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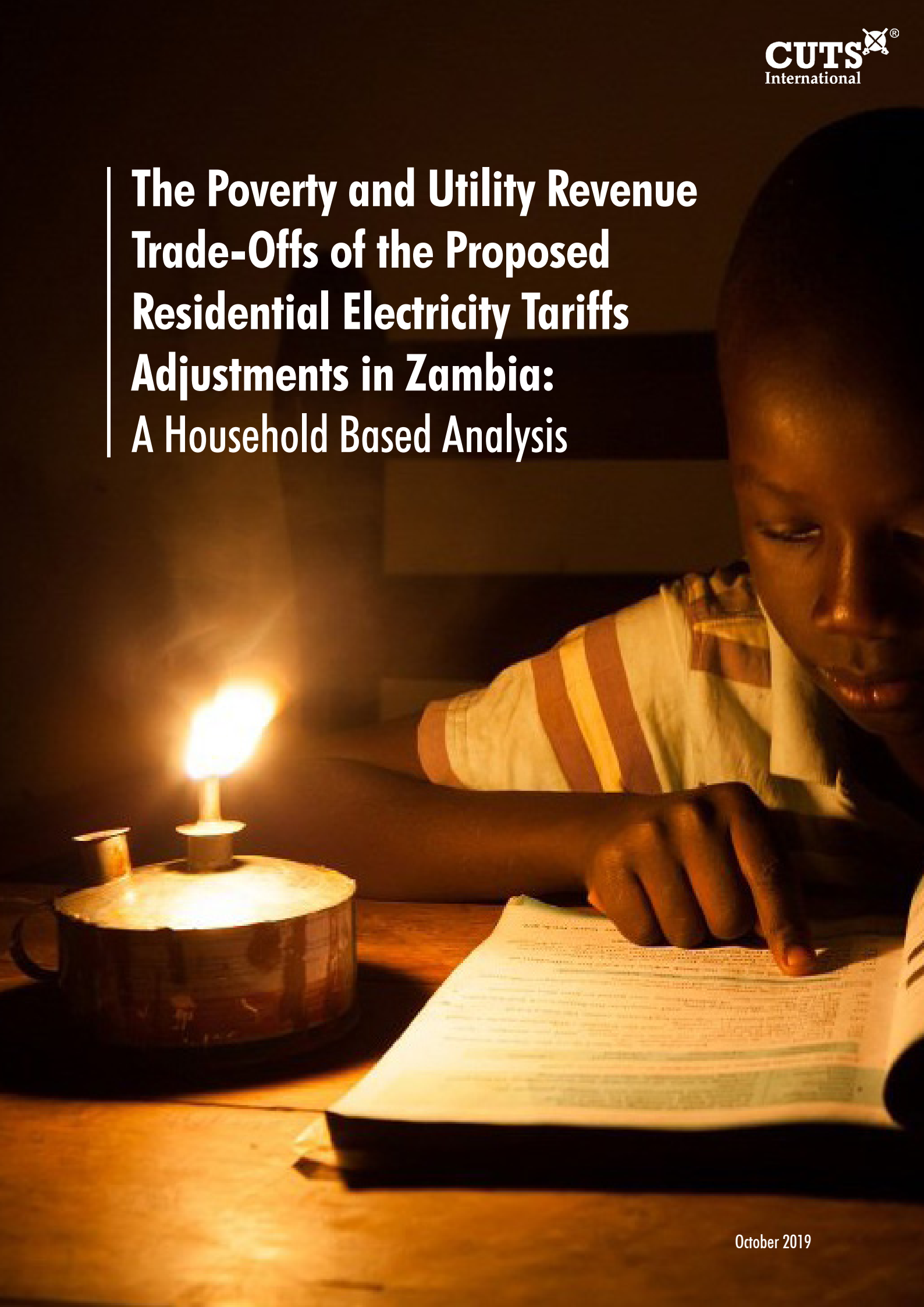
The Poverty and Utility Revenue Trade-Offs of the Proposed Residential Electricity Tariffs Adjustments in Zambia: A Household Based Analysis



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Summary

This study explores options to increase residential tariffs in light of government's intention to import power to reduce load shedding. It is a working document for discussion with key stakeholders.

