WORKING PAPER

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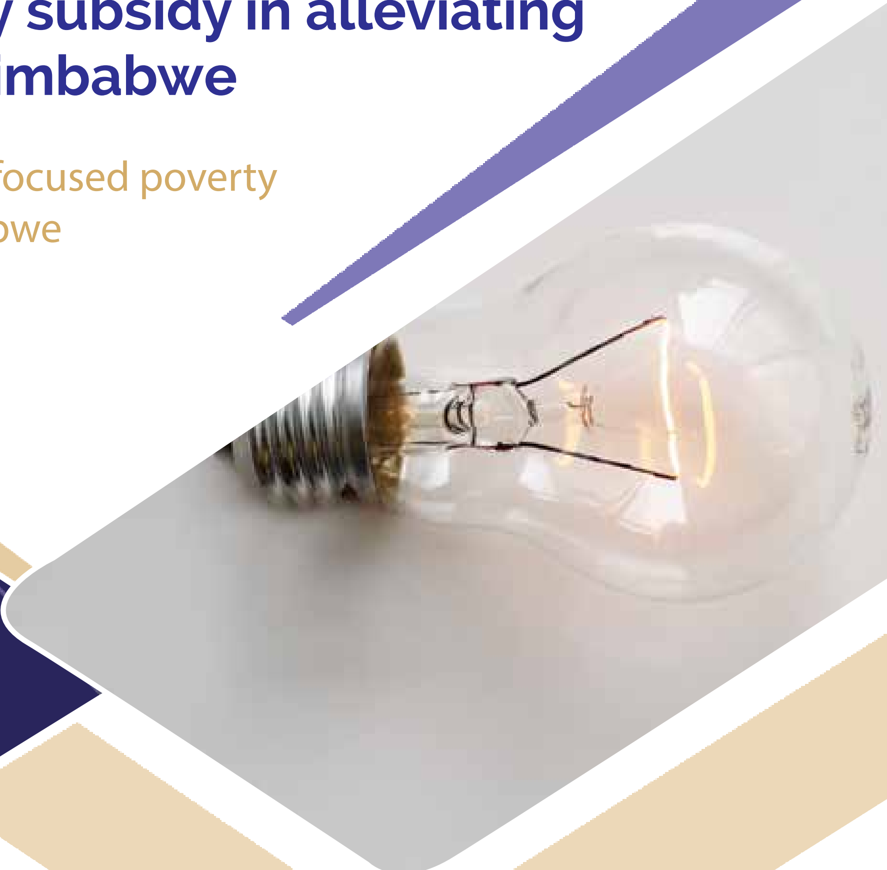
Zimbabwe Economic Policy Analysis and Research Unit

Energy and poverty: the efficacy of electricity subsidy in alleviating poverty in Zimbabwe

Advanced policy-focused poverty analysis in Zimbabwe



Alex Bara
Wellington J. Matsika
Tobias Mudzingwa
Arnold Mabasa Damba

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FOREWORD

The study analyses the importance of electricity subsidies on poverty reduction in Zimbabwe Electricity subsidies are an instrument used to alleviate poverty in developing countries such as Zimbabwe. If properly designed and structured, electricity subsidies have potential to improve access to electricity by the poor, with spillover effects on improving living conditions of the poor by making electricity cheaper and affordable, redistributing income and reducing the burden of electricity costs.

Zimbabwe's electricity subsidies to GDP ratio is high compared to other Sub Saharan African countries. However, empirical evidence carried here-in shows limited connectivity and usage of electricity by the poor and high level of exclusion of the poor in subsidy benefit, not helping in poverty reduction, as poverty in the country beacons. The World Banks' upcoming Zimbabwe Poverty Report 2019 estimate Zimbabwe's headcount poverty rate at 54% based on lower-bound poverty line of US$ 45.6 per person per month, 70.4% using the upper-bound poverty line of US$66.1 and 30.4% using the food poverty line of US$29.8 per person per month.

Statistics based on the 2017 Poverty Income and Expenditure Survey (PICEs) data, indicates that 74.1% of the households have access to the national grid, of which, household connections to the grid are low, at 32.8%. Among the poor, the uptake rate of connections given access is 8.1% while it is relatively higher for the non-poor at 51.8%. More so, statistics from PICES data show low level of usage or uptake of electricity among the poor. Their average monthly total expenditure on electricity of US$12.09, remains low compared to US$22.73 for the non-poor. Low connection, usage of electricity and limited quantity consumed combine to suppress total value of the subsidy received by the poor households per month, leading to uneven subsidy distribution between the poor (10%) and non-poor (90%).

The paper also reflects on and established that current electricity consumption subsidy scheme in Zimbabwe has low target performance, implying that it is not pro-poor. The high level of exclusion due to low access, uptake and connection rates for poor households against the non-poor contribute to the lack pro-poorness in the subsidy scheme. Empirical evidence carried here-in therefore shows that electricity subsidies in Zimbabwe are less effective in alleviating poverty due to the high level of exclusion of the poor from the subsidy and high inclusion of the non-poor, resulting in low rates of beneficiary incidence on the poor. The richer households who consume more electricity and therefore enjoy higher level of electricity subsidies than the poor who do not consume or have low consumption of electricity. Simulation of possible subsidy options reveals that increasing connectivity to electricity by the poor remains critical in ensuring high incidence of benefit on the poor from the consumption subsidy.

Deductions by the study are that electricity connection subsides have a potential for a high impact in alleviating poverty in Zimbabwe and that consumption subsidies alone are not effective in trying to improve the lives of the poor. Consumption subsidies need to be complemented by connection and supply side subsidies that support increased uptake of electricity by the poor.

The policy decision, therefore, should not be about whether or not subsidies should continue to be used as tool of alleviating poverty, rather it should be on how to reform the subsidies in order to optimize their effectiveness in alleviating poverty. The study recommends policy reforms premised on a reviewed electricity subsidy model that combines consumption and connection subsidies, based on household income, differentiated using geography and supported by supply-side power subsidies.

ACKNOWLEDGMENTS

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ABBREVIATIONS AND ACRONYMS

GDP	Gross Domestic Product
IBT	Increased Block Tariff
IPPs	Independent Power Producers
kWh	kilowatt hour
PICES	Prices, Income, Consumption and Expenditure Survey
R&D	Research and Development
VAT	Value Added Tax
VDT	Volume Differentiated Tariff
ZETDC	Zimbabwe Electricity Transmission & Distribution Company
ZERA	Zimbabwe Energy Regulatory Authority
ZESA	Zimbabwe Electricity Supply Authority
ZIMSTAT	Zimbabwe Statistical Agency
ZPC	Zimbabwe Power Company

PART I: INTRODUCTION AND CONTEXT

Introduction

Electricity in Zimbabwe is heavily subsidized. In 2017 the Zimbabwe Electricity Distribution and Transmission Company sold electricity to households at an average of US 9.96 cents per kWh, which was lower than the estimated efficient cost of supply of US 12.4 cents per kWh. This implied a subsidy of 24.5% per kWh consumed by households. Zimbabwe's post-tax electricity subsidies [1] is an outlier in Sub Saharan Africa where other countries' subsidies range between 0% and 8% of GDP (Figure 1a)[2]. This paper provides empirical evidence that these subsidies do not meet the stated aim of alleviating poverty. Simulation and estimation of benefit incidence point to low target performance of the subsidies with minimal benefits accruing to the poor. This, notwithstanding, empirical evidence carried here-in shows limited connectivity and usage of electricity by the poor, high level of exclusion of the poor and this is not helping in reducing poverty amoung the poor, as poverty in the country beacons. In this paper, policy reforms are suggested based on simulations of possible financial consumption subsidy models that combines financial and non-financial and supply side subsides.

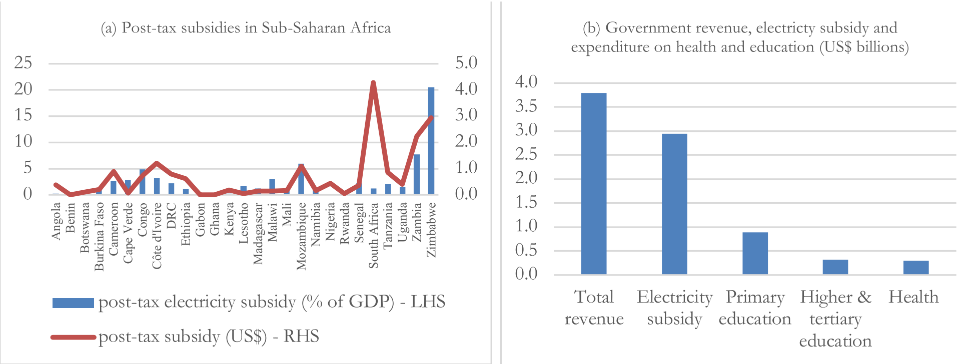
A subsidy is any government intervention that affect the prices/costs of products directly or indirectly to reduce below market price the price paid by consumers or increase above market price the price received by producers or reduce the costs of production (UNEP and United Nations Foundations, 2003). These interventions include direct financial transfers, preferential tax treatment, trade restrictions, direct government provision of services at lower than full cost and government regulation such as demand guarantees, price controls and market access restrictions. The United Nations Sustainable Development Goal Number Seven (7) states that access to affordable, reliable and sustainable energy is crucial to achieving poverty eradication and overall development.

The high proportion of subsidies in Zimbabwe could be compounded by the subsidy design that may be too generous, a low target performance and non-targeted on the supply side. Zimbabwe applies an increasing block tariff (IBT) structure with three blocks[3], which heavily subsidizes the first two blocks of domestic electricity consumption. From October 2019, until June 2020, the applicable tariff rate for the first block (0-50kWh) is 87% less than the cost of supply, while that of the second block (51-200kWh) is 30% less than the cost of

[1]The post-tax subsidy is the true cost of a subsidy which takes into account environmental impact from energy generation and foregone consumption taxes on energy consumption.
[2]Although the concept of subsidies focused on in the study relates to pre-tax subsidies, the available estimates for electricity subsidies refer to post-tax subsidies which are used to give an indicative size of electricity subsidies. Zimbabwe's pre-tax subsidy reported in the IMF study (see footnote 2) for electricity and coal is 18.78% of GDP, of which coal is likely to have a smaller share given its 12.6% share in total post-tax subsidy and its likely high environmental costs.
[3]A new tariff schedule with four blocks was introduced in June 2020

supply.[4] The tariff rate for the third block (>200kWh) is 5% below the cost of supply (ZETDC, 2020). With the newly introduced schedule, tariff rates for the first three blocks are 88%, 73% and 25%, respectively, below cost, with the last block being 17% above cost. Thus, household electricity consumption is subsidized across all the blocks. Even the non-poor who can afford unsubsidized electricity are benefiting from the subsidy, hence increasing costs to the government and crowding out other essential expenditures.

Figure 1: Post-tax subsidies, government revenues and allocated expenditure on education and health, 2015



Source: IMF (2015) – Database on energy subsidies and Ministry of Finance and Economic Development

Besides, the existing consumer subsidy model is not directly linked to the supply side subsides particularly on power generation and distribution. For example, with current consumption power subsidies, ZESA levies Government recommended tariff rate in lieu of tax relief on procurement and operating surplus, with no equivalent compensation for the cost of generation of the subsidized power[5]. The power generation company, therefore, suffers a double loss in cost of power generated plus lost margin on the price. ZESA then absorbs the generation costs of the subsidy, which then has a double knock-on effect (incurred cost-plus reduced price) on its operations. Such a power model does not support operational and power generation substantiality on the part of ZESA. In addition, there are gaps in the current model which militate against promoting generation and distribution of power by IPPs and development of green energy.

[4]It is important to note that the standard tariff rate may be lower than the cost recovery rate for an efficiently operating firm. In that case, it means that the subsidy is even higher than that implied by the standard tariff rate.

[5]There is no model to determine the compensating effect of power generation production subsidies such as tolerance of excessive technical losses, use of subsidized cooling water, Government grants, guarantees and investment in network on the burden of consumption subsidies absorbed by ZESA.

The consumption subsidy model implied in the tariff schedule is to a greater extent not self-sufficient, hence requiring heavy financing by government fiscal transfers and cross subsidies from the commercial sector. This exerts a huge burden on the fiscus which is already struggling with constrained fiscal space and on the commercial sector which is already struggling with high costs of doing business. With no direct compensation to consumption subsidies by government and in the absence of the commercial sector failing to fully cross subsidize residential electricity consumption, the utility companies have to find other means of financing the subsidy such as cutting back on investment and postponing maintenance of electricity infrastructure. Resultantly the power company fails to generate enough power and to invest in network expansion. This poor service delivery leads to low access to electricity by the poor, with the inevitable load shedding disproportionately affecting the poor who lack the means to adapt to sustainable alternative energy sources.

The study perspective

Existing energy subsidy policies in Zimbabwe are not structured to guarantee and ensure access to and usage of electricity by the poor, vulnerable and low income people. Energy subsidy policies, though intended to ensure affordable power, are non-exclusive, non-differentiating and non-redistributive. For example, the block based electricity subsidies for household consumption is universal and the subsidy is differentiated on the basis of consumption level. Under such a model, high income people, who tend to afford connections costs and alternative sources of power, would have better access to power and are likely to have a higher incidence of benefit than the poor. Furthermore, there are subsidy policies for commercial power usage meant to enhance production and support reduction of poverty through entrepreneurship, employment creation, lowly priced products, domestic supply of goods and services, as well as increased per-capita income. However, there seem to be no direct translation of benefits of electricity subsidies for commercial use towards poverty alleviation among the poor. Additionally, whilst electricity subsidies ensure affordability of power that could enhance access to and usage of electricity, they too are a burden to government and are potentially ineffective in alleviating poverty and redistributing income in Zimbabwe. Government often meet the burden of subsides through taxation, which could disproportionately affect the poor.

