprise development. While the study focused on electricity access broadly, its findings are highly relevant to clean cooking transitions. When modern energy replaces labour-intensive household tasks, particularly cooking and fuel collection, it reduces unpaid care burdens and expands women's economic participation. Complementing this, Goldstein et al. (2024) demonstrate that gender-equitable beliefs are associated with higher levels of joint household decision-making, suggesting that shifts in both energy access and intra-household norms are central to women's empowerment.

The Burden of Unclean Cooking and Urban Energy Poverty in Sub-Saharan Africa

Sub-Saharan Africa (SSA) faces a clean cooking crisis of unprecedented scale and urgency. Approximately one billion people across the continent, roughly four out of every five households, continue to rely on polluting solid fuels such as wood, charcoal, and dung for their daily cooking needs (IEA, 2025). Critically, unlike other regions that have made substantial progress and reduced the number of people without clean cooking access, Sub-Saharan Africa has experienced a sustained deterioration, with the absolute number of those lacking access growing annually, unable to keep pace with population growth (World Bank, 2025; IEA, 2025). This regressive trend is concentrated in urban informal settlements and peri-urban areas, where rapid urbanisation outpaces infrastructural and economic enablers for clean energy adoption (RES4Africa, 2025). A growing body of empirical

research has quantified the disproportionate health burden associated with unclean cooking fuel use among women in sub-Saharan Africa.

In a study by Ayebeng et al. (2024), pooling 97,942 women across ten SSA countries (2014-2021), found that women using unclean cooking fuels were 1.21 times more likely to be hypertensive compared to those using clean fuels, after controlling for socio-demographic confounders. The health burden extends significantly to children under five. Amadu et al. (2023), in a study pooling data from 31 SSA countries, demonstrated that children in urban households using unclean cooking fuel had significantly higher odds of cough relative to urban children using clean fuel, while rural children using unclean fuel exhibited even greater odds of rapid short breaths. Empirical studies consistently demonstrate that the clean cooking transition in SSA is non-linear and incomplete. Contrary to the energy ladder hypothesis, which assumes linear progression to modern fuels with rising income, household-level research confirms the dominance of fuel stacking, or the concurrent use of multiple fuels. Providing direct evidence from Zambia, Mukanema et al. (2025) found that (50.1%) of households in Mtendere, Lusaka, actively stack fuels, yet charcoal remains the primary cooking fuel for (92.4%) of households. In Dar es Salaam, Tanzania, Ntiyakunze & Stage (2025) analysed 1000 households using a cross-sectional household survey and found that most households used a combination of fuels rather than fully switching to a single modern option. Charcoal and LPG were the most commonly stacked fuels.

Zambia's Clean Cooking Landscape and Gender Dynamics

In Zambia, household cooking technologies comprise a mix of traditional biomass fuels, electric stoves, biogas and liquefied petroleum gas (LPG) (Zambia Statistics Agency, 2022). Historically, most Zambian households predominantly rely on traditional biomass fuels such as firewood and charcoal for cooking (Wang, Mondela, & Kuuluvainen, 2022). Traditional biomass cooking involved the use of inefficient three-stone stoves fed by fuelwood, charcoal, dung, agricultural waste, and other waste products (Bailis, Drigo, Ghilardi, & Masera, 2015). The report, Zambia Statistics Agency (2022), mentioned that household cooking technologies comprise a mix of traditional biomass fuels, electric stoves, biogas and liquefied petroleum gas (LPG).In Zambia, urban areas have seen a rise in charcoal use due to population growth and the affordability issues associated with cleaner alternatives like liquefied petroleum gas (LPG) and electricity (Mulenga, Tembo, & Richardson, 2019). The use of charcoal persists despite growing access to electricity and the presence of cleaner alternatives like liquefied petroleum gas (LPG).

According to the Living Conditions Monitoring Survey conducted by the Zambia Statistics Agency (2022), (51.4%) of all Zambian households use firewood as the main source of cooking energy, (39.2%) use charcoal, and only (8.5%) use electricity. However, there is a distinct difference between the urban and rural households. In rural areas, (81.9%) of the households used firewood for cooking, followed by charcoal with (15.8 %;) and electricity is used by only (1.2%). In contrast, most households in urban areas use charcoal for cooking (73.0%), followed by electricity (19.1%), while only a small proportion use firewood (7.5%). Recent years have seen a slow but growing interest in more sustainable and modern cooking technologies, including improved biomass stoves and LPG. Improved cookstoves (ICS) have gained some traction as they are designed to burn fuel more efficiently, reducing both fuel consumption and indoor air pollution (Zambia Statistics Agency, 2022). However, the penetration rate of these technologies is still low due to factors such as initial costs, limited awareness, and socio-cultural preferences for traditional cooking methods (Lewis & Pattanayak, 2012; Mamuye, Lemma, & Woldeamanuel, 2018). According to the Zambia Gender Equality Strategy for the Energy Sector (2022-2030), women are disproportionately underrepresented in decision-making processes regarding household energy use, despite being the primary users of cooking fuels (Ministry of Energy, 2022). The National Gender Policy (2023) acknowledges this disparity and promotes gender mainstreaming across development sectors, including energy, but implementation gaps remain.