Our analysis looks to identify a feasible tariff increase which would i) enable residents to share the cost of importing power proportional to usage (estimated at 30percent) while ii) cushioning the impact on vulnerable households.

We identify two feasible routes:

1) The preferable option would be to increase tariffs by around 50percent which should see revenue increase to cover the share of energy imports while maintaining the lifeline tariff. We expect that this would have the effect of pushing 85 070 people into poverty.

2) Recognising the possible impact of load shedding on revenue (as we would expect usage to drop, meaning less consumption in the higher tariff band, creating a disproportionate drop in revenue), an alternative approach would be to reduce the lifeline tariff band to 150kWh and increase the lower tariff by 25percent and the higher tariff by 37.5percent. This would generate more revenue than an increase of 50percent but would also have the effect of pushing 112 220 into poverty. This change to the lifeline tariff band could be made on a temporary basis.

We recognise the need to move to cost-reflective tariffs to address the costly and inefficient energy subsidies in a time of fiscal consolidation, improve financial viability of ZESCO and crowd-in the private sector to meet the country's long-term energy needs.

In line the with the principle that consumers should not incur the burden alone, we make recommendations for i) wider reform to the energy sector and ii) improved targeting of energy subsidies. We welcome the resumption of the cost of service study and planned ZESCO operational reforms and identify their progress as key to unlocking incremental and progressive tariff reform.

It is our intention for this study to provide the basis for constructive engagement with key stakeholders in the energy sector to work together towards meeting Zambia's energy needs.

Introduction

Since the beginning of September 2019, the media has reported imminent increases in electricity tariffs in Zambia. The tariff increases are meant to facilitate the importation of about 300 MW from Eskom (South Africa) at an estimated cost of US$22mn per month to cushion the adverse effects of the current power deficits in Zambia. While the exact details of the imminent tariff increases have not been made public, various media reports citing the Minister of Energy and Senior ZESCO Management suggest that residential tariffs may rise by around 75 percent, with very recent reports suggesting hikes of up to 200 percent. As already stated, the main objective of the increases would be to facilitate the importation of additional electricity from Eskom in South Africa.

Given the centrality of the residential sector to Zambia's social and economic development, this micro-economic analysis assesses the likely impact of changes to the current tariff policy on poverty and Utility residential revenues in Zambia. We identify and recommend tariff adjustments that are both socially and economically efficient. To achieve the aims of this analysis, we simulate the likely marginal changes in the poverty headcount ratio and utility marginal residential electricity revenues under the following tariff increase scenarios:

- Increases in the averages electricity price of 25 percent, 50 percent, 75 percent, 100 percent, 125 percent and 200 percent. This would be the main policy analysis.

- Alternative tariff structures, such as lowering the R1 threshold and introducing a new tier. This is a secondary, complimentary analysis to form a basis for further discussion on tariff reform.

The context and justifications for the above scenarios are provided in section 2.

Methodologically, this analysis uses the latest LCMS household survey[1] and input-output tables[2] to estimate the direct and indirect price effects[3] of electricity increases in the residential sectors using a price-shifting model[4]. The changes in utility residential revenues are estimated by comparing estimated revenues (under various tariff scenarios) with current utility revenues (pre-reform revenues). Our baseline estimates of poverty and utility revenues as at the end of 2018 compare favourably with official estimates[5] thereby suggesting that our model is reliable.

Brief Context to Residential Price Changes in Zambia

Following the 2015-2016 electricity crisis, the Zambian government initiated electricity sector reforms to ensure efficiency and financial viability in the electricity sector. Central to the reform process was the implementation of "cost reflective" tariffs, meant to encourage adequate capital maintenance and investment in the electricity sector.

This also included the commissioning of a cost of service study, which would help ensure that future tariff increases were cost reflective without subsidising ZESCO inefficiencies.

Consequently, ZESCO implemented major electricity tariff increases in 2017, including a 75 percent average increase in residential sector tariffs. At the time, the reforms were understood to be largely cost reflective[6] as communicated by then Managing Director of ZESCO (Mundende, 2017) and the government.

Nevertheless, in April 2019 (about 18 months after the 2017 adjustments), ZESCO proposed another major general tariff adjustment to increase residential tariff rates by 106 percent largely on account of rapidly rising costs of power generation (ERB, 2019), despite not releasing a cost of service study. Following public submissions, ZESCO suspended the April 2019 tariff adjustment proposal.

