



Policy brief

BIOENERGY DIAGNOSTICS STUDY

Authors

Eric Buijsman, Team Leader
Emiel Hanekamp, Contract Manager

25 October 2022



Co-funded by the European Union



This report is supported by the Investment Climate Reform (ICR) Facility. The ICR Facility is co-funded by the European Union (EU), the Organisation of African, Caribbean and Pacific States (OACPS) under the 11th European Development Fund (EDF), the German Federal Ministry for Economic Cooperation and Development (BMZ) and the British Council. The ICR Facility is implemented by GIZ, the British Council, Expertise France, and SNV. This specific intervention is led by Partners for Innovation on behalf of SNV.

The contents of this publication are the sole responsibility of the author and do not necessarily reflect the views of the donors or the implementing partners.

The ICR Facility supports public and private stakeholders in African, Caribbean and Pacific (ACP) countries in creating a more conducive, sustainable and inclusive business environment and investment climate.

More information: www.icr-facility.eu

Implemented by



This document was written by Partners for Innovation



Partners **for**
Innovation

Content

1	EXECUTIVE SUMMARY	4
2	BIO-ENERGY DIAGNOSTIC STUDY	5
2.1	INTRODUCTION	5
2.2	CONTEXT AND BACKGROUND	5
2.3	MAIN FINDINGS	5
3	RECOMMENDATIONS AND CONCLUSION	7
3.1	RECOMMENDATIONS	7
3.2	CONCLUSION	9
	ACRONYMS	10

1 Executive summary

The Investment Climate Reform (ICR) Facility approved technical assistance (TA) to the Ministry of Energy of Zambia (MoE), and the Off-grid Taskforce (OGTF) for a bio-energy diagnostic study. The objective of this study is an analysis of the investment barriers currently holding back the bioenergy sector for clean cooking, focusing on improved wood and charcoal stoves, char-briquettes, biomass pellets, bioethanol and domestic biogas, and productive use of bioenergy for curing and drying purposes (tobacco sector), for power generation (biogas and biomass) and for space heating. Investment into these bio-energy options is limited due to a large number of barriers (box 1) and consequently most households continue to rely on inefficient stoves fuelled with wood in rural areas and charcoal in urban areas and access to power and efficient technologies in rural off-grid areas is limited. The overall conclusion is that the bio-energy market is nascent, but that a tremendous potential exists, which with the right set of policies and actions (box 1) can significantly reduce reliance on traditional biomass and improve the rural economy.

Box 1: Main findings and recommendations

Selected key recommendations which would unlock significant investment are:

1. Levelling the playing field by taxing charcoal or abolishing taxes on sustainable technologies and fuels
2. Create awareness at all levels on energy efficiency and sustainable fuels
3. Access to concessional finance, both for companies and consumers
4. Set-up an ICS support program for ICS producers and sustainable char-briquette producers including a carbon financing program.

Sector specific recommendations in the cooking sector are:

- **ICS:** infrastructure is limited to a handful companies with limited scale, with the exception of a project in the Eastern Province. It is expected however, that companies will up-scale production enabled through carbon financing. Reaching the masses, however, requires engagement with tinsmiths in improving and mechanising production through an ICS support programme.
- **Char-Briquettes:** Various start-ups have entered the market with success in the poultry and pig farming sector but with limited success for residential cooking. Access to finance and technology is necessary for these start-ups to upscale and reduce production costs through mechanization.
- **Biomass pellets:** Pellets are price competitive with charcoal, but growth in the sector requires securing sufficient feedstock and funding to pre-finance gasifier stoves, which are often too expensive to purchase upfront by households. There is ample biomass feedstock available in state-owned plantations but there is no allocation to support sustainable fuel production.
- **Bioethanol:** Significant investment and production capacity will be unlocked by abolishing excise duty on denatured bioethanol for cooking and for transportation fuel blending. This has the potential to be transformative, improve rural livelihoods and significantly reduce fuel imports.
- **Domestic biogas:** There is significant potential to upscale domestic biogas, however a long-term support program is necessary to retain and built capacity in the sector for construction, after sale services and biogas utilization equipment. Innovative financing models combined with valuation of bio-slurry to improve agricultural production is required to make biogas more affordable and improve the business case.