There are high risks of the current subsidy policies and design excluding the ultimate intended beneficiaries. A number of questions arise regarding subsides model in Zimbabwe: Is the current subsidy model designed to meet the intended objectives, that is assisting the poor to have access to power? Who is benefiting from these subsidies? Is there cross subsidisation and re-distributive effect of power subsidies across income levels, towards the poor? How can the subsidy model be restructured in order to be properly targeted with minimal burden to the power generating entity and the sponsoring Government? What policy measures can be put in order to enhance performance of subsidies, limit their adverse impact on the performance of the utilities in the sector, and burden on government?

This empirical investigation sets out to give analytical insights on the distributional effects of access and design attributes of the consumption electricity subsidy model in Zimbabwe on the poor, with the aim of influencing evidence-based policy reform in electricity power subsidies. The study intends to produce empirical evidence that informs policy reform on electricity subsidies towards increased access to and usage of electricity power for poverty alleviation by the poor and vulnerable in Zimbabwe. Specific objectives of the paper are to:

a. Measure the extent to which the subsidy benefits the poor as opposed to other households;
b. Assess the level of electricity subsidy received by the poor and quantify the proportion of the poor households who are excluded from the subsidy;
c. Determine how the access and design attributes of the current subsidy model affect incidence of subsidy on the poor households;
d. Draft a pro-poor subsidy policy reform model and policies on electricity subsidies that optimise on benefits to the poor and reduce burden on the fiscus.

The process of subsidy analysis typically begins with static incidence analysis (Araar and Verme, 2012). Static incidence analysis provides the baseline to evaluate simulated subsidy reforms. To conduct incidence analysis, the study applies an approach developed by Komives et al (2005), Angel-Urdinola and Wodon (2005) and Ore et al (2017). The study also analyses the targeting performance of the subsidy, by computing the subsidy targeting performance indicators as well as decomposing subsidy targeting performance. The study follows the approach by Angel-Urdinola and Wodon (2005) to decompose the benefit incidence into access and subsidy design factors that influence the overall performance of the subsidy. Further, the study attempts simulation of electricity subsidy reforms based on the standard economic consumer's choice model suggested by Araar and Verme (2012)[6]. The study output is a critical evaluation of benefits of subsidies among the poor, determination of access and design of the current subsidy and a pro-poor subsidy reform model through simulating optimal subsidy design for policy consideration. The ultimate outcome would then be enhanced effectiveness of subsidy policy on electricity for poverty alleviation in Zimbabwe. The study also contributes to the literature on access to utilities and poverty reduction by investigating the efficacy of electricity subsidies in reducing poverty using the case study of Zimbabwe. The study is possibly the first in Zimbabwe to use a household survey data on poverty, income, consumption and expenditure to measure the pro-poorness of electricity subsidies on households, and simulate possible reforms that would improve the effectiveness of electricity subsidies in reducing poverty while minimizing the subsidy costs to government.

Electricity Subsidies and Poverty: The Broader Context

Power generation and consumption subsidies take various forms, including R&D, investment, generation, consumption and decommissioning (Kitson, Wooders and Moerenhout, 2011). There are several reasons why subsidies are important in the context of poverty reduction. Subsidies make utility services affordable to the poor and act as an alternative instrument for redistributing income (Komives et al, 2006). Direct subsidies reduce the burden of electricity

[6]A detailed discussion of the methodology is in Annex 1

costs on the poorest 40% of households in Central America, thus contributing to poverty reduction (Ore et al, 2017; Angel-Urdinola and Wodon 2007). Electricity subsidies improve the social welfare of the poor by facilitating their access to and use of electricity services, as well as to redistribute resources to increase their ability to afford electricity tariffs (Vega et al 2019). In most developing countries, modern energy is subsidized in order to improve household living conditions by making energy more affordable (Sovacool, 2017)

The efficiency and effectiveness with which subsidies reduce poverty and redistribute income to the poor is, however, predicated on the assumption that subsidies are pro-poor, reach and disproportionately benefits the poor more than the rich. Vega et al (2019), however, questions the effectiveness of utility subsidies in reaching and distributing resources to the poor. In Central America, subsidies reduced poverty with high levels of inefficiency because a large proportion of subsidies (more than 60cents per dollar) benefited high-income households (60% of the households (Ore et al (2017)). Arze del Granado et al. (2012) found that electricity subsidies were regressive in 20 developing countries because the poor were consuming disproportionately less electricity than the rich. In Argentina, even though subsidies protect the poor, they are not effective because they benefited the rich and non-residential consumers more than the poor households (Lakner et al, 2016).

Kitson, Wooders and Moerenhout (2011) pointed three common approaches to measuring subsidies. The price gap approach, which measures the difference in observed price for electricity versus a free market reference price. This the measure that is currently being applied in Zimbabwe using the IBT tariff schedule. The down side of the approach is that subsidies to generators will only be captured to the extent that these are reflected in the price to consumers. The transfer measurement approach, quantifies the subsidy associated with a given program, regardless of whether this has an effect on end price. The integrated approach, combines direct financial transfers (including those benefiting producers through government assumption of risk) as well as transfers generated between producers and consumers and vice versa as a result of government policies. The main example of which is the Producer Support Estimate and Consumer Support Estimate (PSE-CSE) framework applied in particular by the OECD.

The design of a subsidy matters in determining the efficiency of a subsidy in reducing poverty and redistributing income. The threshold to determine household eligibility to a subsidy and the depth of a subsidy (i.e. the subsidy amount per unit of electricity consumed) are the main drivers of the efficiency of a subsidy scheme in Central America (Ore, 2017). The targeting strategy that relies on the amount of electricity consumed as an indicator of rich/poor households results in higher levels of errors of inclusion or exclusion because the relationship between electricity consumption and income is not perfect.

Most of the studies on the benefit incidence explain the targeting performance of subsidies but do not explain the factors behind the performance of the subsidies. Angel-Urdinola and Wodon (2007) found out that consumption subsidies for electricity in Cape Verde, Rwanda, and Sao Tome and Principe are regressive mainly due to access factors that prevent the poor from using electricity. The study established that shifting from IBT structure to VDT structure and from consumption to connection subsidies, though it may not make the subsidy pro-poor, improves the targeting performance of electricity subsidies. They also note that the increase in targeting performance is mainly due to subsidy targeting and the quantities consumed and that well designed connection subsidies are pro-poor than consumption subsidies as they raise the benefit incidence above one (Angel-Urdinola and Wodon, 2007).

Reforming subsidies has potential to generate substantial fiscal savings. In Central America it is estimated that reducing subsidy leakages to high-income households reduces fiscal costs by 30% to 50% without increasing poverty (Ore et al, 2017). However, it is noted that even though subsidy reform may increase the pro-poorness of the subsidy scheme, some households, especially middle-income households would be negatively impacted and therefore the government should address such costs to the affected households. Progressive taxation and targeted fiscal transfers are found to be more efficient than residential electricity subsidies in achieving poverty reduction, distributional equity and macroeconomic stability (Ore et al, 2017). Araar and Verme (2012) showed that restructuring of utilities' tariffs has great potential of improving equity and efficiency of government spending. Komives et al (2006) revealed that targeting mechanisms (e.g. IBT, VDT, geographic) do not address the utility services access gap between the poor and the rich, hence implying that subsidy reforms that seek to improve targeting mechanisms can only reduce poverty up to a limited extent. It also implies that connection subsidies are very important in reducing poverty when the access gap between the poor and the rich is very high.

Subsidy reform can be gradual or big bang. The latter gives rise to sharp increase in prices of electricity if subsidies are generally significant, thus resulting in higher welfare losses which the poor can fail to absorb. Ore et al (2017) suggested reforming electricity subsidies by integrating them into social assistance programmes[7] which have better mechanisms for identifying beneficiaries and distributing the subsidies with greater accuracy, addressing errors of exclusion (i.e. excluding the poor from subsidy benefits) or inclusion (i.e. including the rich in subsidy benefits).

Countries have looked at different ways of reforming their subsidy schemes. In El Salvador, the government eliminated the electricity subsidy targeted at middle- and high-income groups of the population that consumed 100kWh to 300kWh of electricity in order to reduce fiscal costs associated with the subsidy (Ore et al, 2017). Honduras introduced geographic targeting whereby high-income neighbourhoods are excluded from the more generous subsidy scheme in order to improve the targeting performance of the electricity subsidy (Ore et al, 2017).

[7]The integration of electricity subsidies into social assistance programmes, however, works well when the country has a high quality social assistance roster which identifies low-income households at national scale.

Lessons from international experience suggest that it is important to consider the following when reforming subsidies: (a) Identifying the population groups that will be negatively affected by the electricity subsidy reforms and consult them in advance and provide compensatory policy measures to reduce adverse impact on their welfare and secure their buy-in; (b) Making public the benefits of the electricity subsidy reform and ensuring that the reform efforts are credible; (c) Recognising and addressing political economy challenges to increase chances of success in reforming the subsidies; (d) Ensuring that the reform agenda enjoys sufficient support from the government; and (e) Improving targeted social assistance Replacing subsidies with more accurately targeted forms of social assistance can often advance the same policy objectives at a lower fiscal cost (UNEP and United Nations Foundations, 2003).

The downside of power subsidies

Good as they are intended and perceived, subsides have their own downside:

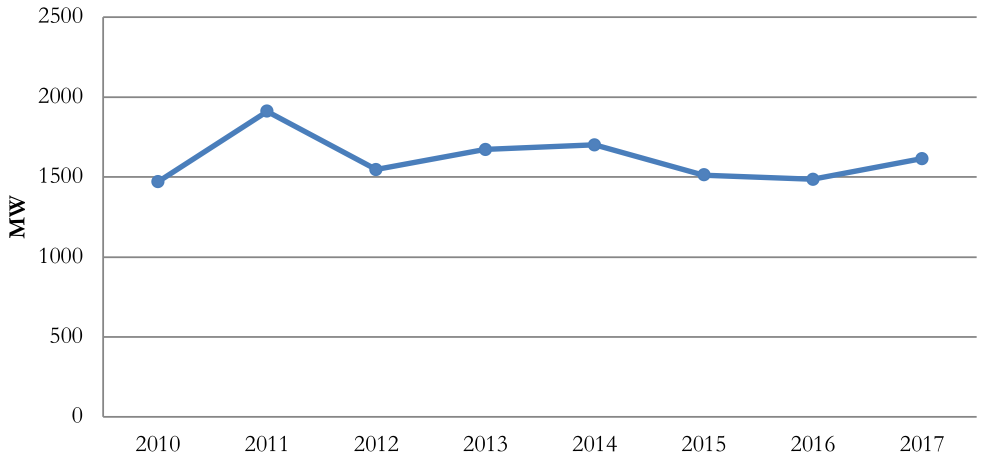
- Subsidies for electricity may aggravate the level and intensity of poverty. The energy-subsidy programmes intended to promote the purchasing power of the poor households or rural communities' access to electricity through lower prices may paradoxically leave the poor worse off, since the costs of the subsidy are shared by the entire population including the poor (United Nations Environment Programme Division of Technology, 2008). Thus, if the tax system used to finance the electricity subsidies is regressive, then it is possible that the net benefit of the subsidy is negative and therefore increasing poverty.
- Electricity subsidies entail substantial fiscal costs for countries facing tight fiscal space and usually give rise to unintended economic, environmental and social distortions (Akasaka, 2007). In the midst of low revenue-to-GDP ratio and high fiscal constraints, subsidies constitute high opportunity cost in the form of public investment and social services such as health and education (Sovacool, 2017).
- Subsidies may create market distortions. They under-price products and artificially increase demand hence creating shortages as well as funding pressure to provide the necessary infrastructure to meet demand. In Myanmar, fixed prices for domestic electricity resulted in shortages when price fell below international market levels because suppliers were prompted to focus on export markets such as China and Thailand at the expense of domestic market (Sovacool, 2012; United Nations Environment Programme Division of Technology, 2008). In China the average household price distortion for electricity was estimated at 11.8% (Jiang et al., 2015). In addition, the fixed prices also negatively impacted on the revenues needed to maintain and expand utility infrastructure.
- Energy subsidies contribute to negative externalities that may disproportionately affect the poor. The subsidization of fossil fuels has significantly contributed to high carbon footprint which lead to global warming and climate change which affect the poor who lack the means to adapt their livelihoods. Between 1980 and 2010 it is estimated that 36% of global carbon emission was attributed to fossil fuel subsidies (Stefanski, 2014). Subsidies for coal-fired electricity in Australia are estimated to have resulted

in a smelting industry that produces 2.5 times greenhouse gas emission per tonne above the world average (Turton, 2002). In the European Union and Japan, subsidies for coal are estimated to have contributed between 50 and 100 million additional tons of carbon dioxide emission (European Commission, 2007).

Electricity Generation, Pricing and Subsidies in Zimbabwe

The demand for electricity in Zimbabwe significantly exceeds the available internal electricity generation capacity. While the average 'suppressed' electricity system maximum demand is about 1600 MW (Figure 2), the average internal generation capacity reported in the ZETDC daily power supply status hardly reaches 1000MW. Thus, there is significant unmet demand, resulting in load shedding and expensive electricity imports from neighbouring countries such as South Africa and Mozambique. However, Zimbabwe has installed electricity generation capacity of 2306 MW. The system maximum demand is rather suppressed in the sense that the country is and has been operating at a low industry capacity utilisation.

