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Summary

2019 has been characterized with arguably the worst power crisis Zambia has ever seen with load-shedding for 8 months of the year and power shortages reaching up to 20 hours a day in some areas.

Load-shedding in 2019 has had a negative impact on economic growth, with expected growth for 2019 to drop below 2 percent. The ERB estimated that the average loss in turnover for small businesses as a result of the 2015 power crisis was over K19,000. Load-shedding this year has been worse than in 2015 and comes at a time when the private sector is facing many other challenges: depreciating kwacha and inflation increasing the costs of inputs; increased taxes, fees and charges; uncertainty over the sales tax; and government payment arrears.

Zambia needs to diversify its energy supply away from hydropower, but in the current fiscal context, there is little resource for public investment. With ZESCO heavily subsidizing electricity tariffs, consumers, businesses and the mines all paying below the unit cost for producing power and ZESCO is selling power at a loss. Low tariffs are dis-incentivising the much-needed private investment in the energy sector as far as independent power companies are concerned. They will not make a return on their investment. In recognition of the challenges to the energy sector, and the impact this has on the wider economy, government committed to accelerate reforms that will ensure that the energy sector attains cost reflective tariffs.

However, high poverty rates in Zambia means that a blanket increase in residential tariffs will disproportionally impact vulnerable households and risk pushing more people below the poverty line. It is estimated that the tariff increases proposed by ZESCO earlier this year would cause over 180,000 people to drop below the poverty line. Essential to sustainable reform in the energy sector is ensuring that vulnerable households are protected from price increases and further hardship, given the current economic context. ZESCO loses a significant amount of potential revenue through its current tariff structure by offering generalised subsidies to consumers regardless of their ability to pay. Targeting subsidies to only the poorest households would help result in improved utility cash flows, increased power generation, expanded access as well as better subsidy packages for the poor.

This brief recommends further exploration of removing subsidies for higher-income residential users. This could be achieved through:

- Lowering the lifeline tariff: The current residential lifeline band in Zambia is generous compared to regional averages and internationally recommended rates. ZESCO should explore options for reducing the lifeline tariff. To protect low-income households from unexpectedly high electricity bills in cases where the poor households exhaust the lifeline tariff block, a small intermediary tariff block could be introduced at a higher, but still slightly subsidised, rate, with a third block being the cost-reflective tariff rate. Reductions in the lifeline tariff could also be implemented gradually and according to a publicly available schedule.

- Targeting low income consumers: Subsidies (via the lifeline tariff) could be only offered to low-income qualifying households. These households could be determined through either means-based testing or geographical targeting. For ineligible households, full consumption would be charged at cost-reflective rates.

- Targeting low usage consumers as a proxy for income: This model would assume that low-income households use less electricity, and so those whose electricity consumption falls under a pre-determined threshold are granted access to a subsidized tariff. If the consumer exceeds a pre-determined kWh threshold, then he loses access to any subsidised rates and are required to pay market price for their full usage.

Currently, we estimate that ZESCO loses over K1.8bn in revenue through subsidies to residential consumers. Pursuing one or a combination of these options to better target subsidies to the poorest households could save over 90 percent of this cost. Whilst it is clear that savings can be made, these need to be further analysed against what is achievable, given the current ZESCO infrastructure and the potential costs of implementing a new subsidy system.

Modernising the tariff regime in a way that raises tariff revenues whilst still protecting the poor is key for ZESCO to move towards cost-reflective tariffs in a sustainable way. This is essential for putting ZESCO on stronger financial footing and crowding in private sector investment in the power sector. Reform to the tariff structure should, however, be one part of a wider set of reforms to ZESCO's financial model and operating costs.

1. Context

Zambia is currently experiencing unprecedented power outages, which reached up to 20 hours per day in some areas. Challenges in the power sector are a result of several years of under-investment in generation capacity and under-pricing of electricity services. Poor cost recovery has resulted in a failure by the electricity sector to attract investment for hydropower expansion or renewable energy diversification projects. Last year's drought exacerbated the problem by severely constraining hydropower production, which accounts for 83percent of electricity generation capacity, and ZESCO's financial position limited its ability to mitigate the climate shock by importing power.