Sector specific recommendation in the productive use of bioenergy for off-grid applications are:

- **Biogas and char-briquettes for the poultry and piggery sector:** There is a significant potential for biogas for pig pen and chick brooding stable heating – as a source of reliable and sustainable energy with significant monetary saving. Access to concessional finance is required to up-scale production.
- **Energy efficient barns for the Tobacco curing:** Wood consumption in the tobacco sector could be reduced significantly with the introduction and promotion of existing energy efficient barns while at the same time improving quality of the cured and dried product. Awareness campaigns are necessary to accelerate dissemination.
- **Biogas and biomass power generation:** On-grid generation is not viable due to the low electricity tariffs and off-grid generation is challenging due to low demand, the highly geo-spatial rural settlement patterns which increases cost in distribution networks. More study is required at biomass hotspots to identify the potential.
- **Biogas for village electrification:** There is one grant funded village electrification plant in Zambia, but that project is not successful. Revitalization this plant, and an understanding what prevented success is necessary before such a model could be replicated.

2 Bio-energy diagnostic study

2.1 Introduction

The Investment Climate Reform (ICR) Facility approved technical assistance to the Ministry of Energy of Zambia (MoE), and specifically the Off-grid Taskforce (OGTF) within the Department of Energy for a bio-energy diagnostic study. The objective of this assignment is an analysis of the investment barriers currently holding back the bioenergy sector. The scope of the study covers the most important bioenergy applications, which were selected based on a sectoral analysis in close consultation with OGTF/MoE. The (sub)sectors included residential cooking (improved wood stoves, improved charcoal stoves, char-briquettes, biomass pellets, bioethanol, domestic biogas) and productive use of bioenergy for curing and drying purposes (tobacco sector), for power generation (biogas and biomass) and for space heating. This policy brief is a summary of the bio-energy diagnostic report prepared for the OGTF/MoE focussing on the identified gaps and key actions that will enable the improvement of Zambia's bioenergy sector. The study is a bottom-up analysis of data collected through intensive stakeholder consultations, both in-country and virtual and extensive literature review.

2.2 Context and background

Zambia's current consumption of traditional biomass is mostly firewood and charcoal (83.4% of the households). These traditional fuels are used in open fires (46.4% of households with wood and 0.3% with charcoal), traditional brazier stoves or mbaula (35.9% with charcoal and 0.3% with wood) and improved manufactured stoves (0.4% use charcoal. Of the population 0.1% relies on LPG for cooking and 16.5% of the households are cooking on electricity (ESMAP, 2019).

It is estimated that 90% of the roundwood obtained from natural forests is used as wood fuel (FAO, 2020).. Since the level of annually sourced wood exceeds the mean annual increment of biomass, deforestation takes place, at an annual rate of an estimated 172,000 hectare per annum (Ministry of Finance and National Planning, 2022). Although the major drivers of deforestation are attributed to the expansion of agricultural land and human settlements, replacing current sources of wood fuel with sustainably sourced woody residues or with other types of biomass residues would reduce the pressure on natural forests (FAO, 2020). FAO, in its bioenergy and food security (BEFS) study, outlines viable feedstock and sustainable bioenergy supply chains. The study concludes that briquettes (i.e., charcoal briquettes or biomass briquettes) and biogas are potential variable alternative cooking fuels and could meet 14% of the countries clean cooking target. Alternatively, these fuels could be used to generate up to 1,192 MW electricity. The focus of this study is to investigate the potential of utilizing the residues for cooking and productive use and on measures to reduce the reliance on traditional biomass.