Figure 2: Electricity Maximum Demand 2010-2017



Source: ZETDC

While the installed electricity generation capacity is at 2306 MW, the actual available generation is about 1000 MW. Water shortages, old power generation plants and inadequate maintenance constrain the power generation plants from operating at full capacity. There are also inefficiencies in the generation, transmission and operation of the electricity utilities (Table A1)[8]. The electricity transmission operating costs are significantly high (15%) above the expected benchmark of between 3% and 5% of gross asset value of the transmission

[8]Thermal efficiency, which measures the ability of a thermal power plant to convert coal into power, is below expectation for all the thermal stations in the country

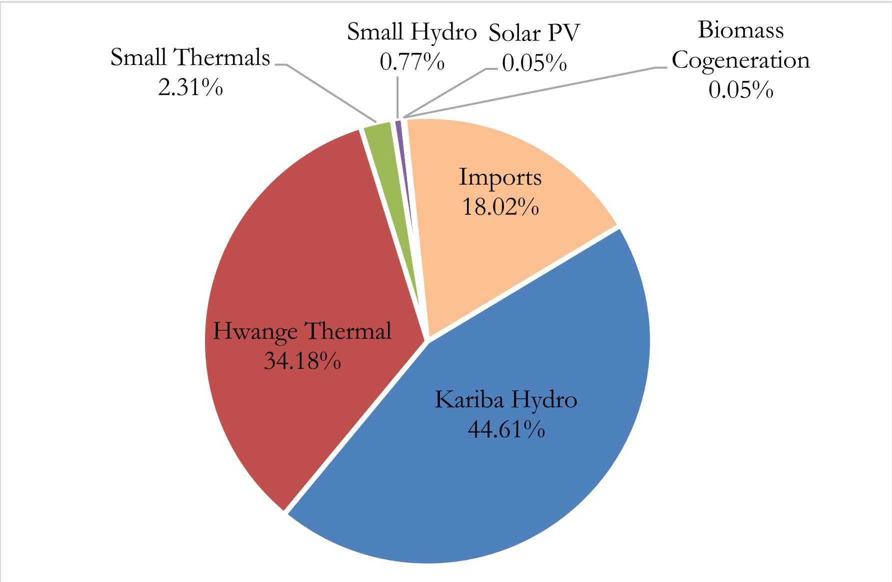
assets. Unfunded subsidies, have contributed to the inability of the utilities to invest into new generation capacity or repowering of the existing plants.

Non-renewable sources still occupy a significant share in the electricity generation mix of Zimbabwe (Figure 3). About 36% of electricity is generated from coal-powered thermal power stations[9]. Hydro electricity is the main source of electricity generation, contributing 45% from Kariba and 1% from IPPs, while 18% of electricity is imported. Although hydro electricity generation is relatively cheaper, clean and renewable, it is vulnerable to climate change. Droughts have affected water levels in dams and rivers that generate hydro-electricity power, leading to reduced electricity generation in the country, and high dependence on electricity generated and imported from other countries.

Localised sources of power generation such as small-hydro, solar, wind and biomass have potential to improve electricity access to the poor at lower costs that the major generation plants.

The localised sources may be closer to the poor without access thus reducing costs of transmission and distribution infrastructure and losses.

Figure 3: Electricity energy generation mix in Zimbabwe (GWh), 2019



Source: ZERA 2019 Annual Report

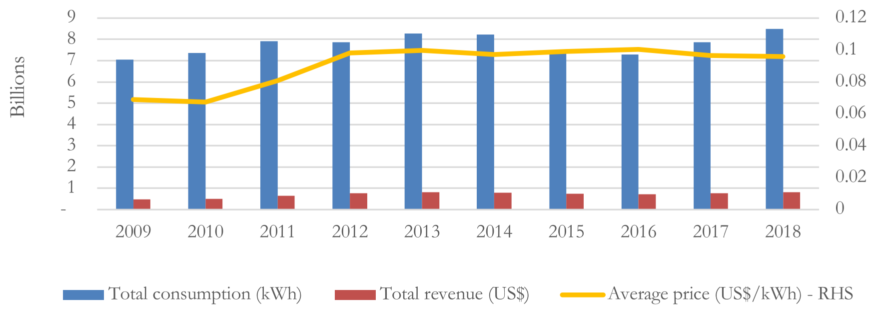
[9]These power station contribute to environmental pollution and partly explain why the post-tax subsidy for electricity is quite elevated in Zimbabwe.

Costs of generating, transmitting and distributing electricity

The Zimbabwe Energy Regulatory Authority uses a tariff code to guide the determination of electricity tariffs levied to end users of electricity. The code is meant to ensure fair prices by licensees to consumers in the light of the need for prices to be sufficient to allow licensees to finance their activities and obtain reasonable earnings for their efficient operation. ZERA moderate the revenue requirement and the attendant tariffs that ZETDC seeks for approval before implementation[10]. Whilst a cost recovery tariff for producers is sought, the regulator also ensures that consumers are not burdened by higher tariffs that reflect avoidable inefficiencies of the generating, transmitting and distributing system. As a result, the tariff that the utility companies request are always at variance with the ZERA awarded tariffs. The average end-user tariff implied by the operating costs and kWh sold by ZPC and ZETDC were around US0.18/kWh in 2014 and 2016 before it dropped to US$0.1541/kWh in 2017 (Table A3.1). The approved or awarded tariffs were around US$0.09 giving a negative variance between the average implied cost of supply against the average implied price (tariff awarded), indicative of the average level of subsidy that ZESA has been giving to consumers of electricity.

The average cost of supply proposed may be higher reflecting inefficiencies in the generation, transmission and distribution of electricity. The average price over the years 2013 to 2018 hovered around US$0.10/kWh, with total electricity consumption ranging between 7 billion kWh and 8.5 billion kWh, and revenues of between US$0.49 billion and US$0.82 billion (Figure 4).

Figure 4: Consumption, revenue and average prices

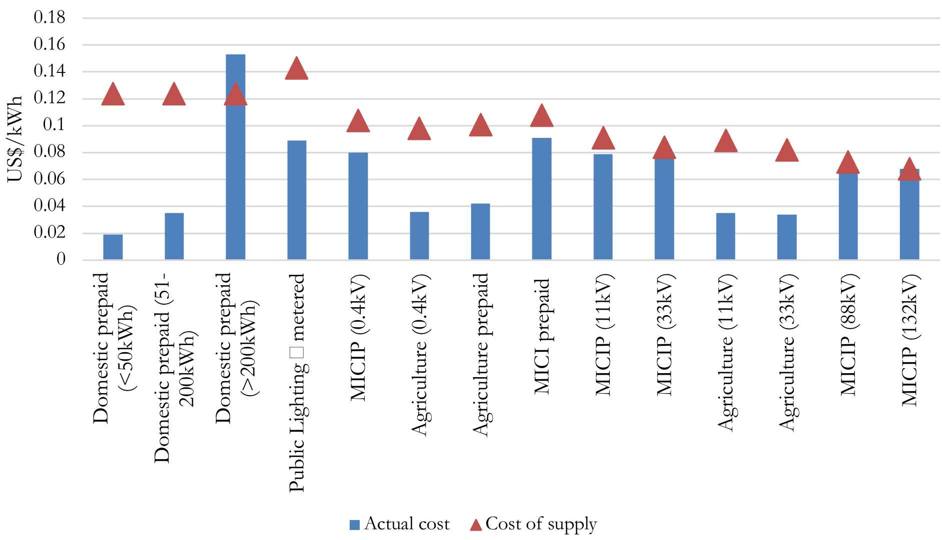


Source: Authors' construction from data from ZETDC

[10] While in principle the moderation played by ZERA in the tariff determination seeks to ensure fair pricing for the producers and consumers of electricity as espoused in the tariff code, the practice on the ground also indicates that affordability issues are also considered.

Generally, electricity is subsidised for most customer categories except for domestic prepaid consumption above 200kWh. There are also high electricity subsidies for non-household consumption, mostly in agriculture (Figure 5). With most of the customers subsidised, there is potentially very limited cross subsidisation among customers and the subsidy scheme is not self-financing, hence potentially raising a fiscal burden on the government and undermining performance of the electricity utility companies.

Figure 5: Actual vs estimated cost of supply of electricity by customer category, March 2020



Notes: MICI = mining, industrial, commercial and institutional; MICIP = mining, industrial, commercial, institutional and pumping.
Source: Authors' construction from data obtained from World Bank (2020)

Consumption electricity subsidies in Zimbabwe

In Zimbabwe, electricity is subsidised in many forms, directly and indirectly. Electricity subsidies takes many forms including R &D, investment, generation, decommissioning and consumption. Examples of consumption linked subsidies include reduced rate of import duty for solar components, quantity based IBT schedule tariff subsidy, below-cost grid connection charges to consumers and VAT exemption of domestic electricity consumption. Subsidies have enabled access to low tariff power by consumers although at the burden of Government. Power generation subsidy framework in Zimbabwe is not explicitly structured given the overlap between Government funding and ZESA Operations which are influenced by Government directives. The country, however, has a clear power consumption subsidy framework, which has been implemented over decades. The major benefit has been reduced power tariff for beneficiaries. Although the benefits of subsidised household power consumption are direct, the question is on performance of the target and how optimal they are in meeting the intended objective. The design features of any power subsidy model determines who benefits and the redistributive effect of the subsidy model.

Overall subsidy structure implicit in households' tariff schedule

In Zimbabwe, the IBT schedule is used in the pricing of electricity and delivering of the subsidy to households. Zimbabwe has never applied other subsidy targeting methods such as means-testing, or geographic targeting. The electricity pricing for households are as shown in the IBT schedule below (Table 1), i.e. the tariffs for 2011-2020 (see annex for full tariff schedules). The tariffs for Zimbabwe were almost stagnant from 2013 until they were reviewed in March 2020 in line with the prevailing inflation and they are now inflation indexed.[11]

Table 1: 2013-2020 (Mar) IBT Tariff Schedule

Metering	Tariff Block	Charge per kWh in US dollars (2011-2017) and ZWL (2019-2020)			
		2011	2014-18	2019 (Oct)	2020 (Mar)
Conventional Meter	1-50kWh	0.02	0.02	0.41	0.49
	51-200kWh	0.02	0.02	0.91	1.08
	51-300kWh	0.11	0.11	3.87	4.61
	Balance	0.15	0.15	3.87	4.61
Prepaid Meter	1-50kWh	0.01	0.02	0.41	0.49
	51-200kWh			0.91	
	51-300kWh	0.06	0.11	-	1.08
	Balance	0.15	0.15	3.87	4.61

Source: ZETDC

The first 50 kWh units consumed by households are considered to be the lifeline, charged a tariff of US$0.02/kWh to ensure that the vulnerable and poor households can afford to purchase electricity. The second block of consumption has 51-300 kWh, but this block was revised to 51-200 kWh in October 2019 in an effort to reduce subsidies as envisaged in the

[11] Electricity charges for domestic customers or households are zero rated for VAT in terms of Statutory Instrument 168 of 2012, whilst fixed charges on commercial and domestic electricity are Zero rated for VAT in terms Statutory Instrument 245 of 2005. Implicitly, from 2009 to 2019 electricity sales, Government has forgone a total of about US$430,158,414.79 ($430 million) in value added tax (VAT) exemptions.

tariff determination code. This block was charged a tariff of US$0.11/kWh until 2019 when revisions were made to reflect inflation and exchange rate dynamics. The final block, which has consumption beyond 300kWh is charged a tariff of US$0.15/kWh.

In June 2020, Government announced a new tariff schedule with four blocks (Table 2). The new tariff schedule introduced a new block of 201-300kWh with a relatively lower tariff rate compared to the then existing tariff for consumption to that level, whilst maintaining tariff levels for the next band as before.

Table 2: The Current IBT Tariff Schedule-June 2020

Metering	Tariff Block	Charge per kWh in ZWL (US dollars*)	Quantity weighted Subsidy depth
	<50kWh	0.49 (0.0196)	15%
	51-200kWh	1.08 (0.0432)	36%
	201-300kWh	2.94 (0.1176)	8%
Conventional/Prepaid Meter	301+	4.61 (0.1844)**	-17%

**the conversion was at the official rate of 1USD to 25$ZWL*
***at the time of completion of the study, the exchange rate had moved to 1USD to 57.3$ZWL, giving a subsidy depth of 49% for the block.*

The new IBT schedule has some important implications for poverty. Holding other things constant and assuming a cost of supply of US$0.124/kWh, this tariff schedule implies a quantity weighted cumulative subsidy depth for the four consumption blocks of 42%[12] below the cost of supply which compares with 44% of the three consumption blocks applied in 2017. The third block of the new tariff schedule, however, has a subsidy redistributive effect, allowing the ZESA to charge above efficient cost reflective tariff[13] .

Notwithstanding the negative subsidy benefit on the fourth block, which is a result of the fixed exchange rate at the point of this analysis, the subsidy benefit on new tariff schedule remains similar to the old schedule, which is biased toward increased consumption. This significantly increases affordability and access to electricity by the higher consumers of power, often the non-poor. It also implies that the subsidy is significantly reducing the burden of electricity expenditure among the non-poor, as compared to the poor. In addition, the new tariff schedule lacks an effective threshold beyond subsidized consumption level.