In September 2019, following the depletion of electricity supply and an increase in load shedding to 12 hours per day in some places, ZESCO indicated plans to further increase tariff rates, to facilitate the importation of 300MW of electricity from Eskom (South Africa) at the cost of US$22mn or K289mn per month. The power imports are meant to mitigate the adverse impacts of the power deficit on the residential, commercial and industrial, and mining sectors.

The exact details on the proposed tariff adjustments and cost-sharing schemes are currently not publicly available. However, given the imminence of the power imports, it is important that ZESCO and the ERB must take into account the likely effects of a wide range of tariff price policy options, particularly for the residential sector.

In this context, this analysis evaluates the impact of various tariff adjustment scenarios on both household welfare and revenue generation potential. Given that ZESCO's actual proposed increases remain publicly unavailable, we simulate several plausible residential sector tariff options based on past policy changes, media reports, opinions of the Minister of Energy as well as interviews and press statements from the utility company, ZESCO.

What are the Likely Poverty and Revenue Trade-Offs of Implementing Various Residential Tariff Increases?

This section analyses the likely increases in both the poverty headcount and marginal utility revenue assuming that the current tariffs were increased by various rates, ranging from 25 percent to 200 percent as shown in Table 1.

Table 1: Simulated Changes in Residential Tariff Prices

Current structure		Tariff increase in respective consumption block					
Bands (kWh)	K/ kWh	25%	50%	75%	100%	125%	200%
0-200	0.15	0.19	0.23	0.26	0.30	0.34	0.45
200+	0.89	1.11	1.34	1.56	1.78	2.00	2.67

Note: In all simulations, only the block prices were varied while holding the fixed charge constant.

The range of tariff adjustment options in Table 1 are based on historic increases and public statements from ZESCO and the Ministry of Energy. For example, an increase of 25 percent would be similar to the last residential tariff increment effected in September 2017. Tariff increases of 75 percent and up to 200 percent have been frequently reported in both the public and private media. To gauge the likely poverty and utility revenues implications of various tariff increases, Table 2 below presented the simulated trade-offs.

Table 2: Simulated Changes in Poverty and Utility Residential Revenue Due to Difference Changes in Tariff Prices

Tariff change (1)	Percentage point change in poverty headcount ratio (2)	Number of people falling into poverty (3)	Total annual revenues (K'Millions) (4)	Monthly marginal (or additional) revenues due to ZESCO (K'Millions) (5)
25%	0.27%	48 870	2 699	40
50%	0.47%	85 070	3 192	81
75%	0.66%	119 460	3 686	122
100%	0.93%	168 330	4 179	164
125%	1.13%	204 530	4 672	205
200%	1.83%	331 230	6 152	328

Table 2 broadly shows that increasing residential electricity tariff increases poverty but yields higher utility revenues from the residential sector as expected. As shown in column (2), poverty incidence would increase by 0.27 to 1.83 percentage points if tariffs increase by 25 percent to 200 percent (respectively). The corresponding number of individuals that fall into poverty ranges from an estimated 48,000 to over 330,000 (respectively). These increases in poverty certainly represent a significant social cost of higher tariff changes.

Columns (4) and (5) show that correspondingly, both the annual total revenues and the marginal revenues would rise. Specifically, residential revenues would increase from the estimated total of K2.2 billion to about K2.7 billion if a 25 percent tariff increment were effected as described.

The total revenues would further rise to about K3.6 Billion per annum for tariffs increases of 75 percent, and K6.1 billion under a 200 percent increase. The large increase in total revenue suggests that ZESCO can easily raise the required Eskom import bill and potentially realise significant excess revenues[7].

While excess revenues would improve ZESCO's financial position, this would come at a high cost to the residential sector, pushing thousands of households below the poverty line. Further, the residential sector should not be used to subsidise other sectors, but rather, should pay no more than their share of usage of the electricity import. From a social and economic perspective, an optimal tariff policy should be one that minimises the social and poverty impacts, while just generating the required revenues to finance the Eskom imports.