To help improve the financial viability and efficiency of the electricity sector, the government has recently embarked on wide-ranging electricity sector reforms. In 2017, for example, residential tariffs were increased by over 100% to make the prices more cost-reflective. Other reforms included reductions in the lifeline tariff block from 300 kWh to 200 kWh to minimise the subsidy loses from the provision of subsidised electricity.

There is, however, room to further reform the current residential subsidy policy, to both improve the targeting of subsidies and help minimise current financial losses at ZESCO. At present, ZESCO offers some of the most subsidised electricity rates in the region. The untargeted nature of the subsidy scheme means that all consumers, regardless of their ability to pay, have access to highly subsidised rates under the generous lifeline tariff.

The subsidies are, therefore, highly regressive and inefficient. This fact is well illustrated in Maboshe et al (2019) who found that more than 60 percent of total electricity subsidies accrue to the richest 20 percent of the population, while the poorest 20 percent only receive less than 1 percent of the electricity subsidies. An additional factor to consider – though beyond the scope of this paper – is that, especially in Zambia, a large proportion of the poor do not have access to the grid, and, therefore, do not benefit from subsidised rates.

Given the financial constraints ZESCO faces, combined with the need to raise capital to diversify away from hydropower, appropriately targeting the subsidy benefits could help to improve revenues and make progress towards cost-reflective average tariffs, whilst protecting the poorest consumers. This policy brief reviews the literature on the ways electricity subsidies are delivered to the poor, especially in sub-Saharan Africa. The aim is twofold: first, highlight the common types of electricity subsidies and, second, to identify potential targeting modalities relevant for Zambia.

2. Why Subsidise Residential Electricity?

Cost-reflective tariffs are key to sustaining profitability and investment in the electricity sector. However, efficient pricing must be balanced with the social objectives of ensuring that the poor can have access to affordable electricity services. Subsiding electricity reduces cost barriers to accessing power for low income households with access to the grid. The literature summarises the benefits of subsidising electricity for the poor as follows (DTI, 2010):

- Electricity subsidies can encourage a switch from environmentally harmful energy sources such as firewood and charcoal to cleaner energy such as hydropower even among the poor.

- Electricity subsidies can be an effective way to address income poverty in situations where direct cash transfers are difficult or expensive to administer. Subsidies could, therefore, complement, or even supplement, social cash transfers.

- Access to and consumption of cleaner and more reliable energy is strongly associated with improvements in households' health, children's education outcomes and small business growth among the poor. So, electricity subsidies could facilitate economic development among the poor.

Although the benefits of subsidising electricity for the poor are hard to dispute, identifying the right type of subsidies and delivery mechanisms are not straight forward and require political will. The next section highlights the common types of electricity subsidies available and options for targeting subsidies to the poor.

3. Subsidy Models in Developing Countries

There are broadly three classes of electricity subsidies, namely; supply-side or production subsidies, consumption, and connection subsidies. Most developing countries, including Zambia, have provided electricity subsidies through a combination of the above forms. The overall effect of any country's subsidy programme thus depends on the design and extent to which various types are used. Below are the key features of subsidy programmes commonly used in developing countries, together with their associated targeting and implementation efficiencies.

3.1 Supply-side or Production Subsidies

These subsidies are usually provided by governments to support utility companies in meeting their electricity generation and transmission capital costs and may include operational and financial costs.

Examples of production subsidies include the recently completed Kariba North Bank power extension project or various rural electrification projects whose capital costs were partly financed by euro-bond loan acquired by the Zambian government. A disadvantage of supply-side subsidies is that they are highly regressive. Subsidy benefits are usually passed onto consumers in proportion to consumption and thus mostly accrue to the relatively better-off households (or larger companies or industries) who typically consume the most energy.

A risk of supply-side subsidies is that they create a dependency on subsidies, thereby stifling domestic competition and innovation. Production subsidies can weaken efficiency incentives for the utility, creating a vicious cycle of rising losses and increasing subsidies, with average tariffs falling further short of what is required for financial viability.