[12] This figure jumped to 131% immediately upon movement of exchange rate from 1USD to 25ZWL to 57.3ZWL

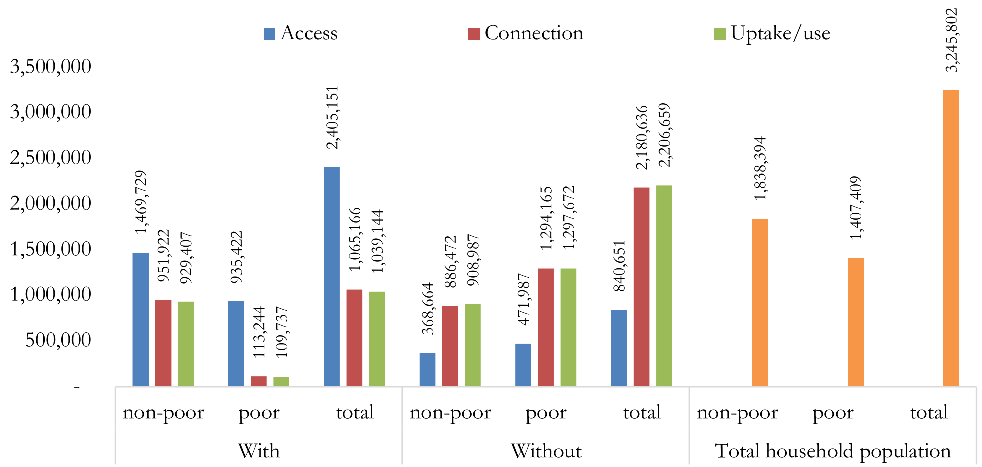
[13] This negative subsidy depth is only available for a given/fixed exchange rate between USD and ZWL. If the exchange rate moves, the implied subsidy also changes and the net effect is dependent on whether tariffs responds to movement in the exchange rate.

Thus, even if households increases consumption, say to beyond 1000kWh, they will still receive a subsidy for the subsided portion, with no tariff penalties for over consumption regardless of whether or not such consumption is inefficient for a household. As a result, the current IBT subsidy model does not discourages inefficient consumption. Ideally, there should be a threshold beyond which the price overshoots the cost of supply of electricity. That thresholds should exempt most of the poor and ensure that the non-poor who can afford are subsidising the poor.

PART II: PICES DATA: ELECTRICITY ACCESS, UPTAKE, AND CONSUMPTION

The study used data from the 2017 PICES that had a total of 31,192 households of which a sample size of 30,155 remained for the analysis after data cleaning[14]. However, for purposes of analysis the study used sample weights to re-scale data to reflect the national proportions (See Annex 4 for sample data based statistics and analysis). The rebased lower-bound poverty line for 2017 applied on the sample established that about 43% (1,407,409)[15] of the households were considered poor (Figure 5). The summarised statistics for electricity access, connection and uptake in Zimbabwe, using lower bound poverty line are as shown in Figure 5 (See Annex 4 for statistics using extreme –food- poverty line).

Figure 6: Electricity access, connection and uptake, 2017



Source: Authors' construction from Zimstat 2017 PICES data

[14] 1037 households were dropped for missing values on total expenditure, making it difficult to classify them as either poor or non-poor, while some household had missing values on household size.
[15] The poverty level is based on household poverty which might not compare with the rebased lover bound poverty headcount rates for 2017 of 54% contained in the Zimbabwe Poverty Report 2019.

Access to electricity through the national grid is moderate among the households, with 74% of the households indicating that they have access to the grid.[16] However, household connections to the grid are very low at 33%. Among the poor, the uptake rate of connections given access is 8% while it is relatively higher for the non-poor at 52%. Thus, there is a huge gap between access and connections to the grid, indicating some challenges among households in getting connected. The connection fees are currently pegged at US$100 equivalence of the local currency. This is almost twice the average monthly income (US$50.30) of the poor households with access but no connection to the grid (Table 6). In addition to the costly connection fees, the households have to purchase their own materials in order to get connected, making it very expensive and out of reach for the poor households to get connected to the grid.

On the other hand, uptake or use of electricity among those with connections is relatively high (97% for the poor and 98% for the non-poor), suggesting that once a household is connected it has a higher propensity to consume electricity. Thus, uptake or use of electricity increases once households are connected to the grid. Only about 3% of the poor household do not use electricity despite being connected to the grid, which could be due to non-affordability or availability of other alternatives.

The statistics show that 34% (471,987) of the households are poor and have no access while 58% (822,178) are poor, have access but are not connected. Implicitly, these poor households do not consume electricity from the grid and therefore they are automatically excluded from the consumption subsidy. The proportion of the poor households not using electricity from the national grid (92%) is relatively higher than that of the total population (68%), thus making the subsidy regressive.

Disaggregated electricity consumption by location and poverty status

Urban access to the national electricity grid is lowest in the Mashonaland Central Province (5%), where both the non-poor and the poor have the lowest access levels relative to the other Provinces (Table 3). The Bulawayo Province has the highest urban access (96%). Rural access is lowest in Harare Province and both the non-poor and the poor have the least access compared to the other Provinces. However, rural access to the national grid is highest in Mashonaland Central.

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[16] Households that live in the neighbourhood of the national grid are considered to have access in addition to those who already use electricity from the grid. Those households who indicated that they live far away from the national grid as a reason of not having a connection were considered as not having access; a few households who could not give a specific reason for not having a connection were also regarded as not having access. In some studies, e.g. Angel-Urdinola and Wodon (2005), households are considered to have access if they stay in an enumeration area where other households have a connection, although this may overestimate access when the enumeration areas are large. The huge variation between access level and connections could be indicative of the definition of access which is seemingly broad and over inclusive.

Table 3: Access - households with access as a % of total households in the province

	Urban			Rural			H/H in the province
	Non-Poor	Poor	Total	Non-Poor	Poor	Total	
Bulawayo	90.6	5.2	95.8	-	-	-	183,465
Harare	73.2	8.8	82.0	-	-	-	499,777
Manicaland	13.2	3.0	16.1	21.2	36.6	57.8	457,294
Mashonaland Central	4.3	0.4	4.7	17.4	45.7	63.2	300,309
Mashonaland East	13.4	2.3	15.8	25.3	29.3	54.6	375,569
Mashonaland West	20.0	2.5	22.6	19.8	33.9	53.8	357,054
Masvingo	11.3	0.8	12.1	28.5	28.2	56.7	390,484
Matabeleland North	8.9	1.5	10.5	21.6	27.9	49.6	161,019
Matabeleland South	11.2	1.2	12.4	27.6	27.9	55.5	164,515
Midlands	26.2	3.4	29.7	17.4	24.9	42.3	356,316
Grand Total	**27.7**	**3.3**	**30.9**	**17.6**	**25.6**	**43.2**	**3,245,802**

Source: Authors' calculations from PICES 2017 data set from Zimstat

As with access, urban connection to the national electricity grid is lowest in Mashonaland Central (4%) and highest in Bulawayo Province (93%), while rural connectivity is lowest in Harare (1%) and highest in Mashonaland West (Table 4).

Table 4: Households with connection as a % of household population by province

	Urban			Rural			H/H in the province
	non-poor	poor	total	non-poor	poor	total	
Bulawayo	88.81	4.51	93.32	-	-	-	183,465
Harare	66.82	5.28	72.10	0.24	0.37	0.61	499,777
Manicaland	11.39	1.74	13.13	5.05	1.46	6.51	457,294
Mashonaland Central	3.78	0.24	4.02	3.38	3.15	6.53	300,309
Mashonaland East	11.73	1.27	13.00	5.57	1.54	7.11	375,569
Mashonaland West	18.55	1.97	20.51	5.92	4.12	10.03	357,054
Masvingo	10.47	0.45	10.92	5.58	0.49	6.07	390,484
Matabeleland North	8.23	1.24	9.47	3.65	0.82	4.47	161,019
Matabeleland South	9.42	0.63	10.05	5.27	0.93	6.20	164,515
Midlands	24.06	2.18	26.25	3.69	0.65	4.35	356,316
Grand Total	**25.45**	**2.09**	**27.53**	**3.88**	**1.40**	**5.28**	**3,245,802**

Source: Authors' calculations from PICES 2017 data set from Zimstat

Again as is the case with access and connectivity, to the national electricity grid, the uptake or usage of electricity in urban areas is lowest in the Mashonaland Central Province and highest in the Bulawayo Province (Table 5). On the other hand, uptake in rural areas in lowest in Harare and highest in Mashonaland West. Generally, uptake is lower for the poor (2% in urban areas and 1% in rural areas) relative to the non-poor for all the Provinces.

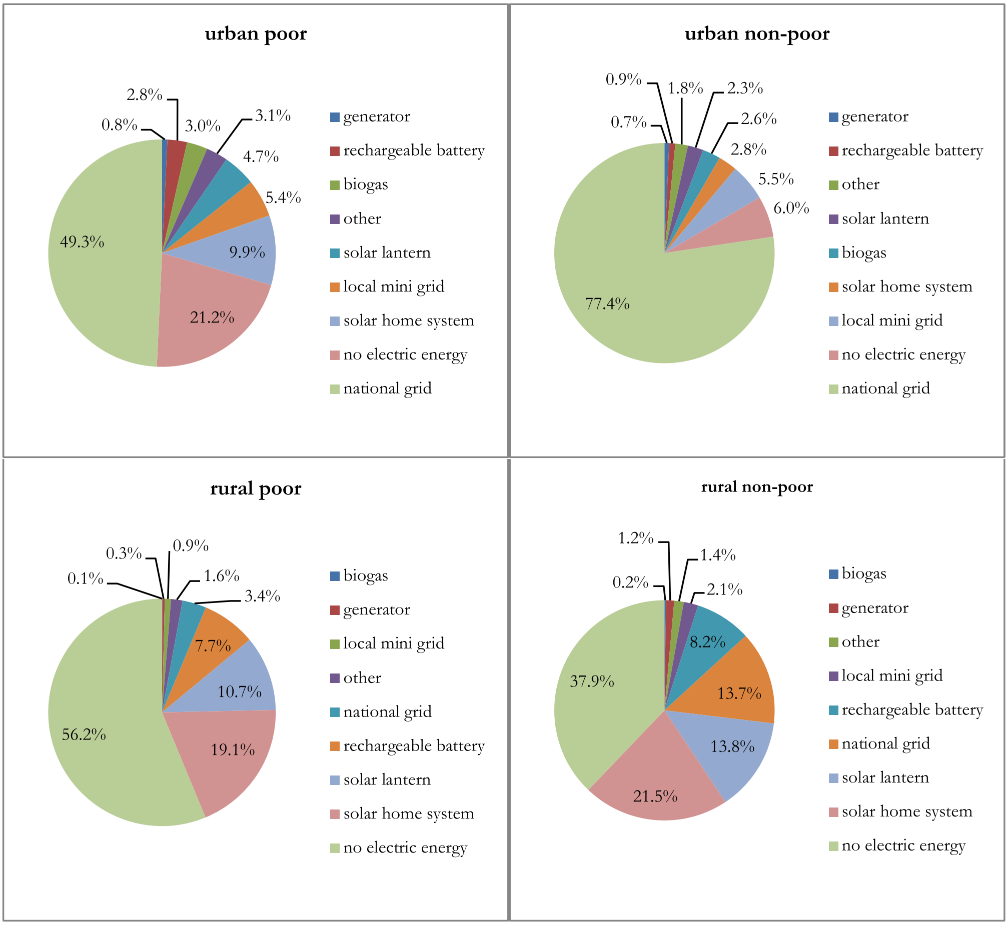
Table 5: Households with uptake as a % of household population by province

	Urban			Rural			H/H in the province
	non-poor	poor	total	non-poor	poor	total	
Bulawayo	87.80	4.39	92.20	-	-	-	183,465
Harare	64.80	5.28	70.08	-	-	-	499,777
Manicaland	11.30	1.74	13.04	5.00	1.33	6.33	457,294
Mashonaland Central	3.73	0.24	3.97	3.22	2.83	6.06	300,309
Mashonaland East	11.49	1.24	12.74	5.18	1.31	6.49	375,569
Mashonaland West	18.44	1.97	20.40	5.64	4.05	9.69	357,054
Masvingo	10.39	0.45	10.84	5.00	0.49	5.49	390,484
Matabeleland North	8.03	1.21	9.24	3.47	0.75	4.22	161,019
Matabeleland South	8.89	0.59	9.48	4.99	0.91	5.90	164,515
Midlands	23.75	2.18	25.93	3.69	0.58	4.27	356,316
Grand Total	**24.94**	**2.07**	**27.01**	**3.69**	**1.31**	**5.00**	**3,245,802**

Source: Authors' calculations from PICES 2017 data set from Zimstat

The distribution of sources of energy used differs by location and poverty status (Figure 6). In urban areas the predominant energy source is electricity from the national grid which is mostly skewed in favour of the non-poor compared to the poor. However, the use of mini local grid and generators is almost similar among the urban poor and non-poor, whereas the use of solar home systems and solar lanterns is more pronounced among the urban poor. In urban areas, households without any source of electric energy are predominantly the poor households compared to the non-poor households.