To identify such tariff policies, a comparison of the marginal revenues and monthly costs of the Eskom import bill would be required. To perform the marginal revenue and marginal costs analyses, we define marginal monthly revenues as the difference between the estimated monthly residential revenue under a given tariff increase proposal, and the current estimated monthly residential revenues ZESCO is getting. This is then compared to the monthly estimated share of the Eskom bill, which is estimated as 30 percent of the US$22mn Eskom import bill.[8] The resulting marginal revenues and marginal cost comparisons are presented in Table 3.

Table 3: Comparison of Monthly Marginal Residential Revenues and Eskom Import Costs by Alternative Tariff Scenarios

Tariff change (1)	Total annual revenues (K'mn) (2)	Monthly marginal (or additional) revenues due to ZESCO (K'mn) (3)	Monthly marginal (or additional) revenues due to ZESCO (US$mn) (4)	Estimated surplus/ (shortfall) of residential sector contribution to monthly Eskom bill (US$mn) (5)
25%	2 699	40	$3.1	-$3.5
50%	3 192	81	$6.3	-$0.4
75%	3 686	122	$9.4	$2.8
100%	4 179	164	$12.6	$6.0
125%	4 672	205	$15.7	$9.1
200%	6 152	328	$25.2	$18.6

Note: The estimated residential sector contribution to the monthly Eskom import bill is US$6.6mn.

Table 3 indicates that implementing tariff increase beyond 50 percent would result in residential customers more than compensating ZESCO the month Eskom import cost.

For example, increasing tariffs by 75 percent as often suggested would result in households over-paying their fair contribution of the monthly Eskom bill more than 40 percent or US$2.8mn. And as expected, the marginal excessive bills increase with higher tariff adjustments as shown in column (6).

Based on the original aims of this analysis, it's clear that a socially and economically optional tariff adjustment should be one that minimises poverty while generating sufficient extra revenues to break even. According to our estimates in Table 3, the optimal increase should be a 50 percent increase in current electricity tariffs. Specifically, a 50 percent increase in residential tariffs roughly provides the required contribution by the residential sector.

This, however, comes at the cost of pushing more than 85,000 Zambians into poverty. A lower 25 percent tariff increase would reduce this poverty number to 49,000 people, although this would require a government subsidy of US$3.5mn per month from the central government.

Based on the above analysis, we derive the following summaries regarding the poverty-revenue trade-offs that the government faces:

i) 0 percent residential tariffs increase: No Zambian would fall into poverty, but this would require up to US$6.6mn monthly subsidies for the imports.

ii) 25 percent residential tariffs increase: An estimated 85,000 Zambians would fall into poverty, but this would require government subsides of US$3.5mn monthly for the imports.

iii) 50 percent residential tariffs increase: An estimated 120,000 Zambians would fall into poverty. No government subsidies required. ZESCO would break even.

Based on the above, government should consider increasing tariff rates by no more than 50 percent.

Impact of Load Shedding on Consumption

Due to load shedding schedules of the last 6 months, it is highly likely that consumption of electricity has dropped. Regular power cuts mean that more people are consuming less than the threshold of 200 kWh, and therefore reducing demand for electricity at the higher R2 rate.

We suspect this is having a detrimental impact on government revenue. Without the latest consumption data, it is difficult to model this change in behaviour, however, ZESCO could consider opting for a modest increase of 25-50%, combined with temporarily lowering the R1 threshold in line with the fall in the consumption due to load shedding.

How Would Changes to the Residential Tariff Structure Impact Poverty and Utility Residential Revenues?

Finally, we briefly consider the likely poverty and revenue implications of changing the current tariff structure: reducing the lifeline tariff and implementing a three-tiered structure (as proposed by ZESCO in April).[9] This exercise compares the impact of revenue and poverty and compares the impact to the proposal to increase tariffs without structural changes The models to be simulated are presented in Table 4 below:

Table 4: Tariff Structure Options

Current struc-ture		Model 1 (a)		1 (b)	Model 2(a)		2(b)
Block	K/kWh	Block	K/kWh	K/ kWh	Block	K/kWh	K/ kWh
0-200 kWh	0.15	0-150 kWh	0.17	0.23	0-100 kWh	0.47	0.35
200 kWh +	0.89	150 kWh +	1.11	1.34	100-300 kWh	0.85	0.64
					300 kWh +	1.94	1.46
Fixed	18.23	18.23	18.23	18.23		-	-

Note: The incremental consumption blocks are also known as R1, R2 (and R3) respectively.