Production subsidies are, however, straightforward and very cost-effective to administer as they are mostly administrative transfers from central governments. Despite their high costs and regressive nature, a recent review by Promethium Carbon (2016) suggests that production subsidies are quite common in sub-Saharan Africa, with Zambia, Botswana and Malawi being some of the countries that subsidise power production.

3.2 Consumer Subsidies

Discounting tariff rates for set quantities of electricity consumption is the most common type of electricity subsidisation in developing countries. Consumption subsidies are often delivered through the Increasing Block Tariff (IBT) or Volume-differentiated Tariff (VDT) mechanisms.

3.2.1 IBT (Increasing Block Tariff)

The IBT is a nonlinear pricing schedule where the first blocks of electricity consumption are charged lower tariffs with higher prices applied to higher blocks of consumptions. This is how Zambia's current subsidy regime is designed, with units of electricity under 200 kWh heavily subsidised by ZESCO. If well-designed and targeted, the IBT could deliver the following advantages:

- Make subsistence electricity affordable for low income households.

- Encourage responsible energy use and conservation, especially among the non-poor.

- Could be used to cross-subsidise the electricity to the poor or to the social services sectors if the design charged higher than market price tariffs for high consumption.

Although IBTs offer some advantages, our review finds that IBTs in developing countries are not well-designed and largely untargeted, leading to regressive electricity subsidies and significant financial losses for power utilities.

Poorly designed IBTs, if incorrectly judged, can also lead to weak conservation outcomes through either encouraging excessive energy usage due to the provision of wide subsidised lifeline bands, or, if too expensive, causing a shift to cheaper "dirtier" power sources such as charcoal.

In Zambia, previous research (PMRC 2017) showed that the average consumption of households was 312kWhs, whilst the average consumption of the poorest 50 percent was 226kWhs. Empirical studies suggest that about 50-75 kWh per month would be enough for subsistence use such as basic lighting, basic water heating using a kettle, and operating a radio or TV for a typical poor household (Winkler, 2006; IMF, 2013). As such, the lifeline tariff in Zambia – the aim of which is to maximise access to basic electricity needs – is generous at 200kWhs, covering 64% of average consumption.

Furthermore, in Zambia, under the additional IBT schedule, everyone – regardless of income – has access to the lowest tariff block. Though there are obvious inefficiencies associated with untargeted subsidies, their main advantage is that they are easy and cost-effective to administer. The implementation cost of targeted IBTs depends on the type of existing metering infrastructure and whether such infrastructure can be integrated with existing social support records and systems. Targeted subsidies which are more efficient in delivering subsidies to the poor could be quite expensive to implement as significant effort is often required to collect and maintain administrative data. There are, however, various means of implementing targeted subsidy schemes, and it is likely that the savings would be more than enough to cover investment costs. The different methods of targeting subsidy beneficiaries are also discussed in section 4 below.

3.2.2 VDT (Volume-differentiated Tariff)

The VDT is similar in design to the IBT, except that the total consumed electricity units are billed using a single rate – typically, the highest tariff corresponding to a household's final consumption block. For example, under a VDT, if a household exceeds the lifeline threshold of 200 kWh, their entire electricity consumption would be charged at the higher tariff rate. VDT is better at excluding higher consumption households from benefitting from any subsidies in the lower lifeline blocks if consumption is above the set limits. VDTs also strongly incentivise conservation. However, the consumption bands need to be carefully considered under a VDT system to avoid imposing significant financial penalties on poor households, or causing wealthier households to switch to private power sources such as inverters or generators. The use of VDT in the sub-Saharan region is not common, except in a few countries such as Benin and Cameroon where hybrids of the VDTs have been applied (Kojima& Bacon, 2014).

3.2.3 Connection Subsidies

Connection subsidies, which reduce or eliminate the one-off charges associated with new connections to the grid, are becoming increasingly common in developing countries as a way of encouraging and accelerating access to cleaner energy, especially among the poor. Historically, electricity connection fees have been very high, equivalent to most households' monthly average expenditure in Africa (Kojima and Trimble, 2016).