Figure 7: Sources of electric energy by location and poverty status

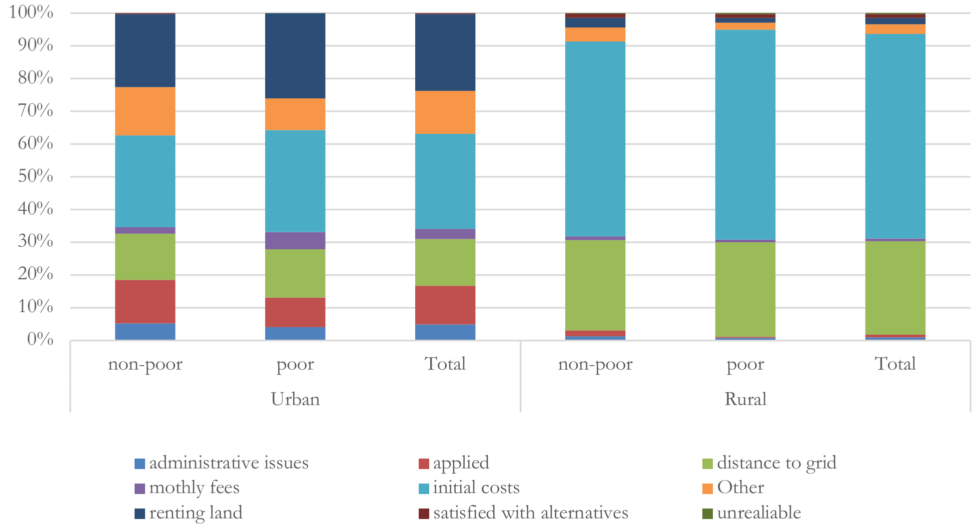


Source: Authors' calculations from PICES 2017 data set from Zimstat

On the contrary, in rural areas most households do not have any form of electric energy and the most affected are the poor (56% without electric energy against 38% non-poor). Solar home systems are the predominant source of electric energy in rural areas for both the non-poor and the poor, followed by solar lanterns. However, the use of electricity from the national grid is predominant for the non-poor in rural areas (14%) than for the poor (3%). The use of rechargeable batteries is also relatively high for the non-poor compared to the poor in rural areas.

The main reason for not having a connection to the national electricity grid differ across location and poverty status (Figure 7). In urban areas the predominant reason cited for not having a connection is the initial costs involved in getting connected, followed by renting land or property. These obstacles are even more pronounced among the poor in urban areas. In rural areas, the predominant reason for lack of connection is initial costs involved and this obstacle is even more distinct in rural than urban areas as expected due to sparsely populated households. The second main reason in rural areas is distance to the grid. While in urban areas renting land or a property was one of the major reasons for not having a connection, in rural areas this is not an issue because land is very cheap and most rural dwellers own the land.

Figure 8: Main reason for not having connection to the national grid



Source: Authors' calculations from PICES 2017 data set from Zimstat

Consumption Pricing and Subsides

Consumption subsidies potentially benefit directly those who consume the subsidized product. The PICES data shows that about 32% (i.e. 1,039,144) of the total number of households are potential beneficiaries of a consumption subsidy. **Among those households that are potential beneficiaries, the proportion of the poor households (11%) was lower than that of non-poor household (89%)**. Indicatively, this makes the subsidy less progressive and less effective in reducing poverty. The skewness of access, connectivity and use of electricity towards the non-poor shows that the existing consumption-based subsidy model is potentially not pro-poor.

The study also estimated the **total quantities of electricity consumed, the average price of electricity per household and the value of the subsidies,** using the increasing block tariff schedule for 2017 (Table 6).[17]The monthly total quantity of electricity consumed was estimated at 236,395,909 kWh with the poor accounting for 7% of the total quantity consumed at an average of 149.87kWh per household. On the other hand, the non-poor accounted for 93% of the total electricity consumption and an average of 236.66 kWh per month. The average price of electricity was estimated at US$0.0950 per kWh. There has been a marginal difference between the average price that poor households purchased electricity (US$0.0806/kWh) and non-poor households (US$0.0961/kWh), showing a near flat non-differentiated subsidy system that is not pro-poor. There are some very few poor and non-poor households that consume within the lifeline consumption block of the 2017 tariff schedule with 47kWh of consumption, paying a minimum average price of US$0.02/kWh, with a total electricity monthly expenditure of less than a dollar for the actual units consumed.[18]

[17] See Annex 1 for the details about the methodology used to estimate subsidies.
[18] This could be indicative of extreme poverty, power theft, non-payment of post-paid power or complementing electricity with other alternative energy sources.

Table 6: Electricity consumption, prices and subsidies in Zimbabwe, 2017

	non-poor	poor	total
Quantity consumed (kWh) per month	219,949,334	16,446,575	236,395,909
Average quantity consumed (kWh) per month	236.66	149.87	227.49
Electricity expenditure (US$) per month	21,127,739	1,326,379	22,454,118
Average electricity expenditure (US$) per month	22.73	12.09	21.61
Average electricity price (US$/kWh)	0.0961	0.0806	0.0950
Cost recovery price (US$/kWh)*	0.124	0.124	0.124
Average unit subsidy (US$)	0.0312	0.0434	0.0321
Subsidy recipients	929,407	109,737	1,039,144
Subsidy beneficiaries	911,370	109,737	1,021,107
Subsidy (US$)	6,312,411	712,996	7,025,407
Average subsidy (US$)	6.93	6.50	6.88
Subsidy as a share of electricity expenditure (%)	29.88	53.76	31.29
Income all households (US$)	1,263,977,515	91,697,733	1,355,675,249
Average monthly income (US$) - all households	687.54	65.15	417.67
Average monthly income (US$)- households with uptake	963.42	204.56	883.29
Average monthly income (US$ - households with access but no connection)	214.38	50.30	113.71
Minimum subsidy received by beneficiaries (US$)	-80.05	0.61	-80.05
Minimum electricity consumed by households (kWh) per month	47.00	58.00	47.00
Minimum average price of electricity (us$/kwh)	0.0200	0.0324	0.0200
Minimum total expenditure on electricity (US$) per month	0.94	1.88	0.94
Maximum subsidy received by households (US$)	8.66	8.66	8.66
Maximum electricity consumed by household (kWh) per month	3713.33	611.33	3713.33
Maximum total expenditure on electricity (US$) per month	540.50	75.20	540.50
Maximum average price of electricity (US$/kWh)	0.1456	0.1230	0.1456

Source: Authors' own calculations from 2017 PICES data set, and data from the World Bank (2020)

Total value of the subsidy received by the households per month was estimated at US$7,025,407 which was unevenly distributed between the poor (10%) and non-poor (90%). This suggests that the few non-poor get a subsidy that is almost nine times larger than that of poor households, yet the poor households that are potential beneficiaries (i.e. those which use electricity) of the subsidy are no more than nine times less than the non-poor who are potential beneficiaries. This makes the IBT schedule very regressive. On average, the subsidy received per household was estimated at US$6.88. The poor household's average subsidy (US$6.50) was lower than that of non-poor household (US$6.93), suggesting that the subsidy scheme embedded in the IBT was regressive.

Average monthly total expenditure on electricity for the households that use electricity was US$21.61. The poor spent on average US$12.09 on electricity while the non-poor spent US$22.73. With average electricity subsidies of US$6.88 for all households consuming electricity, and US$6.50 for the poor and US$6.93 for the non-poor, thus on average the size of the subsidy was 32% of average electricity expenditure for all the households, while 54% and 30% of the poor and non-poor households' average electricity expenditures, respectively. This suggests a huge burden of subsidies on the government and partly the reason why Zimbabwe has the highest subsidies in Sub-Saharan Africa.

The minimum monthly subsidy received by beneficiaries was negative US$80.05, at the highest level of consumption recorded. The maximum subsidy computed is about US$8.7 for the first 300kWh consumed. In order to exhaust the subsidy, one has to consume an additional 334.6kWh, such that the total consumption that results in an effective zero subsidy benefit is 634.6kWh. Any consumption above 634.6kWh create cross subsidization and the effective benefit of subsidy to the household becomes negative. As such, the minimum subsidy (negative US$80), which implicitly is the maximum cross subsidization, is attained at very high levels of consumption. The consumption threshold level above which a consumer cross subsidizes other consumers (at 634.6 kWh using the 2017 tariff schedule) remains significantly higher compared to average domestic consumption level. This implies that non-poor households have a higher benefit incidence from the subsidy as they increase consumption beyond the reach of poor households, crowding out the poor.

The negative subsidy implies that not all the households receive a positive subsidy and therefore there were some who cross subsidised other households. Households who consume electricity above the subsidised consumption blocks, pay US$0.15/kWh which was about 21% above the cost recovery price of US$0.124, effectively making up for their own subsidised consumption (in the first two blocks of the 2017 IBT) and that of other households. The PICES data shows that there were about 18,037 households, consisting only the non-poor, who cross subsidised other households up to the tune of US$166,433 (or 2.4% of total subsidy). Such cross subsidies reduce pressure on the fiscus and electricity utilities, and also act as an instrument for income redistribution from the poor to the non-poor.

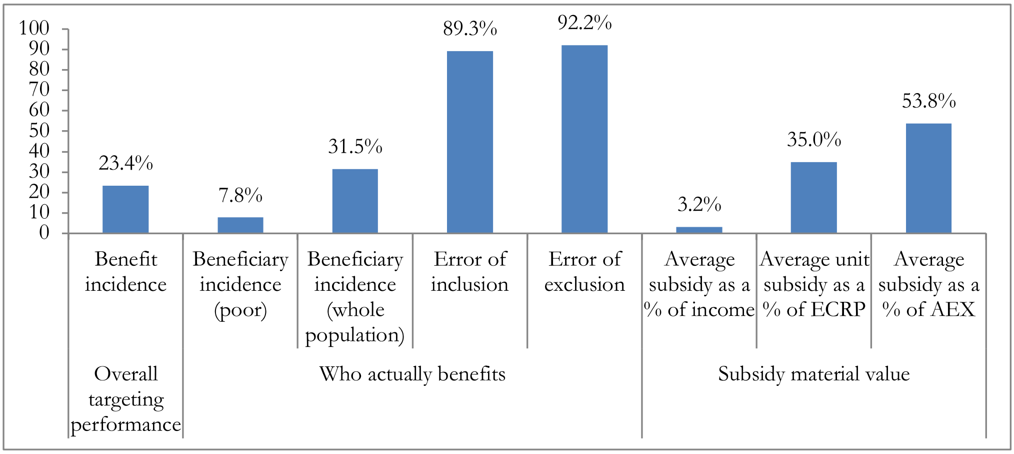
PART III: THE DISTRIBUTIONAL EFFECTS OF CURRENT ELECTRICITY SUBSIDIES

The efficacy of a subsidy in helping to alleviate poverty and reduce inequality can be assessed through investigating its targeting performance. If a subsidy is properly targeted it benefits the poor and the vulnerable who most need the subsidy than the non-poor who can afford without any assistance. In that way, the resource envelop required by the government to assist the poor is reduced, creating fiscal space to finance other poverty reducing programs. In addition, ensuring that the non-poor who can afford unsubsidized electricity do not benefit from the subsidy discourages inefficient use/consumption by the non-poor which could arise if they are also included in the subsidy.

The targeting performance of the electricity subsidy is evaluated by considering three dimensions of performance suggested by Komivies et al (2005). These dimensions are: (i) benefit incidence, (ii) beneficiary incidence and (iii) subsidy material value (or subsidy depth). The benefit incidence informs how well the subsidy instrument targets the poor vis-à-vis the other households (i.e. pro-poorness of the subsidy). It is the average share of subsidy benefits received by the poor divided by the average share of subsidy benefits accruing to the entire population of households. Alternatively, it is the share of the subsidy benefit to the poor divided by the share of the poor in the total population. A value of 1 means the subsidy is neutral because it delivers a subsidy benefit to the poor that is equal to the share of the poor in the population. A value greater than 1 means the subsidy is progressive (benefits the poor more than the non-poor); and a value of zero means none of the poor benefits from the subsidy. The beneficiary incidence shows the extent of subsidy miss-targeting, measured by the error of exclusion (i.e. the proportion of the poor who do not receive a subsidy) or errors of inclusion (i.e. the proportion of non-poor household who benefit from the subsidies. The material value of the subsidy shows the significance of the value of the subsidy received by the poor, thus informing about the generosity and impact of the subsidy on the poor. It is measured by the average value of the subsidy received by poor households as a percentage of their average income.

Benefit Incidence: The targeting performance of the subsidy scheme embedded in the 2017 IBT schedule depicted by a benefit incidence indicator of 23%, implies that the electricity subsidy in Zimbabwe is regressive (Figure 8). This means that the poor households are getting only 23% of what they would have received under a universal targeting program that distributes subsidies equally across all households. Implicitly, the poor households are receiving a share of the subsidy that is lower than the share of the poor households in the population. Thus, the findings suggest that a universal targeting approach that distributes electricity subsidies equally across all households would have been better than the self-targeting mechanism that is used by the IBT scheme.

