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Alternative Energy for Cooking in Zambia: Towards a Sustainable Energy Transition

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Summary

In Zambia, over half of households in urban areas rely on charcoal for energy use. Increased household charcoal demand increases deforestation rates, in turn reducing the country's potential for climate change mitigation. So far, government efforts in enhancing the use of clean energy at a policy level have not had corresponding success at the household utilization level. This policy brief conducts key informant interviews and a literature review to examine trends in alternative energy uses. This analysis reveals a need for a broader, multidimensional understanding of access to renewable energy in order for deployment to be effective. The barriers to the successful adoption of alternative energy technologies to charcoal include poor enabling conditions and policy inadequacies, value chain inefficiencies, underexploited renewable energy, cultural barriers, and heavy reliance on a service-challenged hydro power utility.

Key Policy Recommendations

- A baseline assessment is needed to understand knowledge, perceptions, attitudes, and drivers for renewable energy technology adoption among households.
- In order to make clean energy accessible and affordable to household, short- to medium-term incentives for Small Medium Enterprises (SMEs) engaged in the provision of clean energy, such as LPG, are needed.
- Research into socio-economic barriers to accessing alternative energy by households could help provide insights into targeted policymaking.

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Introduction

The purpose of this brief is to document the trends in alternative energy use based on key informant interviews and synthesizing literature. The major energy sources in Zambia include electricity, petroleum, coal, biomass, and renewable energy [1]. About 70% of the population depends on wood fuel for their energy requirements **(Figure 1)** [2].

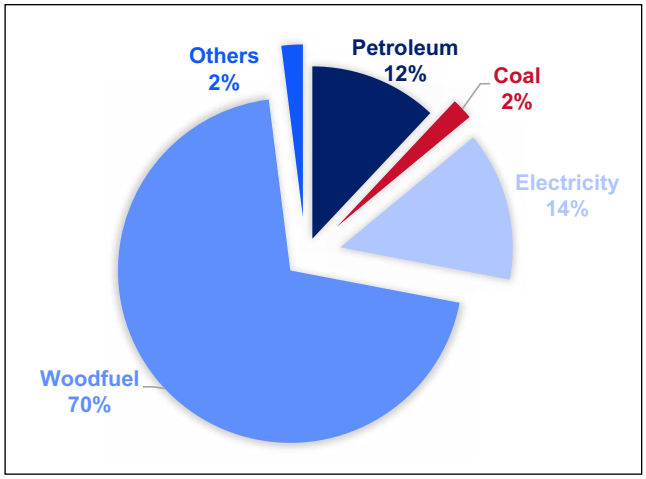

Figure 1: Energy Mix Percentage Contribution – Data Source World Bank

Electrification rates are low **(Figure 2)**, with only 43% of the urban population and 5% of the rural population having access to electricity [3, 4]. Access to other modern sources of energy is still a challenge, especially for rural populations.

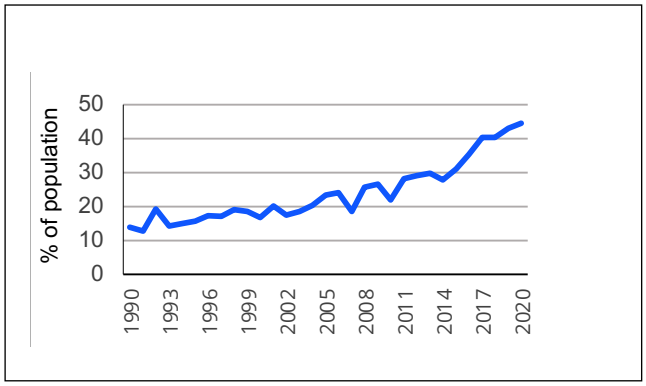

Figure 2: Access to electricity (% of population) – Data Source World Bank

The percentage of population with access to clean fuels and technologies for cooking has been declining for the past 10 years **(Figure 3)**.

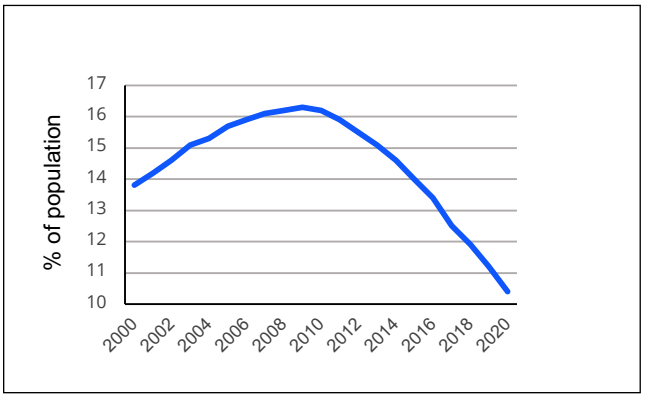

Figure 3: Access to clean fuels and technologies for cooking (% of population) – Data Source World Bank

