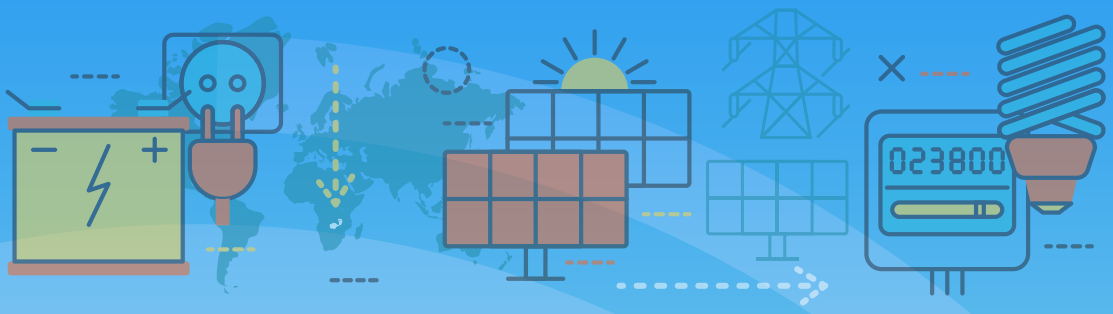

Climate Compatible Growth

COP27 POLICY BRIEF SERIES

Off-grid Renewable Energy Investment in Zambia: Demand-side and Sub-national Constraints

Mashekwa Maboshe [1]*, Sam Bickersteth[2], and Stephanie A. Hirmer [3]

Summary

Zambia has large unexploited potential in renewable energy (RE) sources such as solar, wind, and biomass . However, 85% of the country's electricity generation is dominated by hydropower. To better manage the risk of climate change, and improve rural access to clean energy, the government is actively promoting investment in other RE, especially in rural and low-income areas. Using 11 expert interviews and document reviews, we find that poor affordability and weak sub-national planning structures in rural and low-income areas are a significant threat to attaining Zambia's RE targets. Conducting detailed demand assessments, introducing targeted consumer subsidies, and adequately funding sub-national energy planning would greatly improve the viability of Zambia's RE sector.

Key Policy Recommendations

- Mandate detailed demand-side and energy use analyses to ensure the viability of off-grid renewable energy (RE) investments in rural areas.
- Introduce targeted consumer subsidies for RE to ensure the sustainability of use, especially in low-income rural areas.
- Establish energy sector planning at the sub-national level to improve efficiency in RE investments.
- Build financial and human resources capacity for sub-national energy planning.

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Introduction

This policy brief aims to highlight the often-under-researched demand-side and sub-national planning constraints to sustainable off-grid renewable energy (RE) investment in rural and low-income areas in Zambia.

Zambia has enormous renewable energy potential. The country enjoys an average 2,000–3,000 hours of sunshine per year resulting in an average of 2,000 kWh/m2/year Global Horizontal Irradiation (GHI); reaching 2,150 kWh/m2/year in favourable regions [1]. Abundant forest and agricultural feedstock provide potential for the generation of nearly 500 MW of bioenergy while the country's large rivers and vast water resources have the potential to generate 6,000 MW of hydropower. Yet, despite the huge potential, most renewable energy sources apart from hydropower are underdeveloped. Solar energy contributes only about 3% of the electricity generation (as shown in **Figure 1**) while wind, bioenergy, and geothermal are largely unexploited.

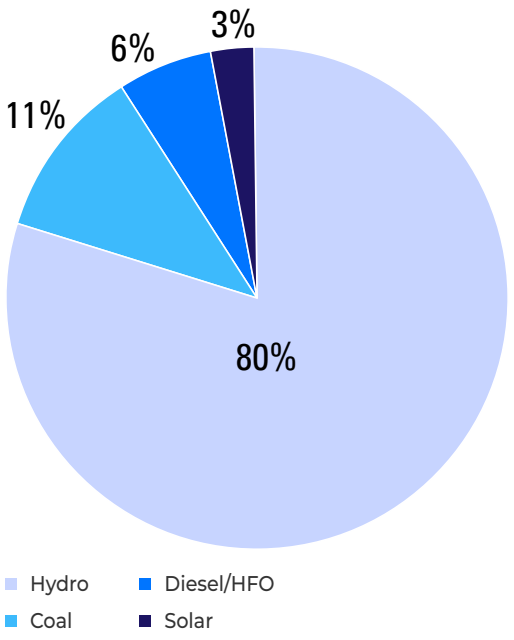

Figure 1: Zambia's electricity generation mix (2020) [2]

The low contribution of solar energy to the electricity generation mix can be attributed to Zambia's historical over-reliance on large hydroelectric power. After independence in the 1960s, the new government relied on large hydropower stations at the Kafue Gorge and Kariba North Bank to supply high voltage power to the copper mines and industrial centres in the Copperbelt and Lusaka provinces. ZESCO, the state-owned power company, has dominated electricity generation, transmission, and distribution since its establishment in 1970. Although state dominance in the electricity sector has somewhat declined due to the liberalization reforms of the 1990s, ZESCO still controls about 75% of all electricity generation and over 90% of electricity transmission and distribution in Zambia.