Figure 9: Indicators of subsidy performance for the 2017 IBT schedule



Source: Authors' own calculations from 2017 PICES data set
Notes: ECRP=efficient cost recovery price of electricity per kWh. AEX=average expenditure on electricity

The challenge with the IBT schedule is that its targeting performance is predicated on the assumption that electricity consumption is a good indicator of household level of income. Therefore, it assumes that poor households consume less electricity and get deeper discounts through the lifeline block and other subsidized lower consumption blocks. On the other hand, the non-poor are assumed to consume more and therefore pay at least the cost recovery price for a greater part of their consumption. However, in Zimbabwe electricity consumption and income have a relatively lower correlation coefficient of 0.44.[19]

Also, the targeting in the IBT scheme is not purposive in the sense that everyone who consumes electricity receives a subsidy for part of their consumption (i.e. lifeline block consumption). By subsidizing up to 300 kWh, the IBT subsidy scheme is too generous and perpetuates high errors of inclusion, whereby rich people benefit from the subsidy, and limits cross subsidization among the households, thus potentially reducing the pro-poorness of the subsidy. In addition, subsidizing a large part of consumption limits the scope for self-sufficiency of the subsidy model which ensures that the non-poor households cross

[19] The Pearson's correlation coefficient was used to determine the correlation between household weighted income and expenditure on electricity. Household total expenditure was used as a proxy for household income. There are several reasons why the correlation value is low in Zimbabwe and these include the following. The data used relates to the period when load shedding was high, hence consumption was constrained by supply and therefore it did not matter how much income one has. The use of alternative sources of energy such as gas and solar especially given the unreliable electricity supply also potentially weaken the correlation between electricity consumption and income.

subsidize the poor household without needing the government to make subsidies. In Costa Rica and Nicaragua the IBT systems are almost self-sufficient (Ore et al, 2017).

The IBT scheme does not explicitly differentiate between the poor and non-poor, and with most of the consumption subsidized (78% of the kWh consumed pay less than cost recovery price), the cumulative benefits of subsides increase with consumption, disproportionately benefiting the non-poor whose consumption is high[20]. The share of subsidised kWh for the poor was only 8% of the total number of subsidised kWh. This was by far less than the 92% share of subsidised kWh for the non-poor. Further to that, the target performance based on consumption level assumed in the IBT schedule does not factor low usage by the non-poor due to limited supply/availability of electricity and use of alternative sources of energy by the non-poor. Given supply side constraints in Zimbabwe, consumption of electricity could also be limited by supply of electricity. The non-poor are able to afford alternative sources of energy while consuming within subsidized range when tariffs go up. The poor would exhaust their income on alternative sources in the absence of electricity and are, therefore, crowded out by the non-poor who have resources to afford electricity and alternative sources.

Beneficiary incidence: The beneficiary incidence indicates who benefits from the subsidy and is calculated as the share of households that benefit from the subsidy. In other words, the beneficiary incidence captures the probability that a household would benefit from the electricity subsidy. The beneficiary incidence is estimated at 8% for the poor and 32% for the whole population. It means the chance or probability that the poor will benefit from the consumption subsidy delivered through the 2017 IBT scheme is 8%. The indicator is very low for the poor, and skewed towards the non-poor. The low beneficiary incidence is explained by the high number of poor households who are not consuming electricity because they either do not have access or they have access but not connected or they have access, are connected but did not consume electricity for other reasons.

Error of exclusion and inclusion: As the case with beneficiary incidence, the error of exclusion and inclusion shows who actually benefits from the electricity subsidies. The error of exclusion in the subsidy scheme is very high at 92%. Thus, the subsidy is to a greater extent not helping much reduce poverty since the bulk of the poor are not included by the current subsidy scheme. This is mainly attributed to household access-to-electricity factors explained by the decomposition of subsidy targeting performance into access and design features of the subsidy (see the next section).

The error of inclusion shows the extent to which the subsidy regime benefits the non-poor. It is the share of the non-poor households that benefit from the subsidy. It is estimated at

[20] The new tariff schedule, with four blocks attempted to address the perpetual subsidy for all consumption levels by having a tariff that was above cost of supply tariff at the time (assuming the then exchange rate of USD1:ZWL$25).

The tariff immediately went below cost of supply (to the moment the RBZ introduced a auction system on foreign exchange with rates

89%, suggesting that almost nine in ten non-poor households benefit from the subsidy. If subsidies are given to the non-poor who could actually afford non-subsidized electricity, it means that the subsidy could actually encourage inefficient consumption of electricity among the subsidized non-poor, resulting in the crowding out of the poor. A high error of inclusion implies that the subsidy is increasing inequality among households instead of reducing it. In this case, the 8% of the poor are included in the subsidy against 89% of the non-poor, hence explaining the low targeting performance and regressive nature of the subsidy scheme.

The error of inclusion is exacerbated by lower rates of electrification in Zimbabwe which is skewed against rural areas (National Renewable Energy Policy, 2020), and therefore majority of the population, mostly rural poor populace, is without access to electricity and thus automatically excluded from subsidy benefit.

High exclusion is more likely to increase inequality among households as benefits of electricity subsides are not accruing to the poor. Access to electricity subsidies enhances quality of life and enables generation of income through other subsistence productive activities. High errors of inclusion also suggest that the government has scope to create fiscal space by reducing the subsidies for the non-poor and redeploy the resulting savings into poverty reducing expenditures. Given the monthly subsidy of US$6,312,411 to the non-poor, the government would save up to US$67,838,367 by reducing the errors of inclusion.

This amount was equivalent to 18% of the 2017 national budget allocation for the Ministry of Health and Child Care, 8% of the allocation to the Ministry of Primary and Secondary Education, 25% of the allocation to the Ministry of Higher and Tertiary Education, and 9% of the total sales revenue for ZETDC. For ZETDC the savings from reducing errors of inclusion could be used to expand the grid to increase accessibility to the poor, or enhance efficiency of the electricity utilities, and reduce the cost recovery price and hence burden of subsidies whilst increasing affordability.

Subsidy material value: The materiality of the subsidy was estimated at 3% of the average poor household's total income[21]. However, with this measure of materiality of the subsidy it is difficult to assess, without additional information, the significance the subsidy. Ore et al (2017) used the amount of subsidy per unit of electricity consumed to indicate the depth of the subsidy. This is the price gap between the efficient cost recovery price of electricity per kWh and the average price of electricity per kWh paid by the poor who benefited from the subsidy. The greater the price gap, the greater the depth of the subsidy and the extent to which the subsidy enhances affordability for the poor. It also shows the extent to which the subsidy creates savings on electricity expenditure for the poor, which savings can be used to increase expenditure on other items. The unit subsidy can be expressed as a percentage

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[21] The material value of the subsidy as a percentage of income is calculated using the formula [RP/T*QP/T*C]/YP/T where the variables are as defined in Table 7.

of the efficient cost recovery price of electricity (ECRP). The study estimated the unit subsidy for the poor at US$0.0434 per unit of electricity consumed or 35% of the efficient cost recovery price. Thus, the subsidy was generous as the poor households saved more than a third of their expenditure per unit of electricity they consumed.

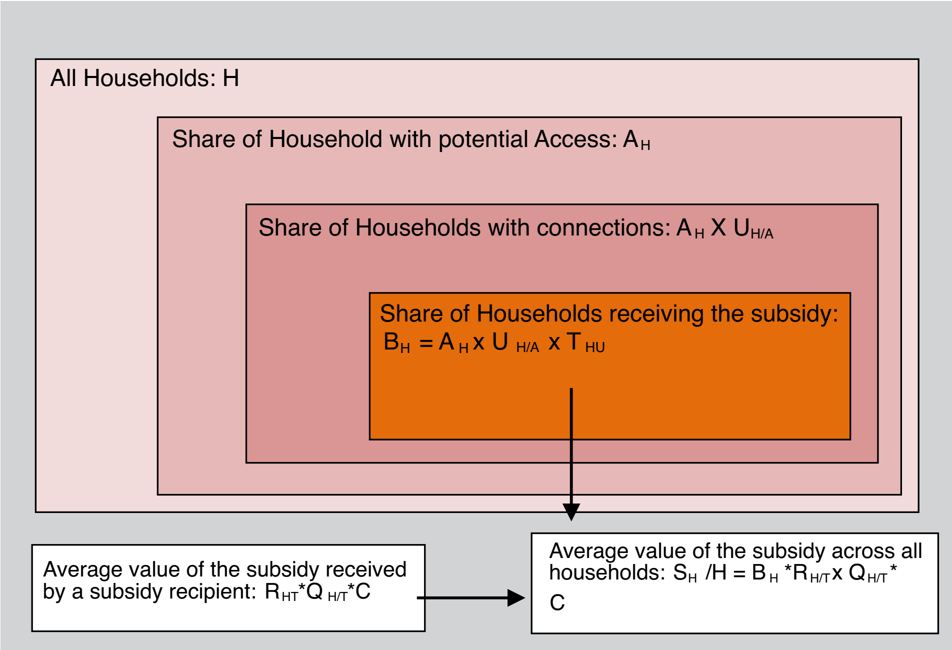
The depth of the subsidy can also be captured by the average subsidy for the poor expressed as a percentage of the poor households' average electricity expenditure (AEX). This shows how much of the poor households' expenditure on electricity is reduced as a result of the subsidy. This indicator is estimated at 54%, showing that the subsidy is very generous as the average expenditure on electricity for the poor is reduced by more than half of what they would have paid without a subsidy.

These indicators show that for the poor who are using electricity, the current subsidy is significant and enhances affordability while creating savings that can be used on other expenditures. However, the challenge is that low access and high errors of exclusion by the poor, reduces the total subsidy benefits they enjoy, resulting in more benefits accruing to the non-poor. Thus, the low benefit incidence of the subsidy, coupled with its generosity, creates scope for significantly reducing subsidies without significantly affecting the poor.

Decomposition of electricity subsidy performance

In order to inform policy reforms, there is need to go beyond merely indicating how the subsidy performed in targeting the poor, to analysing the rationale for or drivers of performance of the subsidy. The three dimensions of subsidy targeting performance described above do not show the drivers of the performance of the subsidy. They only indicate how the subsidy performed in targeting the poor but do not indicate justification for performance of the subsidy. Therefore, **the present study follows the approach by Angel-Urdinola and Wodon (2005) to decompose the benefit incidence into access and subsidy design factors that influence the overall performance of the subsidy. The framework for decomposition of the subsidy performance is shown in Figure 9.**

Figure 10: Framework for decomposing subsidy performance.



Source: Komivies et al (2005)

Decomposition of electricity subsidies assist policy makers identify potential specific areas of reform in the short- and long-term to enhance the impact of the subsidy on poverty reduction. The approach decomposes benefit incidence into five factors: (i) access to the grid (i.e. the grid is within proximity of connection of the household), (ii) uptake or rate of connections to the grid by households that have access to the grid, (iii) targeting mechanism, (iv) rate of subsidization, and (v) quantity consumed. Factors (i) and (ii) are access factor while factors (iii) to (v) are subsidy design factors. Mathematically, the benefit incidence is decomposed as follows:

$$\Omega = \frac{\frac{S_P}{P}}{\frac{S_H}{H}} = \frac{A_P}{A_H} * \frac{U_{P/A}}{U_{H/A}} * \frac{T_{P/U}}{T_{H/U}} * \frac{R_{P/T}}{R_{H/T}} * \frac{Q_{P/T}}{Q_{H/T}}$$

where the variables[22] and their description and values are as given in Table 7. The benefit incidence (Ω) is as calculated and described in the preceding subsection. Its components are the main focus of this section. All the values of the components of the benefit incidence were computed from the household survey data except for the average efficient cost-recovery price which was obtained from the Cost of Supply Study which was conducted for the Zimbabwe Energy Regulatory Authority.

A and U are access factors which determine the households with potential to benefit from subsidies. Households without potential access (A) and with access but without connection or usage (U) have no potential to get a subsidy. On the other hand, the households with access and connection or usage have potential to get a subsidy depending on the targeting mechanism (T) used to discriminate who gets or does not get a subsidy. In the case of IBT used in Zimbabwe, every household that consumes electricity is subsidized and therefore the targeting mechanism indicator takes a value of 1 because everyone with access, connection and usage will get a subsidy. The rate of subsidization on the other hand determines the size of the subsidy that the subsidy beneficiary gets[23]. The rate of subsidization is influenced by the average expenditure on electricity (E) and the average cost of electricity (Q and C); the higher it is for the poor, the more progressive the subsidy regime becomes. Apart from influencing the rate of subsidization, quantity consumed (Q) also influences benefit incidence in its own right. If the poor consume relatively less than the non-poor in a subsidy mechanism which does not discriminate against the non-poor, then the subsidy tends to be regressive.

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[22] Where $\frac{A_P}{A_H}$ is the ratio of the share of poor households that have potential access to electricity to the share of all households with potential access to electricity; $\frac{U_{P/A}}{U_{H/A}}$ is the ratio of the uptake rate among the poor to the uptake rate among all the household (i.e. the ratio of the shares of poor to all households that actually use electricity because the decide to connect to the grid); $\frac{A_P}{A_H} * \frac{U_{P/A}}{U_{H/A}}$ is the ratio of the actual connection rate among the poor to the actual connection rate among all households (i.e. the ratio of the share of poor households that are connected and use electricity to the share of all households that are connected and use electricity); T_(P/U)/T_(H/U) is the ratio of the share of poor households with access and connection who are targeted and actually receive a subsidy to the share of all households with access and connection who are targeted and actually receive a subsidy; $\frac{R_{P/T}}{R_{H/T}}$ is the ratio of the average rate of subsidization for the poor to the average rate of subsidization of all households ; and $\frac{Q_{P/T}}{Q_{H/T}}$ is the ratio of average quantity of electricity consumed by the poor subsidy recipients to the average quantity of electricity consumed by all households who are subsidy recipients.

[23] RH/T = 1-EH/T/(QH/T*C) where C is the average total cost of service a consumer, EH/T is the average expenditure on the utility, in this case electricity and QH/T is the average quantity of electricity consumed by the subsidy recipient.