2.3 Main findings

The main findings in the cooking sector are provided in table 1:

Table 1: Main findings in the cooking sector

Sector	Key findings and gaps
Improved cookstoves (wood and charcoal)	Various companies are active, but few have reached scale. The exception is C-Quest Capital/Comaco, which have distributed over 100,000 stores in the Eastern province funded by carbon finance. Other companies are smaller but will utilize carbon finance to scale up. Tinsmiths are the main producers of traditional charcoal stoves. Non-standardized improved versions exists but sales are low.
Char-briquettes	Various start-ups have entered the market. Their production is mostly manual and labour intensive which is preventing them to reach an economy of scale. Mechanisation of production is required to up-scale production. However, companies face challenges in accessing finance and importing required technologies.
Domestic biogas	Around 5,000 digesters are installed and there are significant opportunities for upscaling. However, customers are often not concentrated in one region which complicates sales and after sale services. The investment barrier is significant, (11,000 ZMW costs the smallest digester, 4 m ³). Improving the business case is necessary through valuation of bio-slurry as potent organic fertilizer and access to concessional finance to improve affordability.

Bioethanol	Investment in the sector has taken place, but none of the companies produce for the Zambian market with the exception of liquor production. The main barrier is excise duty on denatured bioethanol. Removing this barrier would unlock significant investment.
Pellets	Biomass pellets and the matching gasifier stove are sold by one company; Emerging Cooking Solutions. This makes the supply chain vulnerable as there are no alternative suppliers. The company active in Zambia is serving over 3.333 households. Issues preventing upscaling are lack of capital to pre-finance stoves and challenges related to securing feedstock supply for pellet production

Out of the options mentioned above, biogas, bio-ethanol and pellets are considered modern biomass and clean cooking technologies. Improved cookstoves and char-briquettes are improvement over the baseline stove and fuels, and can save significant amount of fuel, but are not considered clean (but cleaner compared to the baseline).

In the productive energy use sector, the key findings are presented in the table (table 2) below:

Table 2: Main findings in the produce bio-energy sector for off-grid application

Sector	Key findings and gaps
Tobacco sector	Tobacco leaf curing is a critical process and requires exposure to hot air for a period of 1 to 2 weeks. Traditionally, inefficient barns are used for this drying process consuming large quantities of wood. A local low-cost improved barn, the Kamanga Barn, can cut this amount in half while at the same time improving the quality of the cured leaf. This technology is disseminated to 1,000 farmers out of the estimated 30,000 tobacco farmers. The main challenge is awareness and reaching farmers not linked to Tombwe processing ltd (the main promotor of this technology)
Biogas and biomass for power generation	There are no commercially viable examples of biogas and power generation with biomass in the off-grid context. Challenges in off-grid areas are low demand, lack of qualified engineers in rural areas, scattered settlements, lack of large electricity off-takers and lack of biomass supply chains. Successful examples exist in other countries, mostly Asian on gasification with mini-grid options which could have viability in Zambia. The ZESCO gasifier, which could be an important capacity building site is broken and needs repair. On-grid application also faces challenges, mostly related to the low replacement value of electricity.
Biogas and char-briquettes for the poultry and piggy sector	Biogas at piggeries or poultry farms to generate heat for piglets or chick brooding is attractive with a pay-back period in the order of 2-3 years. In the case of poultry farmers there are challenges related to collected poultry droppings. More study is necessary to identify business models. Char-briquettes from agricultural residues are in high demand by farms without biogas. These briquettes are price competitive with charcoal but have better burning properties. Char-briquettes producers however face challenges with up-scaling, as outlined in table 1.
Biogas for village electrification	There is one example of a village electrification plant in Zambia, the biogas plant in Pertaue. That plant however is not well managed, the generator is broken and there are issues related to feeding, biogas distribution and bio-slurry usage. Another challenge is that the plant is grant funded, and villagers are unlikely to bear CAPEX costs. Investment opportunities are therefore limited except for the operation and maintenance of a grant funded plant.

3 Recommendations and conclusion

3.1 Recommendations

The key question to be answered in this study is how to increase investment into the bio-energy sector. In this chapter the recommendations made in the diagnostic study are combined into overarching strategies and measures to create an enabling environment for investment. Indicatively, these are grouped in short and medium-term recommendations.