As can be seen, the first model reduced the width of the first block from 200 kWh to 150 kWh while increasing the block tariff prices by various price factors. In model 1(a), both the bottom and top block prices are increased by 25 percent while model 1(b) increases the first block by 25 percent and the second block by 37.5 percent. These scenarios are simply meant to assess how reducing the R1 band while increasing band prices would potentially affect poverty and utility revenues.

Model 2 represents the main model we aim to assess. This model is a 3 tier tariff structure that ZESCO previously proposed to implement in April 2019.

Alongside the original 3-tier structure, we also consider an alternative specification where the originally proposed tariff prices are reduced by 20 percentage points. These models are presented in Table 4 as models 2(a) and 2(b) respectively.

The main difference between the 3-tier and 2-tier system (currently in place) is that the 3 tier system would charge a higher than market tariff rate for the top block.

If implemented, such as the system would arguably be desirable, as higher electricity consumers would pay higher tariff rates to cross-subsidise lower electricity consumers and compensate for the cost of externalities. Table 5 shows the likely poverty and revenue implications of effecting the tariff structure designs discussed above.

Table 5: Simulated Impacts on Poverty and Revenues due to Changes in Tariff Structures

	50% increase	1 (a)	1(b)	2(a)	2(b)
Percentage point change in the poverty headcount ratio	0.47 %	0.44 %	0.62 %	1.01 %	0.63 %
Number of people falling into poverty	85, 070	79, 640	112, 220	182, 810	114, 030
Total annual revenues (K'mn)	3, 192	3, 035	3, 292	4, 132	3, 304
Monthly marginal (or additional) revenues due to ZESCO (K'mn)	81	68	90	160	91
Monthly marginal (or additional) revenues due to ZESCO (US$mn)	$6.3	$5.2	$6.9	$ 12.3	$7.0
Estimated surplus/(shortfall) of residential sector contribution to monthly Eskom bill (US$mn)	-$0.4	-$ 1.4	$0.3	$5.7	$0.4

Note: The estimated residential sector contribution to the monthly Eskom import bill is US$6.6mn.

As seen in Table 5, various tariff structures produce different poverty-revenue trade-offs. Changing from the current tariff design to model 1 (a) leads to a lower increase in poverty than model 1(b), though the former fails to recoup the required Eskom monthly revenues contributions while the later just breaks-even. Therefore, if faced with a choice of reducing the first tariff block while varying the block tariffs, increasing the R1 and R2 by 25 percent and 37.5 percent is one optimal choice. Various optimal tariff designs around the neighbourhood of the above scenario certainly exist. Perhaps a key message from the above is that just as with the tariff rate adjustment simulations (in section 3), conservative rather than drastic overhauling of the current tariff structure is sufficient to keep poverty in check whilst still generating sufficient break-even revenues.

Turning to models 2(a) and 2(b), results show that implementing the 3-tier model as originally proposed yields higher poverty outcomes and higher excess financial burden for the residential consumers in comparison to model 2(b). In particular, effecting a 20 percent cut in the tariff rises proposed by ZESCO for the 3-tier model would results in better social and revenue efficiencies compared to the original proposal.

In summary, our modelling of the two major tariff policies suggests that increasing variable prices by 50 percent is a more efficient option than any of the tariff structure re-design options considered in this section.

In particular, increasing the average tariff prices by up to 50 percent under the current pricing regime results in at most 85,000 people falling into poverty, while the best options under the tariff structure re-design options both have more than 100,000 people dropping into poverty.

However, the revenue calculations do not allow for the impact of load shedding. Depending on the impact on ZESCO revenue, the option to reduce the lifeline tariff basis could be preferable to using the current tariff structure in line with Model 1(b), which proposes reducing the lifeline band to 150kWh and increasing the lower tariff by 25percent and the higher tariff by 37percent. This change could be made on a temporary basis pending a review of the optimal lifeline tariff through the cost of service study as well as measures to improve targeting.