Theoretical Underpinning

This study is theoretically anchored in Intra-household Bargaining Theory and the Energy Justice Framework, which together provide a causal framework for analysing how gendered power relations shape

household cooking energy decisions. Intra-household Bargaining Theory (Agarwal, 1997; Lundberg & Pollak, 1993) conceptualises the household not as a unitary actor but as a site of negotiation in which outcomes reflect differential access to income, assets, education, and socially constructed authority. It directly informs this study by positing that control over cooking energy choices is determined not merely by efficiency or awareness, but by relative bargaining power. Within this framework, women's limited control over financial resources weakens their fallback position, constraining their ability to influence fuel adoption even when they bear the primary responsibility for cooking. Thus, clean cooking transitions are understood as negotiated outcomes shaped by intra-household power asymmetries.

Complementarily, the Energy Justice Framework (McCauley & Heffron, 2018; Jenkins, McCauley, Heffron, Stephan, & Rehner, 2016) conceptualises access to modern energy as embedded within structures of distributional, procedural, and recognitional justice. Distributional justice frames women's disproportionate exposure to indoor air pollution and time burdens from fuel collection as an unequal allocation of energy-related risks. Procedural justice highlights women's exclusion from household and community-level energy decision-making processes. Recognitional justice emphasises the systematic marginalisation of women's lived experiences and preferences within energy governance systems. Together, this framework links gender inequality to structural exclusion in both domestic and policy arenas.

METHODOLOGY

The study was conducted in Mtendere, a high-density, low-income residential settlement in Lusaka, Zambia (see Figure 1), purposively selected for its representative urban energy poverty characteristics, including heavy reliance on charcoal and limited adoption of clean cooking alternatives. Estimates place its population between 106,000 and 109,000 residents. A convergent parallel mixed-methods design was employed to enable triangulation and a comprehensive understanding of gender disparities in household cooking energy decisions. Quantitative data were collected through structured questionnaires administered to 395 households selected using stratified random sampling across five zones: Zone A, B, C, D, and Mtendere Extension, with stratification based on housing type and zone to ensure socio-economic representation; within each zone, households were randomly selected, and interviews were conducted with the household head or primary cook. Qualitative data were gathered concurrently through 10 purposively selected key informant interviews with local government officials, women community leaders, and NGO representatives based on their professional involvement in energy policy, community leadership, and clean cooking advocacy.

Quantitative data were analysed using IBM SPSS Statistics (Version 26), employing descriptive statistics and Chi-square tests of independence to assess associations between gender and cooking energy decision-making, with effect sizes measured using Cramér's V. Qualitative data were analysed using manual thematic content analysis. Through repeated reading, an inductive coding framework was developed around recurring themes: decision-making power, fuel preferences, awareness, and barriers. Codes were systematically applied and iteratively refined. Reliability was enhanced through independent coding of a transcript subset by a second researcher, with discrepancies resolved via discussion. Final themes were aligned with the study's theoretical framework. Ethical approval was obtained from the University of Zambia Ethics Committee, permission was granted from the relevant local authorities, and all participants provided informed consent with anonymity assured throughout.

Figure 1: Geographic Location of Mtendere, Lusaka Province, Zambia

FINDINGS AND DISCUSSION

Socio-Demographic Characteristics of Respondents

As shown in Table 1, a total of 395 respondents participated in the study, with more females (61.8%) than males (38.2%). Most households were male-headed (56.2%), while (43.8%) were female-headed. The mean respondent age was 39.5 years, and household heads averaged 46.7 years. Over half of household heads were married (58.7%), while (14.2%) were widowed, (11.4%) divorced/separated, and (15.7%) single. Educational attainment was relatively high, with (70.1%) having at least secondary education (44.3%) secondary, (25.8%) tertiary, (22.8%) primary, (7.1%) no formal education). Nearly half of households (47.8%) earned ZMW 1,001-3,000 monthly, (22%) earned below ZMW 1,000, (21.8%) earned ZMW 3,001-6,000, and (8.4%) earned above ZMW 6,000. The average household size was 5.2 persons, reflecting typical extended family structures in urban Zambia.