Table 3: Generic reform recommendations

Leading entity	Recommendations	
	Short-term	Medium-term
OGTF / Ministry of Energy	Develop a clean cooking strategy with clear annual stove targets.	In the medium term the strategy should encourage a move away from ICS to higher tier (cleaner) stoves and fuels
OGTF / Ministry of Energy	-	Set-up a database to monitor the status and progress of modern bioenergy in Zambia
OGTF / Ministry of Energy	-	Implement and enforce a tax regime for charcoal and alternative fuels and technologies to create a level playing field
OGTF / Ministry of Energy	Set up of a financing facility that clean cookstove companies could access for working capital, such as a revolving fund.	-
OGTF / Ministry of Energy and Ministry of Finance	Set up a support facility (e.g. technical assistance, co-funding for feasibility studies, advice and support with legal and tax issues, etc) to make Zambia more attractive for bio-energy investments.	-
OGTF / Ministry of Energy and Ministry of Green Economy	Develop programmatic climate mitigation and or adaptation proposals to be submitted to the Green Climate Fund	-

There are various specific barriers and short and medium-term solutions relevant to individual sectors in the cooking space (see table below). Indicatively, these are grouped in short and medium-term recommendations.

Table 4: Sector specific short and medium-term recommendations to promote investment in the bio-energy sector

Sector	Recommendations		Comments
	Short-term	Medium-term	
Improved cook stoves	Review taxation of the charcoal chain	Develop new financing mechanisms (see key actions) to attract more investment into the sector.	Many companies are investing in ICS encouraged by the recovery of the carbon prices.
	Encouraging tinsmiths to set-up cooperatives and supporting these cooperatives with access to capital and knowledge for exclusive production of improved mbaula stoves.	Tin-smith cooperative project could access carbon finance to support the investment.	Local artisans, tinsmiths, will only move away from producing mbaula if a perspective is offered.
	Technical support services (quality control, testing), marketing and promotion, awareness creation.		
Char-briquettes (both for	Create possibilities for access to concessional finance, i.e., as proposed under the ICS support	Develop char-briquette product quality standards.	The main barrier to upscaling and investment is the lack of

Sector	Recommendations		Comments
	Short-term	Medium-term	
cooking and for farms)	programme is essential including support to import briquettes presses and other parts.		technology for mechanisation and access to finance.
Biogas	Organize a taskforce or national program to have concerted effort to create an enabling environment for demand and investment.	-	The value proposition of biodigesters has to be clarified by developing business models, and valuation of productive use of bio-slurry.
Bioethanol	Remove the excise duty on denatured bioethanol for cooking and transportation to unlock significant investments	-	Excise duty is preventing investment into the sector.
Pellets	<p>Support Emerging Cooking Solutions with overcoming their feedstock issues by working with ZAFFICO</p> <p>MoE should take a leading role in ensuring that pellet businesses can grow. In the draft EESAP, Min of Energy is the main implementation body for the action to up-scale pellet production from 1,200 currently to 10,000 ton/year.</p> <p>Encourage other companies to invest in pellet production, like the Tobacco association of Zambia (TAZ) , ZAFFICO, or the Copperbelt Forest Company.</p>	Explore a public private partnership (PPP) model, such as ZAFFICO investing into pelleting and ECS would focus on increasing the supply of gasifiers stove on the market.	ZAFFICO is a government owned company (63% of shares are owned by the Industrial Development Corporation Zambia (IDC). Its mandate is to play a catalytic role by developing projects either on its own or in partnership with private sector players and other development-oriented agencies.
Thermal energy for curing/drying	<p>Understand barriers for existing energy efficient technologies adoption and work with TAZ and Tombwe Ltd to reach all farmers including setting up woodlots.</p> <p>Disseminate at scale existing energy efficient technologies which save wood and improve quality of the product.</p>	Applied research into solar thermal drying technologies.	Energy efficient technologies exist which save wood and improve quality of the product but are not disseminated at scale.
Biogas and biomass for power generation	<p>Repair the gasifier at the ZESCO training centre.</p> <p>Assess opportunities for power generation in the geographical hotspots identified by FAO.</p>	<p>Evaluate support companies, which have a business interest in exploring this. This could be a vehicle to attract investment. Rice mills for example, although not studied have a significant electricity demand for milling and thermal energy for paddy drying, gasification of rice husk could be viable option but needs more study.</p> <p>Develop a grid feed in tariff for biomass and biogas power projects.</p>	Biogas and biomass for power generation is very challenging, due to low electricity demand in off-grid areas and lack of experience.