Conclusion

This paper focussed on the likely trade-offs between marginal poverty and marginal Utility revenues for a range of plausible tariff policy adjustments in the residential sector. Our analysis was based on two simulations: first, changes in the average tariff prices were analysed in the primary scenario; second, changes to the residential tariff structure where considered in the second scenario.

Our main conclusion is that there is scope for modest and conservative tariff reform which is in fact sufficient to support electricity imports for the residential sector. In particular, average tariff increases in the range of 25-50 percent of the current residential prices are deemed socially and financially efficient. This option is also found results in the least increases in poverty, in comparison with options that seek to adjust the actual tariff structures. Given the impact of loadshedding and consumption, this moderate increase could be combined with a downwards adjustment to the lifeline tariff, in line with the fall in average consumption.

Any changes to tariffs for consumers need to be accompanied by wider reforms to address inefficiencies in ZESCO and improve transparency so that consumers can be assured that they are not shouldering the burden of Zambia's energy problems alone.

Recommendations

In line with the principle that consumers should not be made to pay disproportionately for the cost of energy imports, this paper analyses increases in residential tariffs to cover their share of consumption (estimated at 30percent) for the proposed energy imports, while cushioning the impact on vulnerable households. It provides two options:

1) The preferable option would be to increase tariffs by around 50percent which should see revenue increase to cover the share of energy imports while maintaining the lifeline tariff. We expect that this would have the effect of pushing 85 070 people into poverty.

2) Recognising the possible impact of loadshedding on revenue (as we would expect usage to drop, meaning less consumption in the higher tariff band, creating a disproportionate drop in revenue), an alternative approach would be to reduce the lifeline tariff band to 150kWh and increase the lower tariff by 25percent and the higher tariff by 37.5percent. This would generate more revenue than an increase of 50percent but would also have the effect of pushing 112 220 into poverty. This change to the lifeline tariff band could be made on a temporary basis.

Wider reforms: the route to meeting Zambia's energy needs

We recognise the need to move to cost-reflective tariffs to address the costly and inefficient energy subsidies in a time of fiscal consolidation, improve financial viability of ZESCO and crowd-in the private sector to meet the country's long-term energy needs.

However, we are clear that consumers should not shoulder the burden of addressing these issues alone and that vulnerable households are protected through incremental and progressive energy tariff reform. This means improving targeting of the energy subsidy concurrently with wider sectoral reforms to improve efficiency and transparency.

Improving the efficacy of the lifeline tariff band

The Utility must come up with ways to minimise financial losses using the tariff structure, such as reforms to the size of the lifeline tariff band[10] and potential targeting of the lifeline benefits to only the indigent households. The size of the current financial subsidies associated with the R1 is potentially large given that all the nearly 1 million ZESCO customers enjoyed subsidised R1 tariffs including the wealthy. Reforming the size (optimally based on empirical studies) as well as targeting the benefits to only the indigent households would be useful reform projects.

Firstly, government could explore options to accurately target the lifeline tariff to the poorest households and remove the subsidy for households which can afford it. This could be done through targeting low-income neighbourhoods. An alternative, or complementary, approach is to use volume-differentiated tariff where consumption above a threshold leads to a higher price on all consumption, which would have an additional benefit of incentivising more efficient usage.

ZESCO should work with Smart Zambia to develop the necessary technology for smart application of the subsidy either through the current prepaid meter system or planned rollout of smart meters. Government could mitigate the cost impact through seeking donor support and/or a public-private partnership for infrastructure such as smart meters.

Secondly, government should explore options to reform the size of the lifeline tariff band: as the average consumption of the poorest 50 percent of households (by expenditure) is about 226kWh per month, the current lifeline tariff of 200kWh is subsidising non-essential power usage.[11]

Reducing the lifeline tariff would move Zambia into line with other sub-Saharan African countries, for example in the municipality of Cape Town, South Africa, where the lifeline tariff is 50kWh. The impact of this decrease could be mitigated by scrapping the fixed fee for vulnerable households which disproportionately impacts low consumption households. In line with the ERB announcement following the 2017 tariff increase, the cost of service study should be accelerated to inform the optimal size of the lifeline band in line with international best practice and with full consideration to the impact on vulnerable households.

Energy sector reforms

We Further increases to tariffs need to be predicated on the cost of service study which was announced in 2017 but has been delayed. This study will provide transparency on the appropriate energy tariff level.