Table 1: Household and Respondent Profile

Variable	Category	Frequency (n=395)	Percentage (%)
Gender of Respondent	Female	244	61.8
	Male	151	38.2
Gender of Household Head	Female	173	43.8
	Male	222	56.2
Mean Age (Respondent)		—	39.5 years
Mean Age (Household Head)		—	46.7 years
Marital Status (Household Head)	Single	62	15.7
	Married	232	58.7
	Divorced/Separated	45	11.4
	Widowed	56	14.2
Education Level (Household Head)	No Formal	28	7.1
	Primary	90	22.8
	Secondary	175	44.3
	Tertiary	102	25.8
Household Income	< ZMW 1,000	87	22
	ZMW 1,001–3,000	189	47.8
	ZMW 3,001–6,000	86	21.8
	> ZMW 6,000	33	8.4
Household Size	Average size	—	5.2 persons

Cooking Energy Use and Access

Figures 2 and 3 illustrate the prevailing cooking energy landscape in Mtendere, where charcoal constitutes the primary cooking fuel for (92.4%) of households, followed distantly by electricity (4.3%), while liquefied petroleum gas (LPG) (1.3%) and biogas (0.3%) remain negligible. This overwhelming dependence on biomass reflects the persistent structural barriers to clean cooking transitions characteristic of urban low-income settings across sub-Saharan Africa, where charcoal retains dominance despite incremental gains in electricity access (IEA, 2023; Malah-Kuete, 2025). Notably, (50.1%) of households reported engaging in fuel stacking, the concurrent use of multiple fuels, while (49.9%) relied exclusively on a single fuel. This pattern corroborates evidence that household energy transitions do not follow a linear "energy ladder" trajectory but rather involve simultaneous fuel adoption as a risk diversification strategy (Masera, Saatkamp, & Kammen, 2000; Ntiyakunze & Stage, 2025). Affordability emerged as the predominant determinant of fuel choice, cited by (60.3%) of respondents, followed by availability (21.6%) and cultural compatibility (11.9%), with safety considerations accounting for only (6.3%). These findings align with established literature demonstrating that upfront appliance costs, recurring fuel expenses, and supply reliability consistently outweigh health and environmental considerations in household energy decision-making (Lewis & Pattanayak, 2012; Boudewijns et al., 2022). Critically, although (79.2%) of respondents reported awareness of clean cooking alternatives, actual adoption remained marginal, reinforcing that awareness alone is insufficient to catalyse behavioural change in the absence of complementary financial and infrastructural support mechanisms (Tornel, Iglesias, & Loureiro, 2024; Pueyo, Carreras, & Ngoo, 2020).