Zambia is not an exception, connection fees stand at about K769, but this is set to increase to over K3,000 for high density areas and over K9,000 for low density new residential connections (see Table 7, ERB, 2019). Given the high connection fees, discounts would, therefore, be beneficial for low-income households. Unlike consumption subsidies, connection discounts are more efficient as they are once-off by nature. They do not distort energy markets and are an effective way to promote quicker transition to cleaner energy in any country. However, they do not support low income households to access electricity on an ongoing basis.

3.2.4 Fixed Standing Charge

A standing charge is a fixed tariff element that users pay irrespective of their consumption. This helps provide stable revenue to the utility and can be set to ensure that a high proportion of their costs are covered. In some cases, more commonly in developed countries, this can be the only tariff element that users pay. Alternatively, it can be combined with a variable tariff element that is usage-dependent. In Zambia, ZESCO could consider applying a fixed standing charge to high users, similarly to VDTs. This would increase revenue from larger residential consumers without impacting on lifeline tariff rates. This is likely to have a less distorting effect on patterns of energy consumption. A disadvantage is that a tariff structure consisting of a subsidised lifeline tariff plus a fixed 'unlimited' rate might incentivise more electricity consumption by larger users who are above the lifeline threshold. To mitigate this, a second block tariff might be incorporated to the variable tariff element to discourage over-consumption.

3.2.5 Industry Cross-subsidisation

Larger industrial consumers could be billed at higher than the market rates to subsidise the cost of electricity connections and use low income households. Industry cross-subsidisation could be a viable option for providing subsidies, particularly in Zambia, especially if promoted as a corporate social responsibility issue. Cross-subsidy is an inevitable consequence of both RBT and VDT whenever overall tariffs are sufficient to cover utilities' full economic costs (i.e., no additional producer subsidy is required to achieve commercial viability).

3.3 Administrative Targeting of Subsidies

The administrative targeting of any subsidy can be carried out using geographic targeting, categorical targeting or means testing. For all these options, once eligibility has been decided, the actual billing code for the qualifying targeted households would be programmed and linked to the pre-paid meter Ids on ZESCO's central power system. The key features including weaknesses and strengths of these approaches are described below.

Increasing Block Tariffs

As mentioned in the previous section, Zambia's IBT schedule is currently untargeted. There are ways to target the lowest tariff block of subsidised rates to low income households only. These include:

i) Geographical Testing

Geographic targeting could be used to target electricity subsidies in specific locations, such as informal settlements, slums or very remote areas where the poor and most vulnerable are likely to live. These areas identified as eligible for subsidised rates would then have access to a subsidised first tariff block, whilst those not in these areas would pay full price for their electricity. This type of targeting is rare in sub-Saharan Africa, but not uncommon in Latin American countries. While not a perfect tool, geographic targeting would at least direct the majority of the subsidies to poor locations. Implementing geographic targeting is straightforward and has low administration costs compared to precise approaches like means testing. A disadvantage of geographical testing is that it is not precise, as some non-poor households living in targeted areas would also benefit from subsidies. Secondly, as noted in the case of the Dominican Republic, geographic subsidies could induce perverse incentives such as relocation of commercial activities into targeted areas to take advantage of cheaper electricity.

In Zambia, ZESCO could use location to target subsidies towards rural areas and inner-city compounds. However, in Lusaka, for example, wealthier areas are often situated next to compounds and so the risk of unintended subsidies is high (e.g., the close proximity of Sunningdale to Kalingalinga). Additionally, since geographical boundaries will be at the discretion of ZESCO, this opens an additional opportunity for lobbying and rent-seeking behaviour. To mitigate this risk, this process could be managed independently by the ERB. Zoned approaches make it very obvious to a utility where it is making money and where it is losing it. Under financial stress, it would make it almost inevitable to provide its poorest customers with the poorest service.