We are encouraged that the work has resumed on the study but have concerns over the delay since the study was announced in 2017. Government needs to take steps to improve the financial viability of ZESCO so that the cost of improving power generation is passed solely onto consumers without addressing inefficiency in current operations. Steps to take include:

- Restructuring ZESCO operations and employee benefits to improve efficiency and reduce costs.
- Renegotiating purchasing power agreements, refinancing ZESCO debt, unbundling power functions and disposing of assets to raise revenue and improve financial viability.
- Implementing reforms to procurement and planning processes by establishing central processes to improve value for money in commissioning power generation.

We welcome the resumption of the cost of service study and the June IDC instruction for ZESCO to restructure the company, reduce the current workforce and review worker conditions of service. It is essential that government progress on these steps, as well as take wider action, alongside reform to tariffs to develop an equitable and viable route to meeting the country's growing energy needs.

Endnotes

1. The 2015 Living conditions monitoring survey (CSO and World Bank, 2017)

2. Input-output tables describe the structure and inter-relationships among economic sectors (including the electricity sector) in Zambia. These inter-connections allow the estimation of the indirect impacts of the electricity price increases on the household sector. The indirect and direct effects together form the total price effects of the electricity price changes.

3. The direct effect arises from reductions in household purchasing power as a result of direct electricity consumption by households, i.e. lighting while the indirect effects, on the other hand, arise when households consume goods and services that use electricity as an intermediate input (e.g. cooking oil). Our analysis takes into account both of these effects in estimating the total impacts of the electricity price changes on poverty. Full methodological details are available in Maboshe et al (2019).

4. Our simulations employ the popular IMF cost-shifting model to simulate the likely direct and indirect price effects of the electricity price changes. The resulting total income effect is then used to estimate the likely effects on poverty in Zambia. More details are available in Coady et al (2008) and Maboshe et al (2019)

5. Our baseline poverty estimates are the same as those reported by the CSO (2017) for 2015. However, to produce realistic estimates of the actual number of people that fall into poverty in 2019, the 2015 survey we adjust the 2015 sampling weights by the ratio of the population sizes at the end of 2018 vs 2015. Furthermore, our estimates of the CPI-adjusted household residential bills as at the end of 2018 yields based on the LCMS produces an estimate of K2.2 billion as the total household expenditures on electricity. This survey based estimate is remarkably close to estimates of the 2018 ZESCO residential sector revenues (K2.1 billion) generated using ZESCO's financial statement data projections or ERB's revenues trends projections (see ZESCO (2018) 2017 audited financial statements, page 26 and ERB (2019), page 14)

6. At that time however, Government had yet to complete a comprehensive cost of service study to estimate the actual required cost reflective tariff rate. So the ZESCO proposed tariff hike was largely provisional.

7. Consumer demand is unlikely to drop significantly due to the price increases. Empirically, residential electricity sector elasticities of demand are quite low. We assume an elasticity parameter of 0.1 following Maboshe et al (2019).

8. Based on the Ministry of Energy (2018) estimates, the residential sector's share of total ZESCO power is 30 percent, Mining takes up 50 percent while the remaining 20 percent is shared among the other domestic industrial and commercial sectors. Therefore, assuming an equitable sharing of the US$22mn Eskom import bill, the most the residential sector would contribute to the Eskom bill is 30 percent or US$6.6mn per month.

9. This analysis does not attempt to estimate the optimal block bands or block rates, but simply simulates various plausible hypothetical tariff structures and assess the likely poverty-revenue trade-offs.

10. The R1 (lifeline tariff band) is the lowest priced tariff band currently applied to the first 0-200kWh. The main objective of the R1 according to the ERB is to ensure electricity remains accessible and affordable for the low-income consumers.

11. PMRC. 2017. "Energy Policy Reform: The Impact of Removal of Electricity Subsidies on Small, Medium Sized Enterprises and Poor Households. Available at https://www.pmrczambia.com/wp-content/uploads/2017/09/PMRC-Energy-Reform-Policy-Brief-The-Impact-of-Removal-of-Electricity-Subsidies-on-Small-Medium-Sized-Enterprises-and-Poor-Households.pdf

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