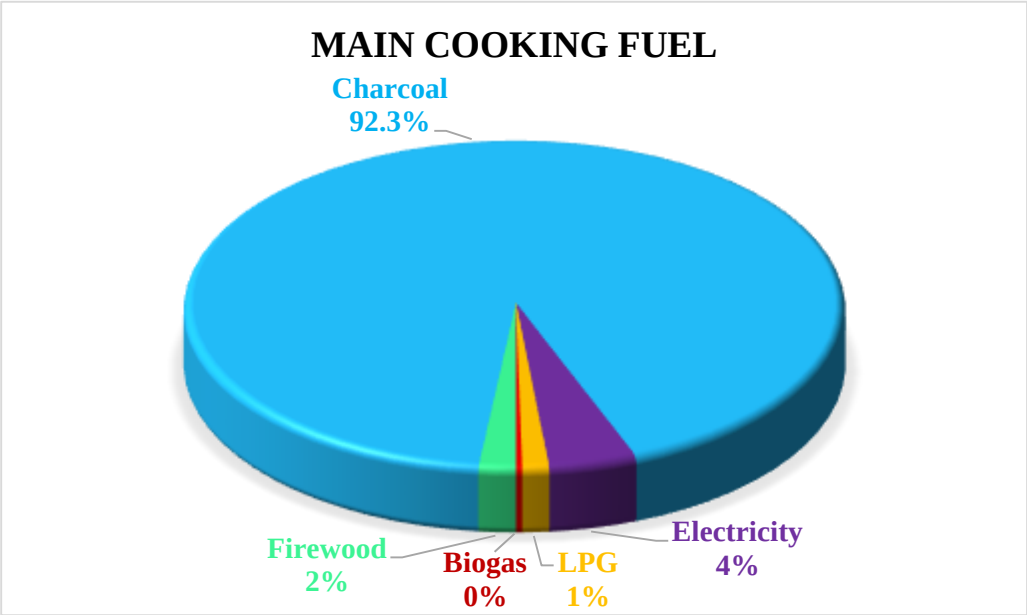

Figure 2: Main Cocking Fuels

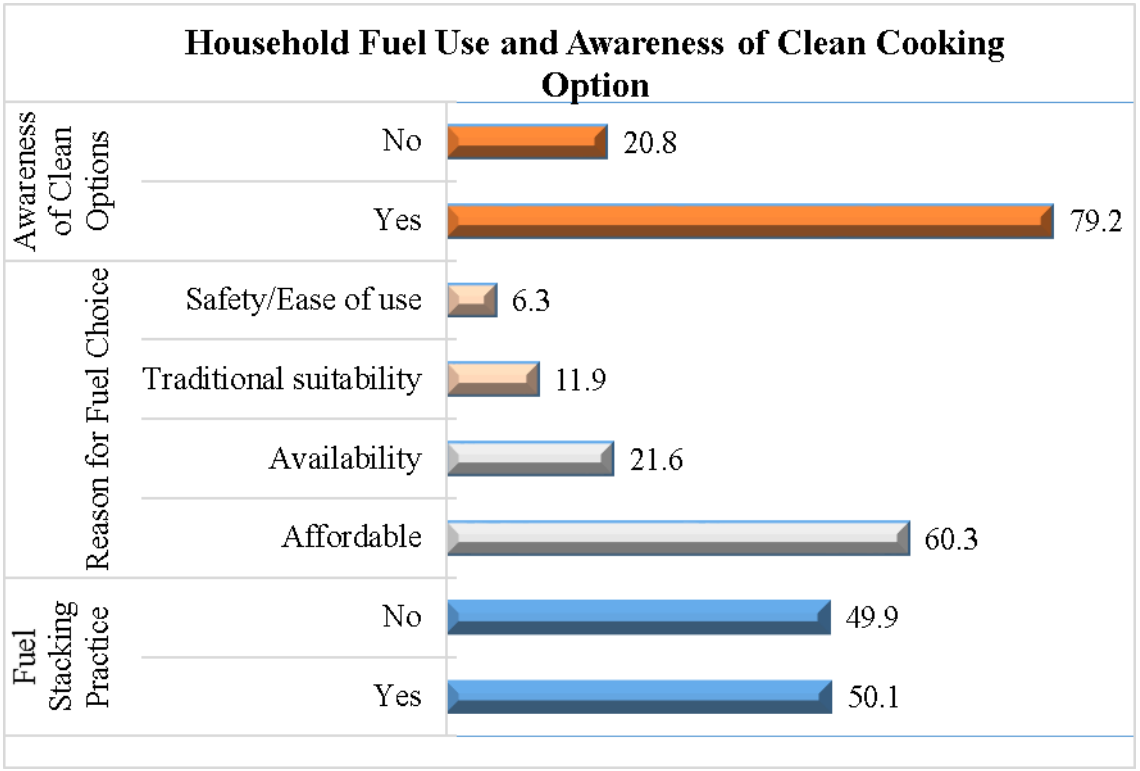

Figure 3: Household Fuel Use and Awareness of Clean Cooking Option

Figure 4 reveals a stark gendered division of labour in household cooking practices. Women were identified as the primary cook in (87.8%) of households, compared to only (8.4%) where men held this role, and (3.8%) with shared responsibilities. Despite shouldering this domestic burden, only (34.7%) of women reported any involvement in decisions regarding cooking fuel. This disparity underscores a structural imbalance within household energy governance, wherein responsibility for execution does not confer authority

over choice. Similar patterns have been documented across sub-Saharan Africa, where women disproportionately bear the health and time costs of cooking while remaining excluded from financial and energy-related decisions (ENERGIA, 2019; Perelli, Cacchiarelli, Peveri, & Branca, 2024; Pachauri & Rao, 2013). Decision-making authority over cooking fuel remains heavily concentrated among male household heads. In (60%) of households, the male head was reported as the final decision-maker, compared to (26.1%) where women held that role and (13.9%) where decisions were made jointly. Furthermore, (65.3%) of respondents indicated that women are not consulted in energy-related choices, and nearly half (49.6%) perceived themselves as having little or no influence.

These findings are consistent with empirical studies demonstrating that male control over household expenditures significantly constrains women's capacity to influence clean energy adoption (Clancy, Winther, Matinga, & Oparaocha, 2012; Totouom, 2024). Nevertheless, expressed preferences reveal latent demand for cleaner alternatives. When asked to choose freely, most respondents favoured modern fuels, LPG (35.4%) and electricity (24.1%), with only (18.5%) preferring charcoal. This aspirational shift contrasts sharply with actual usage patterns, where charcoal remains dominant. The persistence of traditional fuels appears driven less by preference than by structural constraints. The most frequently cited barriers were high fuel costs (56.9%) and appliance costs (40.5%), followed by safety concerns (22.8%), cultural familiarity (16.5%), and limited local supply (12.7%). These multidimensional barriers reinforce evidence from broader African contexts, where economic constraints, gendered bargaining power, and infrastructural limitations jointly shape energy transitions (Pueyo, Carreras, & Ngoo, 2020; Boudewijns et al., 2022).