The sources of energy used for cooking include, wood-fuel (charcoal and firewood), accounting for about 78%, with electricity contributing around 11% to the total energy consumed [5–6]. The other sources of energy are petroleum products and coal, which account for about 9% and 2%, respectively [6]. Energy efficiency is important to improving the lives of all people, providing affordable and reliable energy access, supporting economic growth and resilience, enhancing security of supply, and accelerating clean energy transitions [2]. Focus on energy efficiency is key to delivering a net-zero energy system and sustainable transition.

> *In Zambia, only 43% of the urban population and 5% of the rural population have access to electricity.*

Zambia is self-sufficient in renewable energy resources; it has hydro, biomass, solar, wind, and geothermal energy that can be exploited [2–4, 7] to improve access to affordable, reliable, and sustainable energy for social and economic

development [3]. This could introduce new employment opportunities and enterprise development. One of the fundamentals for fostering green growth and the achievement of sustainable development goals is to adopt renewable energy [8].

Zambia's alternatives to charcoal include electric stoves, Liquid Petroleum Gas (LPG), bio-ethanol liquid gel, processed biomass (e.g., pellets), and biogas [9]. A range of innovative technologies are also available to increase the efficiency, affordability, and accessibility of alternative energy fuels [9].

Despite the country having many alternatives to charcoal, it has one of the highest deforestation rates in the world, losing between 180,000 and 250,000 hectares each year [10]. Nearly 25% of deforestation and forest degradation is attributed to charcoal production [9]. The factors contributing to high charcoal consumption are attributed to erratic electricity supply (caused by recurrent load shedding), lack of access to electricity and electric stoves, and household size [11].

Conversely, charcoal use also contributes significantly to greenhouse gas (GHG) emissions that drive global climate change. Unfortunately, the widespread adoption and deployment of renewable energy and fuels is currently hindered by poor enabling conditions, value chain inefficiencies, and cultural barriers [9].

Methodology

This policy brief explores trends in alternative energy use in Zambia through interviews and literature review. Firstly, key informant experts in the energy sector were interviewed on alternative energy sources for cooking in Zambia. Sixteen (16) key informant interviews were conducted with purposively sampled experts from the organizations shown in **Table 1**.

CATEGORY	NUMBER OF INTERVIEWEES	ABBREVIATION IN TEXT
National Government (energy)	8	NG
Quasi Government	6	QG
Local Government	2	LG

Table 1. Interviewees by category

Data collected from these key informant interviews related to the identification and rating of the viability of using alternative energy to charcoal for domestic use in Zambia. Further, a comprehensive synthesis of literature on energy was undertaken by employing keywords to search for relevant peer reviewed papers, relevant Government documents, and World Bank Reports in Google Search Engine and Google Scholar. The synthesis was done according to methods proposed by Page [12] and Snyder [13].

Key Findings

ALTERNATIVE SOURCES OF DOMESTIC ENERGY

A Likert scale was administered to key informants in order to assess the viability of use of domestic energy alternatives commonly used in Zambia, namely electricity, LPG, bio-ethanol, biomass, and biogas (Figure 4). For each of the energy alternatives considered, key informants provided experts ratings for the availability of the technology, access to the technology by households, affordability of the alternative, and the widespread use of the alternative. The rated

categories were themes regarding the viability of energy assessment generated during key informant interviews. The overall mean rating was presented as the total rating, representing the comparative viability of the energy alternative.

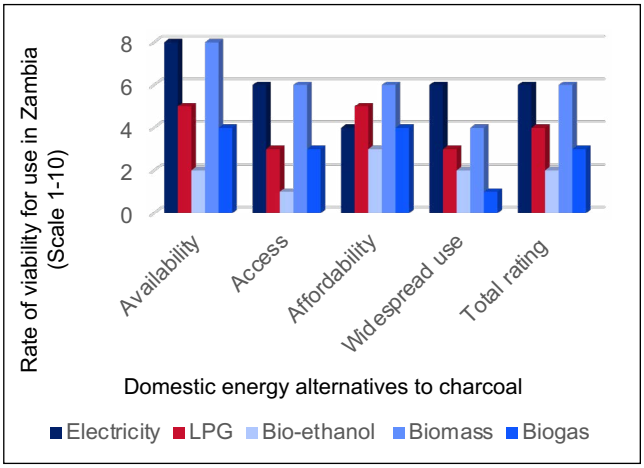

Figure 4. Stakeholder rating of viability of use of alternative energy sources to charcoal in Zambia on a scale of 1–10, with 1 representing a low success rate and 10 representing a high success rate