Sector	Recommendations		Comments
	Short-term	Medium-term	
Biogas for productive use	Heating of barn (piglets and chick brooding): Interview more farmers and other stakeholders in the sector to understand further what is holding back investment in biogas. Integrate productive use of in the taskforce /national program (see sector biogas).	-	Significant savings are possible with using biogas for heating with a relative short pay-back period.
	Community scale biogas: study the experiences in Petauke and evaluate how to replicate the model.	-	Community scale biogas for cooking and productive use has great potential to improve livelihoods but are often, and in the case of Petauke 100% grant funded. It is unlikely that the community can bear the cost if the facility is financed by a commercial investor. Business opportunities are therefore absent. If grant funding were available, there might be opportunities for companies to operate and maintain the facility.

3.2 Conclusion

The overall conclusion of this study is that the bioenergy market in Zambia is nascent, both for cooking and productive use. A range of activities and projects take place, but none have achieved scale. There is a general lack of information and coordination in the sector which makes it difficult to track progress and to build on on-going initiatives. Nevertheless, with the right policies and measures, the potential to transform the market is very high.

Acronyms

CFP	Copperbelt Forestry Products
EESAP	Energy Efficiency Strategy and Action Plan
ICS	Improved cookstove
MoE	Ministry of Energy
NEP	National Energy Policy
OGTF	Off-grid task force
PFI	Partners for Innovation
TAZ	Tobacco association of Zambia
ZMW	Zambian kwacha

REFERENCES

This policy brief is based on the bio-energy diagnostic study (2022) developed by Partners for Innovation for the OGTF and the MoE. Literature in the bio-energy study is:

- A2C. (2021). *Final prpoosal Fiscal incentives on ATFs*. USAID.
- AfricaReport. (2022, April 5). *Household Pollution*. Retrieved from The Africa Report: <https://www.theafricareport.com/191102/kenyas-koko-networks-plans-ethanol-cooking-expansion-in-africa-asia/>
- AgriFocus. (nd). *Market Analysis study for uptake of biogas and bio-slurry*. SNV.
- AgriProFocus. (2016). *Market Analysis study for the uptake of biogas and bio-slurry*. SNV.
- Atteridge, A., Heneen, M., & Senyagwa, J. (2013). *Transforming Household Energy Practices Among Charcoal Users in Lusaka, Zambia: a User-centered approach*. Stockhold Environmental Institute.
- Bal, L., Satya, s., & Narayan, s. (2010). Solar dryer with thermal energy storage systems for drying agricultural food products: A review. *Renwable and Sustainable Energy Reviews*, 2298-2314.
- Barnett, A. (1990). The Diffusion of Energy Technology in the Rural Areas of Developing Countries: A Synthesis of recent experiences. *World Development Vol 18*, 539-553.
- Buysman, E., & Mol, A. (2013). *Market-based biogas sector development in least developed countries —The case of Cambodia*. Phnom Penh: Elsevier Energy Policy.
- CEEEZ. (2016). *DEVELOPMENT OF AN OVERARCHING COMPREHENSIVE FRAMWORK FOR ASSESSING THE ECONOMIC BASIS FOR SUPPORTING INVESTMENTS IN BIOMASS TECHNOLOGY IN ZAMBIA AND ASSESSMENT OF INVESTMENT CLIMATE FOR BIOMASS ENERGY AND APPROACHES*. CEEZ.
- Company, I. A. (n.d.). *Zambia Sugar Plc company website* . Retrieved May 4, 2022, from <https://www.zamsugar.co.zm/>
- CSO Zambia. (2015). *Living conditions monitoring survey - key findings*.
- DT Global. (2021). *Renewable Energy Strategy and Action Plan for Zambia*. Ministry of Finance.
- E.Buysman. (2009). *Feasibility Study for Community-Based Eco-Businesses and household electrification from Renewable Energy Generation Systems (Bioenergy, Wind, Hydro & Solar power)* . Eindhoven: TUE.
- Energy Sector Management Assistance (ESMAP). (2019, 11 29). *Multi-Tier Framework Survey for Measuring Energy Access 2017-2018*. Word Bank. Retrieved from <https://microdata.worldbank.org/index.php/catalog/3527>
- ESMAP. (2019). *Energy Access Diagnostic Report*.
- FAO. (2020). Sustainable bioenergy potential in Zambia – An integrated bioenergy assessment. *Environment and Natural Resources Management Working Papers No. 84*. Rome.
- FAO; The Ministry of Energy of Zambia. (2020). Sustainable bioenergy potential in Zambia – An integrated bioenergy assessment. *Environment and Natural Resources Management Working Papers No. 84*. Rome.
- GEF/UNDP. (2019). *Strengthening Management Effectiveness and Generating Multiple Environmental* . Lusaka: GEF.
- Gov. of Zambia, M. o. (2017). *National woodfuel study*. Ministry of Energy.
- Gumbo, D. J., Moombe, K. B., Kandulu, M. M., Kabwe, G., Ojanen, M., Ndhlovu, E., & Sunderland, T. C. (2013). *Dynamics of the charcoal and indigenous timber trade in Zambia: A scoping study in Eastern, Northern and Northwestern provinces*. CIFOR.
- Hitofumi, A., Katayama, A., Bhuneshwar, P., Torio, T., & Samy, S. (2007). Potential for rural electrification based on biomass gasification in Cambodia. *Biomass and Bioenergy* 31, 656-664.