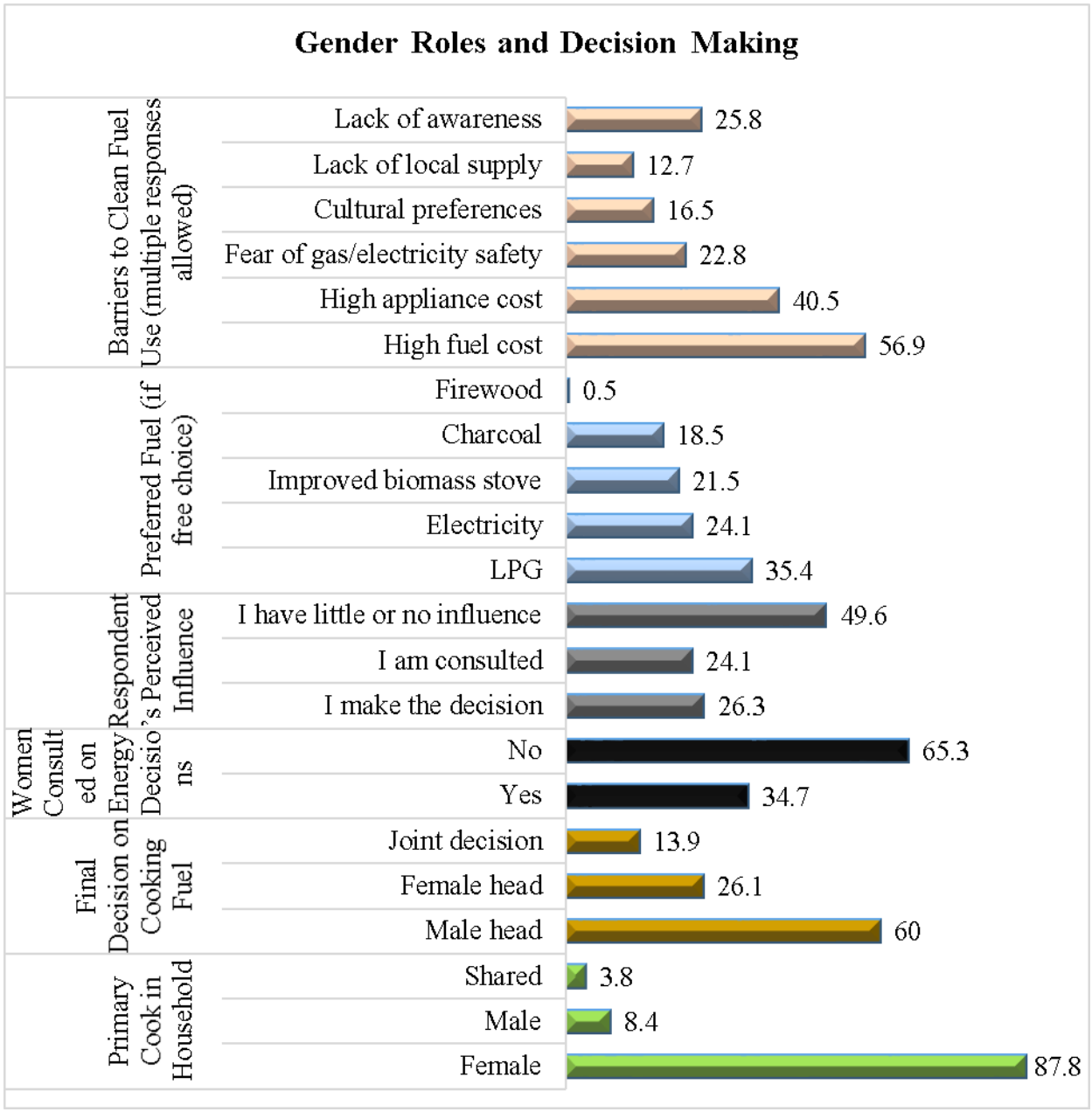

Figure 4: Gender Roles and Decision Making

Table 2 summarises respondents' perceptions and health awareness related to gendered health impacts and women's roles in clean cooking initiatives. Chi-square goodness-of-fit tests revealed that responses to all four statements deviated significantly from a uniform distribution ($\chi 2$ values ranged from 126.69 to 283.50), indicating strong and non-random patterns in community attitudes. Specifically, (74.4%) of participants agreed or strongly agreed that women are more exposed to health risks from traditional cooking fuels than men, indicating widespread recognition of this disparity. Likewise, (68.9%) agreed or strongly agreed that women in the home are generally aware of the health hazards associated with biomass fuels, reflecting relatively high health awareness. A strong majority (82.2%) supported prioritising women in public health campaigns about clean cooking, and (86.1%) agreed that women should receive training on cleaner cooking technologies. These results demonstrate a clear consensus that women bear disproportionate health risks from