Since the 1970s, Zambia had enjoyed surplus power generation; however, the country started experiencing deficits in the early 2000s as rising energy demand outstripped generation capacity. The deficit worsened following the 2014–2015 rain season when historic low water levels at Zambia's large hydroelectric power reservoirs resulted in unprecedented power outages lasting up to 8 hours per day across the country [3]. To mitigate the risk of climate change in the electricity sector, and to promote access to affordable, reliable, sustainable, and modern energy in rural areas in line with the United Nations Sustainable Development Goal 7 (SDG7), the Zambian government, as of 2015, has promoted investments in alternative renewable energy. These have specifically targeted increasing the share of non-hydro renewable energy in electricity generation to at least 15% by 2030 [4].

Methodology

This study reviewed key policy documents and interviewed 11 renewable energy experts from varying organizations (given in Table 1) using open-ended interview questions[1].

Category	# of interviewees
National Government Institution(s) (NGI)	7
International NGO (INGO)	1
Private Investor (PI)	1
Independent Energy Expert (IEE)	1
Local Council (LC)	1

Table 1. Interviewees by category

The aim of the study was to gain insights on the constraints to sustainable renewable energy investments in low-income rural areas in Zambia. From this study two key constraints emerged: a) weak demand, and b) a lack of sub-national planning. These are discussed next, together with ways forward.

Constraints

A. **Weak affordability and demand for renewable energy in most rural areas**

Eighty percent of the experts interviewed indicated that the high rural poverty (estimated at 77% [5]) negatively impacts the demand for renewable energy (RE). Further, the seasonal nature of rural economic activities such as agriculture or fishing adversely impacts the sustainability of RE investments in rural areas. Thus, despite the vast abundance of RE sources such as solar, poor incomes and the seasonality of rural economies make off-grid RE investments unsustainable. Five interviewees cited Mpata solar - a K9 million 300 PV mini-grid project in Samfya district – as a common example of project failure due to weak affordability. The mini-grid project which started off well, with over 480 household connections, was decommissioned after a few years of operation due to a lack of proper ability to pay.

> *"Very few households can afford to pay for electricity from non-hydro based renewable sources."* *IEE Interviewee*

Our study further established that while feasibility studies are usually undertaken before RE investments, these largely focus on the technical feasibility of renewable energy supplies but with little rigorous assessment of the sustainability of demand (i.e. how many people will be able to use and afford electricity, and how much will they use?). The experts interviewed called for detailed demand-side and energy use analyses to accompany any off-grid RE investments to ensure there is sufficient and sustainable demand before RE investments are undertaken in a given location.

Renewable energy feasibility studies must therefore invest more in **assessing both the short- and long-term viability of domestic and entrepreneur activities in the rural areas**. But given the high incidence of poverty in rural areas, government and cooperating partners must consider providing holistic programmatic support to RE investment **including provision of consumer subsidies**

[1] While the number of interviewed experts is somewhat low, the sample represents the diversity and structure of the renewable energy sector in Zambia.

in rural areas. The provision of targeted RE electricity subsidies would be justified given the high level of subsidies provided to the hydro-power consumers who are mostly urban based [6]. However, any subsidy programme would have to be targeted, have a clear exit strategy, and potentially be externally funded given the ongoing debt crisis in Zambia.

B. Weak sub-national energy planning and programming

Another important finding from most of the interviews is that most renewable energy (RE) activities such as policy formulation by the Ministry of Energy, regulation by the ERB, and management and implementation by ZESCO and the REA are highly centralized, quite segmented, and have little coordination with local council planning authorities. At least two of the experts highlighted that some initiatives such as the Scaling Solar programme run by the Industrial Development Corporation and International Finance Corporation [7] exist outside of the normal planning process; and more than half of all the experts interviewed indicated that the 2008 Rural Electrification Master Plan (REMP) [8] has not been updated for nearly 15 years now and as such it does not reflect current rural electrification and diversification plans as highlighted in the Seventh and Eighth National Development Plans [9, 10]. Our other findings from at least four experts further established that there are no sub-national structures to facilitate energy planning and programming at lower administrative levels. This is largely due to a lack of clear decentralized policy; severe shortage of energy planning staff; and a lack of energy planning budgets.

> *"Electricity planning also appears to be dispersed and inconsistent."* NGI Interviewee

A review of the 2022–2026 Decentralisation Master Plan shows that while decentralization of energy services is planned for the next 5 years, there is no budget allocated for this for the year 2022, while 2023 and 2024 only have paltry allocations [11]. The current decentralization plan prioritizes social sectors such as public health and education with very little focus on electrification programmes.

Recommendations

To realize Zambia's vision of increasing the share of alternative (non-hydro) renewable energy in electricity generation and increasing the rural electrification rate from 4% to 51% by 2030, the following recommendations are suggested:

- Mandate detailed demand-side and energy use analyses to ensure that off-grid RE investments in rural areas are viable and sustainable in the long-run.
- Introduce targeted consumer subsidies for RE to ensure the sustainability of renewable energy use in low-income rural areas with very little ability to pay for renewable energy.
- Establish energy sector planning at the sub-national level to improve efficiency in the development of renewable energy solutions in rural communities.
- Build financial and human resources capacity in sub-national councils to facilitate effective energy planning and implementation.

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