- IEA. (2019). *IEA Energy Statistics*. (IEA) Retrieved 2022, from <https://www.iea.org/countries/zambia>
- IEA. (2021). *World Energy Statistics and Balances*. IEA.
- Johnson, M. A., & Chiang, R. A. (2015). Quantitative Guidance for Stove Usage and Performance to Achieve Health and Environmental Targets. *Environmental health perspectives*, 820-826.
- Jürisoo, M., Serenje, N., Mwila, F., Lambe, F., & Osborne, M. (2019). Old habits die hard: Using the energy cultures framework to understand drivers of household-level energy transitions in urban Zambia. *Energy Research & Social Science*, 53, 59-67.
- KMPG. (2017). *Zambia Economic Snapshot H2, 2017*. Retrieved from <https://assets.kpmg/content/dam/kpmg/za/pdf/2017/12/Zambia-2017H2.pdf>
- Kwofie, E. E. (2019). Fish Processing and Its Energy. *Journal of Sustainable Bioenergy Systems*, 2019, 44-63.
- Lam, J. (2022, MA). Biogas for poultry sector. (E. Buysman, Interviewer)
- Lusaka times. (2022, September 20). *Lusaka times*. Retrieved from Economy: <https://www.lusakatimes.com/2022/08/20/government-to-setup-ethanol-plants-in-provincial-centres/>
- Lusaka times. (2022, July 9). Retrieved from <https://www.lusakatimes.com/2022/07/09/world-bank-has-re-classified-zambia-to-low-income-status-from-lower-middle-income/>
- Luzi, L., Lin, Y., Koo, B., Rysankova, D., & Portale, E. (2019). *Zambia–Beyond Connections: Energy Access Diagnostic Report Based on the Multi-Tier Framework*. World Bank.
- Makanday. (2021). *THE MILLS ARE GRINDING TO A HALT*. Retrieved from Centre for investigative journalism: <https://www.makanday.com/posts/the-mills-are-grinding-to-a-halt>
- McCall, M. (2001). *Boiling Point 47: Brewing Rural Beer Should be a Hotter Issue*. Practical Action.
- Middelink, E. (2008, June 29). SME Cambodia - rural electrification. (E. Buysman, Interviewer)
- Ministry of Finance and National Planning. (2022). *8 National Development plan*. Lusaka.
- MLNR. (2020). *Natural Capital Accounts for Forests Version 2.0*. Republic of Zambia, Ministry of Lands and Natural Resources, Forestry Department.
- MoE. (2017). *National wood fuel study*. MoE.
- MoE. (2019). *National Energy Policy*.
- MoE. (2020). *National Woodfuel study 2017*. MoE.
- MoE. (2021). *Zambia National Energy Efficiency Strategy and Action Plan (draft)*. Ministry of Energy of Zambia.
- Nazare, Z., Manzungu, E., & Chekenya, B. (2013). *REDESIGN OF COMMONLY USED TOBACCO CURING BARNS IN ZIMBABWE FOR INCREASED ENERGY*. Retrieved from <https://www.semanticscholar.org/paper/REDESIGN-OF-COMMONLY-USED-TOBACCO-CURING-BARNS-IN-Musoni-Nazare/75d21dccc435ec810b345d5994d43560dd9a62b5>
- Ngoma, E. (2021, 11 19). *Africa Energy Futures: Zambia*. Retrieved from DLA Paper Publication: <https://www.dlapiper.com/en/uk/insights/publications/2021/11/africa-energy-futures/africa-energy-futures-zambia/>
- Power Africa. (2018). *Zambia Power Sector Assessment*. USAID.