traditional cooking fuels and should be central to efforts promoting clean cooking solutions.

Table 2: Perceptions and Health Awareness Regarding Gendered Health Impacts

Statement	Response	Observed (O)	Expected (E)	$(O - E)^2 / E$
1. Women are more exposed to health risks from traditional cooking fuels than men.	Strongly Disagree	17	79	53.95
	Disagree	26	79	38.61
	Neutral	58	79	5.53
	Agree	171	79	60.76
	Strongly Agree	123	79	26.66
	Total χ^2 (4) = 185.51, p < 0.001			
2. Health risks of biomass fuels are well known among women.	Strongly Disagree	24	79	39.17
	Disagree	34	79	23.46
	Neutral	65	79	2.45
	Agree	158	79	49.34
	Strongly Agree	114	79	12.27
	Total χ^2 (4) = 126.69, p < 0.011			
3. Women should be prioritized in public health campaigns.	Strongly Disagree	11	79	56.06
	Disagree	15	79	45.78
	Neutral	44	79	12.99
	Agree	172	79	62.51
	Strongly Agree	153	79	64.17
	Total χ^2 (4) = 241.51, p < 0.021			
4. Women should receive training on cleaner cooking technologies.	Strongly Disagree	8	79	72.77
	Disagree	12	79	56.64
	Neutral	35	79	19.41
	Agree	180	79	67.45
	Strongly Agree	160	79	67.23
	Total χ^2 (4) = 283.50, p < 0.001			

A chi-square value in Table 3 below, of 6.39, indicates a statistically significant association between awareness of clean cooking options and adoption of clean fuels. However, the low adoption rate among those aware suggests that awareness alone is insufficient to drive adoption since economic, cultural, and supply constraints likely play a stronger role.

Table 3: Association between Awareness of Clean Cooking Options and Clean Fuel Adoption

Awareness of Clean Cooking Options	Clean Fuel Users	Traditional Fuel Users (n, %)	Total
Aware (n=302)	23 (7.3%)	290 (92.7%)	313 (79.2%)
Not aware (n=79)	0 (0.0%)	82 (100%)	82 (20.8%)
Total	23 (5.8%)	372 (94.2%)	395 (100%)
Chi-square: χ^2 (1) = 6.39, P<0.011			

Relationship between Gender and Involvement in Cooking Energy Decisions

Table 4 shows the relationship between the gender of the household head and the final decision maker on cooking fuel. There was a highly significant association between the gender of the household head and who makes the final decision on cooking fuel ($\chi2$ (2) = 257.76, p<0.001, Cramér's V = 0.81), indicating a very strong relationship. In male-headed households (n = 257), the vast majority (92.2%) reported that the male head made the final cooking fuel decision, with very few decisions made by females (4.7%) or jointly (3.1%). Conversely, in female-headed households (n = 138), the final decision was primarily made by the female head (65.9%) or jointly with others (34.1%), with no decisions reported to be made solely by males.

These findings align with a growing body of literature demonstrating that intra-household energy decisions are shaped by structural gender inequalities that constrain women's agency (Pueyo, Carreras, & Ngoo, 2020). Studies consistently show that male control over household expenditures often determines fuel choice, even where women bear the primary health and time burdens of cooking (Pachauri & Rao, 2013; Malah-Kuete, 2025; Clancy, Winther, Matinga, & Oparaocha, 2012). Empirical evidence from sub-Saharan Africa further indicates that women's decision-making authority significantly increases the likelihood of clean energy adoption (Pueyo, Carreras, & Ngoo, 2020; Totouom, 2024). The observed autonomy in female-headed households in this study, therefore, reinforces broader findings that empowering women within household governance structures is central to accelerating clean cooking transitions.