Table 7: Description and values of the components of the benefit incidence indicator

SYMBOL	DESCRIPTION	VALUE
Ω	Benefit incidence	0.234
SH/H	Average subsidy benefit in the entire population	2.164
SP/P	Average subsidy benefit among the poor (US$)	0.507
C	Average cost-recovery price of electricity (US$)	0.12
BH	Probability of receiving a subsidy in the whole population (i.e. beneficiary incidence)	0.31
BP	Probability of receiving a subsidy among the poor (i.e. beneficiary incidence)	0.08
AH	Share of households with access in total household population	0.74
AP	Share of the poor households with access in total poor households	0.66
UH/A	Share of households using/up-taking electricity among those with access	0.43
UP/A	Share of poor households using electricity among the poor with access	0.12
TH/U	Share of households subsidized among those with access, connection and targeted	0.98
TP/U	Share of poor subsidized among the poor with access, connection and targeted	1.00
RP/T	Rate of subsidization for the subsidized poor	0.35
RH/T	Rate of subsidization for the subsidized population	0.26
QP/T	Average quantity of electricity consumed by the poor	149.87
QH/T	Average quantity of electricity consumed by the households using electricity	214.03
EH/T	Average expenditure on electricity in the population using electricity	19.66
EP/T	Average expenditure on electricity among the poor	12.09
AH * UH/A	Actual connection rate to the electricity grid for all households	0.32
AP * UP/A	Actual connection rate to the electricity grid for the poor	0.08

Source: Authors' computations from the PICES household survey data sets, 2017

Using the values in Table 7 the determinants of subsidy targeting performance were computed with comparative analysis between the poor and total households (Table 8). The poor have a lower share in most determinants of subsidy performance, indicative of poor performance of subsidies towards poverty alleviation among the poor. For example, the poor have a lower expenditure rate, quantity consumed, share of access, connections and receipt of subsidy compared to the entire population. The rate of subsidisation, among the poor with access, however, remains higher than the average for the country. This is partly because the poor consume relatively less electricity and therefore enjoy the deeper discounts at lower levels of consumption. As consumption increases, the subsidy depth reduces, resulting in lower rate of subsidisation associated with the non-poor who consume relatively more.

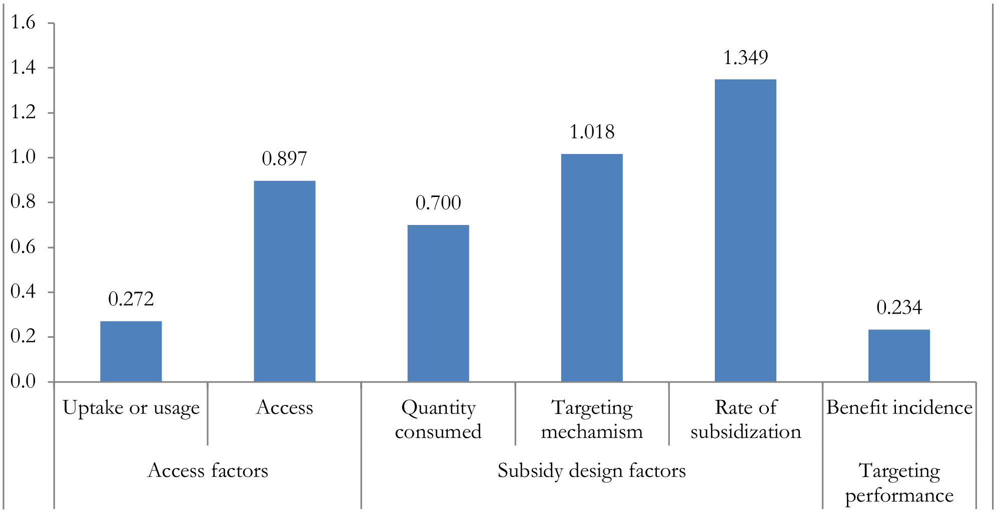
Table 8: Decomposition of Determinants of Subsidy Performance

	share of households with access (A)	share of households with uptake or usage (U)	share of households subsidized (T)	rate of subsidization (R)	average quantity consumed kWh/month (Q)
poor households	0.66	0.12	1.00	0.35	149.87
all households	0.74	0.43	0.98	0.26	214.03
ratio (poor to all)	0.90	0.27	1.02	1.35	0.70

Source: Authors' calculations from PICES 2017 data sets based on framework by Angel-Urdinola and Wodon 2005a.

The relative comparative ratios between the share of the poor and all households then gives decomposition of drivers of subsidy targeting performance (Figure 10). The key driver for poor targeting performance revealed by the benefit incidence indicator of 23%, computed from the given data, is low uptake or usage of electricity.

Figure 11: Determinants/drivers of subsidy targeting performance



Source: Authors' calculations from PICES 2017 data sets

While access for the poor households is almost at par with that of all households, their uptake rate of electricity is relatively lower compared to that of the non-poor. This suggests that the gap between access and usage of electricity is mainly underpinned by low actual connections to the grid among the poor[24]. As noted in Table 5, the access rate for the poor (66%) is relatively closer to that of all the households (74%). However, the usage rate is very low for the poor at 12% compared to 43% for all the households[25] for those with access. Thus, the actual connection rate to the grid for the poor is very low at 8% (i.e. A*U=66%*12%) compared to 24% for all the households with access. As a result, the targeting performance of the subsidy is very low (about 23%) mainly because of lower usage of electricity which is mainly driven by lower rate of connections among the poor. This implies that in order to improve the subsidy targeting performance to the advantage of the poor, priority has to be given in addressing connections to the grid by the poor. A significant share of the poor has access but not connected (58%) hence it is automatically excluded from the electricity consumption subsidy, making the subsidy very regressive. By simply helping the poor households to connect, the targeting performance of the consumption subsidy will improve. Thus, intervention measures by government should be towards facilitating connections to

[24] It might also be indicative of the broadness of the definition of access used in the survey, which seem to be highly inclusive, accommodating households who are in the vicinity of the national grid as mentioned in Part II.

[25] These ratios might have been affected by the broader definition of access.

the grid by the poor households while reviewing the consumption subsidy to optimize the benefits to the poor.

The second factor that is mainly driving the poor targeting performance of the subsidy is quantity of electricity consumed. Consumption subsidies benefit those who consume the subsidized product. Without consumption there will be no benefit. Thus, all the households without access or connection or usage of electricity are excluded from the subsidy benefit. The proportion among poor households without either access, or connection, or usage is very high at 92% which means a significant proportion of the poor households are automatically excluded from the subsidy benefit. Thus, in such cases of higher exclusion of the poor due to lack of access, connection and usage, a consumption subsidy is not a good policy instrument of trying to help the poor.

With consumption subsidies, the higher the level of consumption the more the subsidy amount accrues to the benefit of the consumer (i.e. if there are no thresholds for the amount subsidized and no over-pricing of the product for additional units consumed). In the case of the 2017 IBT schedule most of the electricity consumed (up to 300 kWh) was subsidized and therefore more total cumulative subsidy benefits accrue for higher consumption up to the 300 kWh threshold. On average the non-poor consume relatively more than the poor and this could partially be explained by relatively lower burden of electricity expenditure among the non-poor compared to the poor.

Although the rate of subsidization is progressive, there is more room for improvement. The analyses of the IBT schedule across different tariff blocks support this finding in that the schedule subsidizes the non-poor at the same rate as poor households at lower levels of consumption. As consumption increases to the mid-tier block, consumption is still subsidized despite possibility that a relatively lower share of the poor might not be consuming in the block. However, additional consumption above 300 kWh is priced more than the cost recovery price. This discourages potentially excessive inefficient consumption of electricity, promotes self-financing in the subsidy scheme, reduces the burden of subsidy on the government and promotes income redistribution between the poor and non-poor. The PICES Data shows that some households consume in excess of 3700 kWh, a level which is beyond expected household consumption. Thus, charging a tariff which is at least cost reflective discourages such potentially inefficient consumption (for example commercial use of electric power meant for domestic). Geographical targeting of subsidies should also be considered.

Access to the grid, at a rate of 66%, among the poor against 74% of the entire population leading to an access ratio of 0.9, on paper fairly contributes in improvement of targeting performance of the subsidy. However, with access alone and without connection the poor neither uptake nor use the electricity from the grid and, therefore, the errors of exclusion from the consumption subsidy are magnified. Thus, with limited connection despite high access to the grid by the poor, the consumption subsidies will tend to be regressive.

Attention has to be paid to supply-side interventions that increase connection to the grid among the poor.

The results of the decomposition of the benefit incidence indicator generally show that the main factor undermining the performance of the subsidy targeting is low rate of electricity usage among the poor households relative to the total population, leading to higher rates of exclusion. A relatively large share of the poor with access need to be assisted in connecting to the grid in order to enhance targeting performance of the consumption subsidy. Thus, improving the rate of connections among the poor may increase the pro-poorness of the subsidy. This implies that the government may need to explore connection subsidies instead of consumption subsidies or even exploring a combination of both subsidies. Currently, the government is not subsidizing connections to the grid.

The results also show that subsidizing consumption is not a good priority when connection and usage rates of electricity by the poor are relatively lower, as this makes the subsidy regressive and less beneficial to the poor. However, since quantity consumed is the second main factor influencing the targeting performance, consumption among the poor needs to be encouraged through improving the subsidy design scheme. For instance, higher and potentially inefficient consumption may be penalized by paying above cost recovery price. The rate of subsidization and targeting mechanism have room for improvement, but they are relatively not the main drivers of poor subsidy targeting performance. The targeting mechanism embedded in the IBT scheme does not discriminate between the poor and non-poor and therefore tends to be neutral on its influence on the targeting performance. Purposive targeting needs to be considered to improve the pro-poorness of the subsidy. The subsidy needs to be given to the poor households only or to ensure that the non-poor are subsidized to a very lesser extent.

Weaknesses/Gaps in the existing Electricity Subsidy Model

The above discussion of research findings reveal that the current subsidy scheme is not pro-poor, implying it has high level of exclusion of the poor and low target performance, mainly due to low uptake due to low connection rates and quantity consumed by poor households against the entire population. There are several observable gaps in the existing model that explains this outcome, which could be the points of focus on the subsidy reform programme:

- The existing power subsidy model is not targeted, instead the model uses amount of electricity consumed as an indicator of rich/poor households resulting in what Ore, (2017) termed a higher level of errors of inclusion or exclusion[26]. Under such a model,

[26] For instance, consumption may be low for the rich, leading to errors of inclusion whereby the rich get the subsidy; or consumption may be high for low income households leading to errors of exclusion whereby the poor are excluded from getting the subsidy. An example of the case where the rich consume relatively less electricity than the poor is when they acquire latest gadgets that are energy efficient while the poor are stuck with obsolete inefficient gadgets which consume more electricity.

the subsidy benefit increases with consumption level, wherein those who consume more electricity are expected to enjoy higher level of subsidy than those who consume less. The current model, therefore, does not allow for redistribution of income. The subsidy covers all levels of consumption and there is no threshold beyond which penalties for higher and potentially inefficient consumption. Evidently, high net-worth people are accessing electricity at the same rate as low income people, but are not panelized for higher consumption.

- In other words, the country is using a passive targeting mechanism. The passive targeting of subsidies through quantity consumed (e.g. as in IBT) barely improves the targeting performance of subsidies. Instead, active targeting is more accurate and reduces errors of inclusion, hence leading to higher targeting performance of subsidies. However, it may be considerably difficult to identify and deliver subsidies to people who qualify for it. Active targeting of subsidies requires administrative selection of the beneficiaries (Komives et al, 2005). However, such a targeting system for subsidies may be very costly to design and take many years to build and many more to refine, and once in operation their administrative costs may be very high (Scott and Pickard, 2018). Personal attributes (e.g. student, pensioners, veterans, refugees, etc.), geographic indicators (e.g. poor neighbourhoods, rural areas, high density areas, etc.) and proxy means test variables (e.g. electricity consumption below a threshold, quality of electricity connection, income threshold, electricity expenditure above a burden limit expressed as a percentage of total expenditure, etc.) may be used to administratively identify potential beneficiaries of the subsidy (Scott and Pickard, 2018).

- Despite the difficulties in active targeting of subsidies, the increase in digital solutions has increased the number of means tested (or administrative) targeting mechanisms in use recently (Scott and Pickard, 2018). Active targeting would be relatively cheaper to implement if the social assistance program is very strong, with wide coverage. Then, active targeting would ride on the social assistance database of beneficiaries to identify and deliver the subsidy. In Zimbabwe, already the water utility – Zimbabwe National Water Authority (ZINWA) and municipal authorities– uses active targeting for its subsidies. Specifically, geographic targeting is being used by ZINWA in determining water tariffs, whereby subsidized tariffs are disbursed to neighbourhoods where the poor reside. The framework for geography-based power subsides may ride on the experience and infrastructure to embark on active targeting of electricity subsidies.

- Related to that, the current subsidy model does not have connection subsidies and does not cover for compensation of power infrastructure development by consumers, particularly the poor. The existing arrangement is such that consumers can do connections and install electricity infrastructure at their own costs to expedite connection to electricity[27].

- The overall consumption subsidy model is not linked to the supply side, rather it is focused on the demand side and assumes supply as constant. The model does not factor the loss by the power company (ZESA) through cost of generation, lost margins, power theft and absence of penalties on non-payment of electricity (for households that are not on prepaid metering). Besides, the existing model has a negative trickle-down effect on to power generation and supply. For example, the power company simply reduces the tariff rate as recommended by the Government in lieu of tax relief. The power company does not receive the equivalent amount as a grant from government in compensation for the cost in generation of the subsidies power. ZESA is then forced to absorb the costs of the subsidy, which then threatens its operational and power generation substantiality.