- Resources, M. o., & Department, F. (2020). *Natural Capital Accounts for Forests Version 2.0*. Republic of Zambia, Ministry of Lands and Natural Resources, Forestry Department.
- Schure, J., Dkamela, G. P., van der Goes, A., & McNally, R. (2014). *An approach to promote REDD+ compatible wood-fuel value chains*. SNV.
- SEforALL. (2022). *Zambia*. Retrieved from Sustainable Energy For All: <https://www.se4all-africa.org/seforall-in-africa/country-data/zambia/>
- Shane, A., Gheewala, S. H., Fungtammasan, B., Silalertruksa, T., Bonnet, S., & Phiri, S. (2016). Bioenergy Resource Assessment for Zambia. *Renewable and Sustainable Energy Reviews*, 53, 93-104.
- Singh, G., Alzouma Nouhou, S., & Youba Sokona, M. (2013). *The Zambia Renewables Readiness Assessment*. IRENA.
- Snow Systems Zambia. (2020). *National Woodfuel Study*. Government of the Republic of Zambia; Ministry of Energy.
- Snow Systems Zambia. (2020). *National Woodfuel Study 2017*. Government of the Republic of Zambia; Ministry of Energy.
- SNV. (2021). *Biodigester market development_lessons learnt Zambia*.
- SNV. (2022, September 19). Retrieved from Malian Alliance for Clean Cooking and SNV laung a new quality standard: <https://snv.org/update/malian-alliance-clean-cooking-and-snv-launch-new-quality-standard>
- Standard Bank. (2022, 04). *Zambia: Economic and Political Overview*. (Standard Bank) Retrieved from <https://www.tradecub.standardbank.com/portal/en/market-potential/zambia/economical-context>
- Supamoto. (2022, May 18). *clean cooking*. Retrieved from <http://www.supamoto.co.zm/clean-cooking/>
- Talamanca, C. (2022, May and June). Charbriquetting potential. (E. Buysman, Interviewer)
- Tembo, S., T., M. B., & Sitko, N. (2015). *Cooking fuel choice in urban Zambia: implications on forest cover*. Lusaka: Indaba Agricultural Policy Research Institute.
- The World Bank. (2021, September 23). *The World Bank in Zambia*. Retrieved 04 10, 2022, from <https://www.worldbank.org/en/country/zambia/overview#1>
- UNEP. (2019). *Review of Woodfuel Biomass Production and Utilization in Africa: A Desk Study*. United Nations Environment Programme; African Union. Retrieved from <https://wedocs.unep.org/20.500.11822/28515>
- USAID. (2016). *Climate Change Risk Profile: Fact Sheet*.

USAID. (2021). *A2C Market Analysis report*. Lusaka.

USAID. (2022). *THE INSTITUTIONAL CHARCOAL SURVEY FINDINGS - presentation*. USAID.

Wathum, G., Seebauer, M., & Carodenuto, S. (2016). *Drivers of deforestation and forest degradation in Eastern Province, Zambia - Zambia Integrated Forested Landscape Program*. World Bank; Unique Forestry and land use.

WB. (2014). *Clean and improved cooking in Sub-saharan Africa*.

World Bank. (2022, October). *New World Bank country classifications by income level: 2022-2023*. Retrieved from <https://blogs.worldbank.org/opendata/new-world-bank-country-classifications-income-level-2022-2023>