Electricity and biomass were rated as the most viable for use by households, largely due to the availability of the technology and widespread access. Biomass energy, however, requires efficient cook stoves to enhance efficient use. Such cook stoves are, as yet, not readily available which provides a challenge for adoption. Technological challenges related to the use of biogas and bio-ethanol liquid gel were identified as presenting a barrier for use. The high cost related to LPG was also seen as a barrier as was the lack of mass access to bio-ethanol and biogas.

“Bio-ethanol and biogas are not readily available. In rural areas very few people have even heard about these, let alone know how to them” (Key informant from QG).

While this study did not find statistics on the number of households using alternative energy sources besides charcoal and electricity, one key informant related the choice of energy alternatives to household socio-economic characteristics when he said:

“LPG is one of the clean energy sources usually available to the rich. The poor use firewood or straw [solid biomass]” (Key Informant from NG).

CHARCOAL AS SOURCE OF DOMESTIC ENERGY

Charcoal is widely used for cooking, accounting for 44% of urban households in urban Zambia [11]. The demand for charcoal is consistently on the rise in Zambia, like in most sub-Saharan Countries. Charcoal remains the energy of choice for cooking in Zambia because it is inexpensive relative to other fuel alternatives [14], and its supply is usually more reliable than that of its alternatives [9]. The demand for charcoal is further increased by the fact that there are no easy, affordable, widely adoptable, and safe energy alternatives [14]. Total charcoal demand seems unlikely to fall in the near future, and it is more likely to grow with increasing incomes and urbanization [15]. However, with the environmental concerns that charcoal production and use raises, it is imperative to centre policy discussions around greening of the charcoal value chain [16].

Therefore, we argue that in order for a sustainable energy transition to be achieved, there is need for empirical research to understand the drivers of the charcoal value chain [17], as well as the prospective environmental and socioeconomic outcomes of such an energy transition. Initial sustainability gains could be achieved by focusing more on promoting sustainable charcoal production and boosting the adoption of improved cook stoves – especially among low- and middle-income

households [18]. However, synchronization of different energy mixes could also remove the energy burden from charcoal. For example, besides hydropower, solar energy has been utilized at household level for lighting [8]. Furthermore, there is potential for geothermal and wind energy [8, 19].

The government has also opened up its markets to Independent Power Producers (IPPs) who sell electricity to the Zambia Electricity Supply Corporation (ZESCO), the national utility. The barriers to the adoption of green energy include weak institutional and legal frameworks, inadequate funding, and ineffective coordination of the various actors in the energy sector [14].

Policy Recommendations

This policy brief on alternative energy for cooking in Zambia has conducted interviews with key informants and a literature review, indicating; (i) Electricity and biomass are the most viable alternatives to charcoal; (ii) Charcoal remains the energy of choice for cooking as it is inexpensive relative to alternatives; (iii) demand for charcoal is on the rise due to its affordability, availability, adoptability, and increased safety compared with alternatives.

To advance clean energy use in cooking, this brief recommends the following:

- A baseline assessment is needed to understand knowledge, perceptions, attitudes, and drivers for renewable energy technology adoption among households to develop strategies of increasing use of alternative energy sources to charcoal.
- In order to make clean energy accessible and affordable to households, incentives should be provided by the Government of the Republic of Zambia to Small Medium Enterprises (SMEs) engaged in clean energy provision, such as LPG.
- In order to make clean energy accessible and affordable to households, short- to medium-term incentives for Small Medium Enterprises (SMEs) engaged in the provision of clean energy, such as LPG, are needed.

References

[1] C. Y. Chama, "An econometric analysis of Zambian industrial electricity demand," Lambert Academic Publishing: University of Oslo, 2012.

[2] S. Kaunda and M. Mtawali, "The State of the Energy Sector in Zambia: Implications for Industrial Development, Jobs and Poverty Reduction," Policy Monitoring and Research Centre (PMRC), 2013. [Online]. Available: https://www.pmrczambia.com/wp-content/uploads/2015/06/The-State-of-the-Energy-Sector-in-Zambia-.pdf.

[3] International Labour Organization (ILO), "Renewable Energy and Energy Efficiency Sector: Media Kit." p. 19, 2021, [Online]. Available: https://www.ilo.org/wcmsp5/groups/public/---africa/---ro-abidjan/---ilo-lusaka/documents/publication/wcms_756870.pdf.