Table 4: Relationship between Gender of Household Head and Final Decision Maker on Cooking Fuel

Household Head Gender	Decision Maker on Cooking Fuel	Frequency (n)	Row Percentage (%)
Male-headed (n=257)	Male head	237	92.2
	Female head	12	4.7
	Joint decision	8	3.1
Female-headed (n=138)	Male head	0	0.0
	Female head	91	65.9
	Joint decision	47	34.1
Chi-square: χ^2 (2) =257.76, P<0.001		**Effect Size:** Cramér's V = 0.81	

Qualitative Analysis

Fuel Preferences and Cultural Norms

This theme examined the gap between respondents' preferred cooking fuels and the practical realities that shape their actual choices. While many expressed a preference for cleaner fuels such as LPG and electricity, most still relied on charcoal due to affordability, accessibility, and cultural habits. Key quotes include:

- R4: "I'd prefer gas, it's clean and faster, but we can't afford it."

- R3: "Charcoal is what we know and use. It works for our meals."
- R8: "Electricity is good, but what happens when power goes?"

These qualitative insights corroborate the quantitative findings, revealing a persistent disconnect between fuel preferences and actual household energy choices. While LPG (33.4%) and electricity (22.3%) were the most preferred fuels when cost and access were not limiting, with women specifically expressing preference for LPG (35.4%) and electricity (24.1%), charcoal remains the dominant fuel in use (92.4%). This aspiration-reality gap underscores that economic constraints and cultural familiarity, rather than a lack of preference for cleaner options, sustain charcoal dependence. The finding aligns with Gebreegziabher et al. (2012) and Mukanema & Chiguvi (2025), who demonstrated that households strongly prefer cleaner fuels when affordability and infrastructure barriers are minimised.

Decision-Making Power in Cooking Energy Use

This theme explored household dynamics around who ultimately decides which cooking fuel to use. Responses revealed a pattern of male dominance in energy-related decision-making, even in households where women are primarily responsible for cooking. Key quotes include:

- R6: "Even though I do the cooking, my husband decides what we buy."
- R5: "We discuss, but in the end, it's my husband who decides."
- R2: "In this home, I make the final decisions because I live alone with my children."

These qualitative reflections triangulate the quantitative findings, reinforcing the pervasive gender inequity in household energy governance. The study found that (60%) of respondents reported the male head of the household as the sole decision-maker on cooking fuel, while nearly half (49.6%) indicated they had little or no influence over such choices. These results confirm that women in male-headed households are systematically excluded from energy-related decisions, despite bearing primary responsibility for cooking. In stark contrast, women in female-headed households reported significantly greater autonomy in fuel choices and demonstrated stronger interest in adopting cleaner alternatives. This pattern aligns with the work of Shrestha et al. (2025), who observed that female-headed households are more likely to transition to clean energy when they possess both decision-making authority and access to targeted policy support. The divergence in agency between male- and female-headed households underscores the critical role that intra-household power dynamics play in shaping energy transitions.

Awareness of Clean Fuels

This theme explored the extent to which respondents were aware of cleaner cooking energy options and the health implications of traditional fuel use. While general awareness was relatively high, many respondents lacked in-depth knowledge or practical access to alternatives. Key quotes include:

- R5: "I've heard of gas cookers, but I don't know where to buy them."
- R7: "Yes, I know about clean cooking, but nobody has taught us why it matters."
- R2: "My children in school tell me smoke is bad for my lungs."

These responses align with quantitative findings, which reveal a pronounced disconnect between awareness and adoption of clean cooking technologies. Although (79.2%) of respondents reported awareness of options such as LPG and electricity, adoption remained negligible, with (25.8%) paradoxically citing lack of awareness as a barrier. Qualitative evidence elucidates that this awareness is often superficial, particularly among lower-income and less-educated women, characterised by a limited understanding of health benefits, safety practices, and access pathways.

This explains the continued dominance of charcoal (92.4%), sustained by affordability and cultural familiarity. Notably, when cost constraints were hypothetically removed, many participants, especially women, expressed a preference for LPG (35.4%) and electricity (24.1%). This gap between aspiration and actual adoption demonstrates that information alone cannot drive behavioural change; as Tornel et al.

(2024) contend, meaningful uptake requires targeted subsidies and systemic policy interventions.

Barriers to Adoption

This theme highlighted the various challenges respondents face in transitioning to cleaner cooking fuels. Key obstacles included economic limitations, safety concerns, unreliable infrastructure, and deep-rooted cultural preferences. Key quotes include:

- R1: "Gas scares me. I've seen stories of explosions."
- R6: "Where would I even get a gas tank? No one sells it here."
- R4: "Even if I wanted electricity, the power cuts are too much."

These qualitative reflections support the quantitative findings, which identified high fuel cost (56.9%), appliance cost (40.5%), and safety concerns (22.8%) as the most cited barriers to clean fuel adoption. Respondents also highlighted the lack of local supply (12.7%) and cultural preferences (16.5%) as additional constraints. The qualitative data adds important depth, illustrating that beyond affordability, households are constrained by supply chain limitations, unreliable electricity, and fear or mistrust of unfamiliar technologies.