ii) Categorical Targeting

Categorical targeting is where electricity subsidies are provided based on certain qualifying criteria such as retiree or war veteran households. Unlike geographical targeting, categorical targeting would require a moderate level of administrative work to vet the beneficiaries. This method is, therefore, not as cost-effective or administratively convenient as geographic targeting. In addition, categorical targeting programmes are often inherently defective. For example, pensioners or war veterans may not necessarily be poor and so targeting subsidies on that basis may be inefficient. For example, ZESCO already runs an employee electricity discount programme – essentially a type of categorical targeting – which is an example of a highly regressive targeting mechanism.

iii) Means Testing

Means testing for electricity subsidies is the most accurate way of identifying and targeting electricity subsidies to the poor households. The assessment is typically multi-dimensional, assessing factors such as household incomes and expenditure, household size, assets, type of neighbour and so on. In practice, households wishing to be considered for subsidies would apply and provide documents to ZESCO for review and approval. ZESCO would work with the Ministry of Social Development and the ERB to set the qualification criteria. Means or income testing is, therefore, administration-involving and costly to implement and could also lead to rent-seeking behaviour in determining eligible beneficiaries.

Despite the administrative cost, means testing guarantees that the subsidies are targeted to the most deserving households. South Africa is a good example of where means testing has been used to direct free basic electricity to deserving households. Inchauste et al. (2015) find that South Africa's free basic services are highly targeted, largely due to the stringent means testing criteria used in that country.

Volume-differentiated Tariffs

Targeting by usage would practically involve implementing the VDT (already discussed above) across the entire population. Under the current ZESCO pre-paid billing system, this would involve updating the billing programme to calculate each household's (3 or 6-months) average consumption. Households would then be billed according to the level of their average consumption, with low average consumers being charged discounted prices, while higher average consumers would pay the market rates. The feasibility of implementing this form of VDT could be explored further by ZESCO. In some areas in the city of Cape Town, some pre-paid meter customers receive free basic electricity (free 50kWh) based on their past year moving average consumption level.

4. Viable Options for Reforming the Current Subsidy Policy

To get a sense of the likely financial benefits of providing targeted electricity subsidies, we simulate plausible subsidy savings using the latest Living Conditions Monitoring Survey (LCMS). The simulated subsidy scenarios are presented in Table 1 below.

Table 1: Subsidy Losses and Savings Using Various Targeting Tools

Targeting Option	K'mil-lion	US$'million	% sav-ings
1. Generalised Subsidies (Base-line)	1 845	127	-
2. Income Targeted Increasing Block Tariffs (IBT)	153	11	92%
3. Volumetrically Targeted (VDT)	45	3	98%

The baseline scenario estimates ZESCO's subsidy costs when subsidies are untargeted as is the case under the current policy. Under this option, each household's electricity subsidy benefit is calculated as the difference between the market value[1] of the electricity consumed and the reported subsidized electricity bill. As can be seen in Table 1, the estimated total cost of generalised electricity subsidies is US$ 127 million (or K1.85 billion) per annum. However, as is already known, most of these subsidies are poorly targeted and, therefore, an unjustified expense for ZESCO.

It is, therefore, important that the current subsidy policy be reformed to eliminate poor targeting and direct subsidies to the needy households.

The last two rows of Table 1 show alternative models for improving the targeting of electricity subsidies to poorer households. Option 2 simulates the targeting of electricity subsidies using income as the targeting criteria. Households living above the national poverty line are assumed to have the ability to pay for electricity at cost-reflective rates and, therefore, not allocated any electricity subsidies in the simulations. Poor households, on the other hand, receive electricity subsidies on the first block of consumption according to the current IBT schedule. In other words, this option ensures non-poor households pay the cost recovery rates, while targeting the ITB schedule to only the poor or needy households. As can be seen, targeting subsidies to only the poor on the grid eliminates a significant portion of total subsidy expenditures and results in 92% subsidy savings. This is not surprising, given the well-known fact that subsidies are highly regressive and heavily skewed to the richer household deciles in Zambia. Therefore, targeting the subsidies to only the poor results in a significant reduction in subsidy expenditures.