[4] G. Munyeme and P. C. Jain, "Energy scenario of Zambia: Prospects and constraints in the use of renewable energy resources," *Renew. Energy*, vol. 5, no. 5–8, pp. 1363–1370, Aug. 1994, doi: https://doi.org/10.1016/0960-1481(94)90172-4.

[5] Government of the Republic of Zambia (GRZ), "National Energy Policy." Ministry of Energy, Lusaka, Zambia, 2019.

[6] GRZ, "Scaling-up renewable energy program in low income countries investment plan." Ministry of Energy, Lusaka, Zambia, p. 99, 2019, [Online]. Available: https://www.climateinvestmentfunds.org/sites/cif_enc/files/srep_invetment_plan_for_zambia.pdf.

[7] Zambia Development Agency (ZDA), "Energy Sector Profile." Zambia Development Agency (ZDA), Lusaka, Zambia, p. 13, 2013.

[8] P. Kachapulula-Mudenda, L. Makashini, A. Malama, and H. Abanda, "Review of Renewable Energy Technologies in Zambian Households: Capacities and Barriers Affecting Successful Deployment," *Buildings*, vol. 8, no. 6, p. 77, May 2018, doi: https://doi.org/10.3390/buildings8060077

[9] United States Agecny for International Development (USAID), "USAID/Zambia ECONOMIC DEVELOPMENT ALTERNATIVES TO CHARCOAL (A2C)." USAID, Lusaka, Zambia, p. 2, 2021, [Online]. Available: https://www.usaid.gov/sites/default/files/documents/FINAL_A2C_Fact_Sheet_DEC_2021.pdf.

[10] USAID, "Zambia power Africa fact sheet." 2021, [Online]. Available: https://www.usaid.gov/powerafrica/zambia.

[11] S. T. Tembo, B. P. Mulenga, and N. Sitko, "Cooking Fuel Choice in Urban Zambia: Implications on Forest Cover," Indaba Agricultural Policy Research Institute (IAPRI), Lusaka, Zambia, 94, 2015. [Online]. Available: https://pdf.usaid.gov/pdf_docs/PA00KF5C.pdf.

[12] M. J. Page *et al*., "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews," *BMJ*, p. n71, Mar. 2021, doi: https://doi.org/10.1136/bmj.n71.

[13] H. Snyder, "Literature review as a research methodology: An overview and guidelines," *J. Bus. Res.*, vol. 104, pp. 333–339, 2019, doi: https://doi.org/10.1016/j.jbusres.2019.07.039.

[14] A. Kabechani, B. Deka, and B. S. Mwila, "National Policy on Climate Change. Unlocking Zambia's Potential," Policy Monitoring and Research Centre, Lusaka, Zambia, 2016. [Online]. Available: https://www.pmrczambia.com/wp-content/uploads/2017/11/National-Policy-on-Climate-Change.pdf.

[15] N. Doggart *et al*., "The influence of energy policy on charcoal consumption in urban households in Tanzania," *Energy Sustain. Dev.*, vol. 57, pp. 200–213, Aug. 2020, doi: https://doi.org/10.1016/j.esd.2020.06.002.

[16] M. Kabisa, B. P. Mulenga, H. Ngoma, and M. M. Kandulu, "The Role of Policy and Institutions in Greening the Charcoal Value Chain in Zambia," Feed the Future Innovation Lab for Food Security Policy, 167, 2019. [Online]. Available: https://www.canr.msu.edu/fsp/publications/research-papers/RP_167ac(1).pdf.

[17] Food and Agriculture Organization (FAO), "The Charcoal Transition: Greening the charcoal value chain to mitigate climate change and improve local livelihoods," Rome, Italy, 2017. [Online]. Available: https://www.fao.org/3/i6935e/i6935e.pdf.

[18] A. Atteridge, M. Heneen, and J. Senyagwa, "Transforming Household Energy Practices Among Charcoal Users in Lusaka, Zambia: a User-Centred Approach," Stockholm Environment Institute (SEI), Stockholm, 2013. [Online]. Available: https://mediamanager.sei.org/documents/Publications/Climate/SEI-WP-2013-04-Zambia-Cookstoves.pdf.

[19] Energy Sector Management Assistance Program (ESMAP), "Renewable energy wind mapping for Zambia: 12-Month Site Resource Report," World Bank Group, Washington, DC, USA, 2018. [Online]. Available: https://documents1.worldbank.org/curated/en/528711526549758961/pdf/Renewable-energy-wind-mapping-for-Zambia-12-month-site-resource-report.pdf.

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