These barriers disproportionately affect households where women have lower educational attainment and income, mirroring Boudewijns et al. (2022), who identified high initial costs, limited credit access, and recurring maintenance expenses as key barriers to clean cookstove adoption and sustained use.

Together, these findings demonstrate that gender inequality in energy decision-making is not merely correlated with but structurally embedded in household governance. The stark contrast between male- and female-headed households in decision-making authority (Cramér's V = 0.81) reveals that women's energy agency is primarily constrained not by individual characteristics but by household power structures. This synthesis confirms that achieving SDG 5 and SDG 7 in urban Zambia requires transforming these structures, not merely addressing symptoms.

Policy Implications

Addressing gendered energy poverty in urban Zambia requires transformative interventions targeting intra-household decision-making inequities. First, the Ministry of Energy should establish gender-targeted financing mechanisms, including voucher schemes and micro-credit delivered through existing social protection programmes (e.g., Social Cash Transfer) to reach women lacking decision-making authority. Second, last-mile distribution networks for LPG and improved cookstoves should prioritise women as entrepreneurs, combining expanded access with economic empowerment. Third, investments in electricity reliability and decentralised renewable solutions are essential to build consumer confidence in electric cooking.

These supply-side interventions must be complemented by community-level programmes engaging men as allies in supporting women's energy autonomy. Embedding gender-responsive strategies within Zambia's SDG 5 and SDG 7 frameworks with clear targets, budget allocations, and monitoring mechanisms will accelerate clean cooking adoption while advancing health, climate, and gender equality outcomes. Realising this vision demands coordinated action among the Ministry of Energy, gender-focused institutions, local authorities, private sector suppliers, and development partners.

CONCLUSION AND RECOMMENDATIONS

Conclusion: This study demonstrates a clear gender gap in cooking energy decision-making in Mtendere, Lusaka. Despite being responsible for cooking, most women lack authority over household energy choices, a disconnect that reinforces exposure to harmful fuels and limits the transition to cleaner alternatives. Gender of the household head significantly influences decision-making dynamics, with male-headed households largely maintaining control over energy decisions. Socioeconomic factors such as education and income also play a crucial role in clean fuel adoption, but these are further compounded by gender-based exclusion. To address this, energy policies must move beyond gender-neutral frameworks and actively integrate gender-sensitive strategies. Targeted policy interventions, including subsidies for clean appliances, safety education, and public awareness campaigns, must be paired with

broader efforts to enhance women's decision-making power in households. Achieving SDG 5 (Gender Equality) and SDG 7 (Affordable and Clean Energy) in Zambia will depend on centring women in the energy access agenda.

Recommendations: Based on the empirical findings of this study, the following multi-level recommendations are proposed to address gender disparities in access to clean cooking and accelerate equitable energy transitions in urban Zambia.

For Government and Energy Policy

Mainstream Gender Equality into National Energy Frameworks: The Ministry of Energy should integrate gender-transformative approaches into the National Energy Policy, including enforceable targets for women's representation in energy decision-making structures at all levels.

Establish Gender-Targeted Financing Mechanisms: The government should design direct subsidy schemes, voucher systems, and micro-financing products tailored to women's economic profiles, prioritising female-headed households and women lacking decision-making power over household expenditures.

Strengthen Clean Energy Supply Chains and Infrastructure: Policy interventions should invest in last-mile distribution networks for LPG and improved cookstoves in low-income settlements, while improving electricity reliability and promoting decentralised renewable solutions to build consumer confidence.

For Civil Society and Development Partners

Integrate Clean Cooking into Health and Education Programmes: Development partners should collaborate with Ministries of Health and Education to embed clean cooking messaging into maternal health services, school curricula, and community health worker training.

Promote Women's Entrepreneurship in Clean Energy Value Chains: Programmes should support women as entrepreneurs in LPG refilling, cookstove production, and last-mile distribution, positioning women as active participants in the clean energy economy.

Support Culturally Grounded Behaviour Change Communication: Civil society should facilitate peer-to-peer learning and engage women community leaders as clean cooking champions to bridge the gap between awareness and adoption.

For Community

Mobilise Women Leaders in Clean Cooking Advocacy: Community structures should champion clean cooking adoption through peer education and demonstrations of cleaner technologies within social networks.

Empower Women in Energy Decision-Making Spaces: Civic education should equip women to participate actively in community energy planning forums and infrastructure consultations, ensuring their voices shape decisions affecting their daily lives.

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