The last option then simulates the subsidy savings using the volume-differentiated tariff regime discussed earlier, where consumers lose access to the subsidy if they exceed the usage threshold. This option is simulated by taking data on usage from the LCMS and applying the market rate to households who use over 200kWh (the current lifeline tariff). Those consuming less than 200kWh retain access to the discounted tariff rates. Using the VDT mechanism results in the highest rates of subsidy savings at 98 percent in comparison to the baseline untargeted subsidies model. From the above illustrations, it is clear that undertaking subsidy reforms and targeting the benefits to the poor would help not only minimise wasteful provision but also improve targeting and also minimise the financial losses that ZESCO incurs by wastage on electricity subsidies.

Consequences for Service Provision

Savings of over 90 percent could make significant progress towards cost recovery and the financial sustainability of ZESCO. Higher tariff revenue would make the energy sector more attractive to investors and, over time, bring in new investments and increase the overall capacity for power production in Zambia. This should lead to a better and more reliable service for all consumers.

However, an issue with targeted subsidies and cross-subsidisation is that they result in one set of customers being profitable to supply for the service provider while another class of customers is loss-making. In the short-term, whilst the energy supply is constrained, and the utility is still loss-making overall, there is an incentive to reduce supply to the less profitable consumers while maintaining it for those paying higher rates. Perversely, poorer consumers are worse served than would otherwise be the case. One potential solution to this could be to link any supply-side subsidies to the utility to performance according to volumes supplied to 'qualifying' consumers.

5. Recommendations for Electricity Subsidy Reforms

ZESCO loses a significant amount of potential revenue through its current tariff structure by offering generalised subsidies to consumers, regardless of their ability to pay. Targeting subsidies to only the poorest households would help result in improved utility cash flows and increased power generation, expanded access as well as better subsidy packages for the poor.

Based on the above reviews, the following options for subsidy reform could be explored:

Lower the Lifeline Tariff

The current residential lifeline band is 0-200 kWh per month. Given that the main aim of the lifeline in Zambia is to afford low income household access to basic electricity (ERB, 2017), the current band is generous. Empirical studies suggest that about 50-75 kWh per month would be enough for subsistence use such as basic lighting, basic water heating using a kettle, and operating a radio or TV for a typical poor household (Winkler, 2006; IMF, 2013). ZESCO should explore options for reducing the lifeline tariff. To protect low-income families from unexpectedly high electricity bills in cases where the poor households exhaust the lifeline tariff block, a small intermediary tariff block could be introduced at a higher but still slightly subsidised rate, with a third block being the cost-reflective tariff rate. Reductions in the lifeline tariff could also be implemented gradually and according to a publicly available schedule

Target Electricity Subsidies

ZESCO should consider ways of effectively targeting electricity subsidies to the poor. This could be feasibly achieved through one – or a combination of – the options below:

1. Volume Differentiated Tariffs: If the consumer exceeds a pre-determined kWh threshold then, he loses access to any subsidised rates and is required to pay higher rates for his full usage.

2. Income Targeting via Increasing Block Tariffs: Subsidies (via the lifeline tariff) are only offered to low income qualifying households. These households could be determined through either means-based testing or geographical targeting. For ineligible households, consumption would be charged at commercial rates according to the ability to pay principle.

3. Fixed Standing Charges: Consumers that use over a specified kWh threshold are required to pay an additional (and substantial) fixed tariff for all further electricity usage.

This helps provide stable and predictable revenue to the utility and can be set at a level that ensures a high proportion of their costs are covered.

The analysis presented in this paper demonstrates the savings that could be achieved though a more efficient subsidy system. However, these need to be further analysed against what is achievable, given the current ZESCO infrastructure and the potential costs of implementing a new subsidy system. Modernising the tariff regime in a way that raises tariff revenues whilst still protecting the poor is key for ZESCO to move towards cost-reflective tariffs in a sustainable way. This is essential for putting ZESCO on stronger financial footing and crowding in private sector investment in the power sector. Reform to the tariff structure should, however, be one part of a wider set of reforms to ZESCO's financial model and operating costs.

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Endnote

1. The market rate is yet to be determined through the ongoing cost of service study. We therefore use the highest block tariff rate of K0.89 per kWh as an estimate of the cost-reflect (Mundende, 2017, ZESCO media presentation; Maboshe et al, 2019).

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