- In addition, the current model does not promote distribution of power by IPPs. Whereas most IPPs can generate power to augment current generation by ZESA, they face the challenge of distribution as they rely on ZESA infrastructure. Also, the current model does not deliberately support development of green energy.

[27] For example, people can engage a private contractor to install an electricity line and do in-house installations. ZETDC will then inspect, authorize and energize the connections. ZESA does not pay for the infrastructure as they take it as a donation from customers through an agreement. The ownership and rights of control of the infrastructure will be transferred to ZESA as soon as the connection is done. During the first five years, households who intend to connect from the established infrastructure have to pay compensation to the other households who are the primary financiers of the infrastructure.

PART IV: SIMULATED AND NON-SIMULATED ELECTRICITY SUBSIDY REFORMS

The simulation of electricity subsidy reforms in the study is based on the standard economic consumer's choice model suggested by Araar and Verme (2012) - for more details about the model see Annex 1. Specifically the model is used to compute the impact of changes of the subsidy design on quantities of electricity consumed, poverty, welfare, inequality and government revenue. These outcomes are then complemented by the computations of subsidy targeting performance indicators using the framework suggested by Angel-Urdinola and Wodon (2005). They show that electricity subsidy reform simulations can be done using less information such as a household budget survey showing household total expenditure/income, expenditure on electricity, a poverty line, own-price elasticity of electricity, and tariff schedules for electricity. Kojima, Bacon and Trimble (2014) outlined key considerations for power subsidy reforms as comparison of current subsidy to those in other countries, significance of avoidable losses, extent of underpricing with or without avoidable losses, objectives and beneficiaries of current subsidy, objectives and importance ranking of proposed reforms, subsidy delivery mechanism and feasibility of implementation. Although these factors collectively matter in determining a subsidy reform, the need for policy reforms outweigh the need to satisfy all the factors in instituting policy reforms.

It should be critical at this point to mention that barriers to power subsidy reform are significant. Whilst price subsidies can be quick, easy, and politically expedient to implement; they are equally quick to take root and challenging to remove (Kitson, et al, 2011). Electricity is essential to modern economy, and provision of subsidies creates many vested interest groups. In Zimbabwe, with such a high post-tax subsidy, such subsidies are not only for households. The fact that some large consumers are deemed strategic and therefore are accessing electricity at concessionary rates, creates the vested interest groups. Any reforms should also consider the potential risks on the economy if the existing subsidies are eliminated for certain beneficiaries. Kojima, et al (2014), opinioned that in countries with low electrification rates mainly among the poor, the argument that subsidy reform would hurt the poor might not hold, instead those who are connected and will bear the cost of subsidy reform wield political power and influence to resist such reforms. In Sub-Saharan Africa, households and businesses that are connected to electricity generally have greater voice and political influence than those who are not (Kitson, et al, 2011).

Reform Option 1: Reconfigure the tariff schedule

The current IBT subsidy scheme was deemed to have a low targeted performance with subsidy benefits accruing more to non-poor than the poor. The current electricity subsidy is applicable to every consumption block, potentially resulting in lack of cross-subsidization, income redistribution and self-financing. It was also noted that the targeting performance of the subsidy was mainly driven by lack of usage among the poor. The study simulate modification of IBT schedule and assessing the impact of these modifications on the targeting performance of the resulting modified IBT. The study does not, however, focus on simulating the impact of changing access because as noted by Komivies et al (2005), access is difficult for policy makers to influence in the short-run and that it changes over time due to investments made in the grid expansion. In addition, the simulation of expanding the grid would require detailed information from a supply-side survey which would enable the modelling of the investment behaviour of electricity supply firms. Therefore, the focus of the simulations is on the subsidy design features which are within easy reach of the policy makers to influence and on the connection subsidies as an alternative to consumption subsidies. Three scenarios that modify the subsidy design are considered (Table 9).

Table 9: Scenarios for modifying the subsidy design

BLOCKS	kWh	price	price	kWh	kWh	price	kWh	price	kWh	price
1	1-50	0.02	1-50	0.02	1-50	0.02	0-190	0.062	1-50	0.0199
2	51-300	0.11	51-190	0.11	51-190	0.11	>191	0.124	51-100	0.0399
3	>300	0.15	>191	0.124	191-300	0.124			101-200	0.0699
4					>300	0.13			201-300	0.0998
5									301-400	0.1025
6									>400	0.1197

1) Scenario 1: the IBT schedule for 2017 is modified in two ways. The size of the second block is reduced from 51-300kWh to 51-190kWh. The 190kWh threshold is a conservative consumption level guided by the average monthly power consumption by the poor using upper bound poverty level, which the study set to accommodate all poverty levels[28]. This will likely help to reduce errors of inclusion, although there are also chances of households revising their consumption due to price effects, which may even worsen errors of inclusion. The second modification involves changing the price for the last block to reflect the efficient cost recovery price, currently at US$0.124 per kWh, for consumption above the new threshold of 190kWh.

2) Scenario 2: the modified IBT schedule in Scenario 1 is further modified by introducing a limit of 300kWh on the third block and adding a forth block with consumption of 301kWh and more. Furthermore, a volume differentiated tariff (VDT), pegged at US$0.1600 per kWh is introduced for consumption above 300 kWh. The intuition for this simulation is that the current IBT scheme subsidizes all levels of consumption, thus lacking a threshold

[28] The 190kWh is an average based on poor households' electricity consumption calculated using the ZIMSTAT PICES dataset. The average is not basic consumption as defined by ZETDC's basic or subsistance consumption.

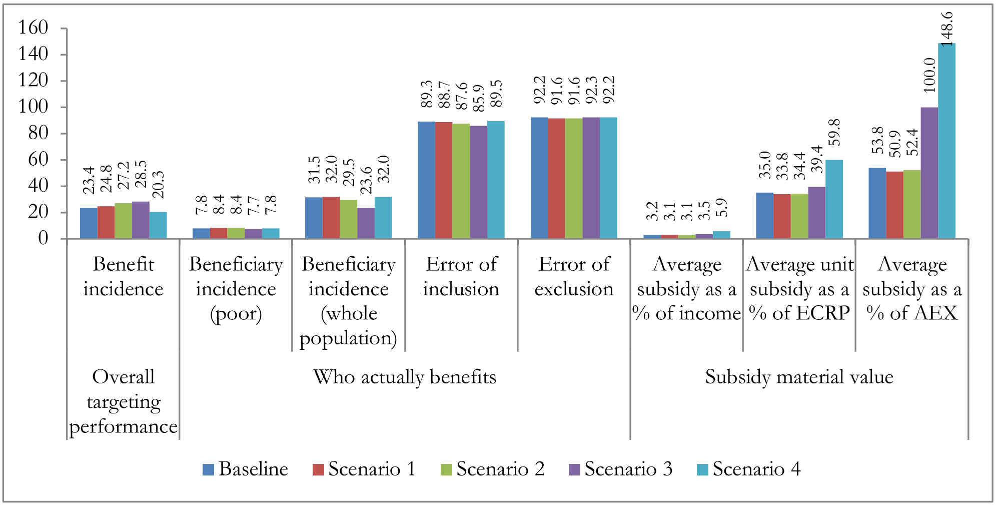
beyond which a punitive tariff is effected to discourage potentially inefficient household consumption of electricity. Therefore, for consumption above 300 kWh a household has to pay a tariff of US$0.1600/kWh for all units consumed. Thus, this will discourage potentially in efficient consumption of electricity. Since the price of US$0.1600 for the final block is greater than the efficient cost recovery price of US$0.124, this scenario is expected to generate some cross subsidies to the extent that households consume way more than the 300 kWh threshold.

3) The third scenario considers a shift from IBT schedule to VDT schedule which gives a subsidy on consumption up to 190 kWh at a price of US$0.062/kWh. For consumption which is above 190 kWh, that is, beyond the conservative upper bound average household electricity consumption by poor households, an efficient cost recovery price of US$0.124 per kWh is effected.

4) Scenario 4 represents the reconfiguration of the IBT schedule in November 2020 wherein ZEDTC introduced a six-consumption-block tariff schedule and changed the marginal prices of the consumption blocks as shown in Table 9. It is expected that increasing the number of blocks reduces consumer surplus and hence increases the revenue accruing to the electricity utility companies. However, one of the setbacks on the tariff schedule modification is that all the consumption remains subsidized regardless of the income level of consumers. Thus, the tariff schedule potentially poses significant subsidy burden on the government and encourages inefficient consumption. Ideally, the threshold beyond which potentially inefficient consumption is penalised by charging at least a cost reflective tariff, should be introduced.

The results of the simulations of the subsidy design under the four scenarios are shown in Figure 11. The results show that the VDT scheme (Scenario 3) outperforms the other schemes with a targeting performance indicator of 29%, a relatively generous subsidy to the poor and relatively lower errors of inclusion. However, this comes at the expense of a relatively slightly lower beneficiary incidence to the poor of 8% and high errors of exclusion of 92% (Figure 11).

Figure 12: Targeting performance of simulated scenarios



Source: Authors' computation using 2017 PICES household survey data

A VDT combined with an IBT (Scenario 2) is the second highest performer in terms of targeting performance (27%), beneficiary incidence and errors of inclusion and exclusion. It appears that the combined tariff schedule's targeting performance is improved through reducing the proportion of on the non-poor among beneficiaries, while increasing the proportion of the poor who benefit. Consequently, the errors of inclusion and exclusion are slightly reduced compared to the baseline. The combined tariff scheme is also relatively less generous compared to the baseline.

A modified IBT in Scenario 1 is the third highest performer with a targeting performance of 25%, and slightly improved errors of inclusion and exclusion, as well as beneficiary incidence to the poor relative to the baseline scenario. However, it slightly falls short in terms of subsidy generosity compared to the baseline.

Scenario 4 (the latest changes to the IBT effected in November 2020) is the least performer among the simulated scenarios in terms of overall targeting performance which is 20%. It does not make any improvement from the baseline in terms of beneficiary incidence to the poor and errors of exclusion. The tariff schedule also increases the proportion of the non-poor benefiting from the subsidy, hence the relatively high proportion of the population benefiting and high errors of inclusion. Nevertheless, the tariff schedule it is very generous as indicated by the highest subsidy materiality indicators. While this scenario greatly increases the material value of the subsidy that accrues to the poor, its major shortcoming is that it is very regressive and therefore less effective in alleviating poverty. Thus, only the few poor households benefit from the generous subsidy while more of the non-poor benefit more because they relatively have a higher rate of electricity uptake from the grid and consume more electricity on average. Under the scenario, the increase in subsidy depth increases the average quantity of electricity consumed from 236.66 kWh in the baseline to 256.96 kWh for the non-poor, but reduces revenues to the electricity utilities by 27% from US$22.5 million in the baseline to US$16.5 million.

Overall, the simulated subsidy scheme scenarios indicate that while changing the subsidy design may improve the targeting performance, this does not cause the consumption subsidy schemes to be pro-poor. The results also indicate that there are trade-offs that are encountered in changing the subsidy design. Thus, policy makers need to be mindful of potential trade-offs that arise with the modification of self-targeting subsidy schemes and therefore prioritize their actions accordingly. In addition, the simulated subsidy schemes marginally changed the errors of inclusion and exclusion. This is attributed to the fact that the simulated reforms targeted subsidy design factors, yet the significant factor underlying poor targeting performance is limited usage due to lower connections to the grid. Thus, no matter how good the subsidy design factors are designed, they cannot significantly influence the targeting performance which is mainly affected by access factors. Access factors need to be addressed by supply-side interventions such as investing in new electricity generation capacity, expanding the grid, subsidizing connections, and improving efficiency to reduce the cost of supply to enhance affordability.

Effects of simulated scenarios on welfare, subsidies, transfers and total budget

The simulated subsidy design schemes were also assessed in terms of their real impact on: (a) welfare as measured by the real per capita level of expenditure; (b) level of poverty; (c) inequality as measured by the Gini coefficient; (d) reduction of subsidies; (e) transfers required by government to offset poverty resulting from subsidy reforms; and (f) budget required for the changes on the subsidy scheme (Table 10).

Scenario 3 (VDT) has the greatest reduction in subsidies of 19% from the baseline, and consequently makes the greatest savings for the government through reducing the subsidy budget (i.e. the required budget for the subsidy and transfers for offsetting the increase in poverty among the poor who are adversely affected by subsidy reduction) by 16%. The reduction in subsidy and burden to the fiscus seems to come at an insignificant cost of rising poverty and inequality, as well as insignificant decline in welfare. The potentially low costs of subsidy reduction are consistent with the results on targeting performance. If the subsidy is poorly targeted, then improving targeting performance of the subsidy is more likely to reduce subsidy burden and create fiscal savings with minimum adverse impact on welfare, poverty and inequality.

Scenario 2 (combined IBT and VDT) also yields a reduction in subsidies by 8% and resultantly makes a 7% reduction in total budget cost of the subsidy and reduction in inequality. However, the reduction in subsidy burden and fiscal savings comes at the cost of marginal increase in poverty and relatively small reduction in welfare. The targeting performance of Scenario 2 (27%) is relatively less than that of Scenario 3 (29%). This potentially explains why the reduction of subsidy in Scenario 2 has relatively higher costs in terms of welfare and poverty. It seems that the higher the improvement in targeting performance, the higher the fiscal savings on the subsidy and the lower the costs in terms of welfare loss and poverty increase. Thus, the results suggest that the reforms which significantly improve targeting performance would significantly reduce subsidy burden, while minimising the potential adverse impacts on welfare, poverty and inequality.

Table 10: Effects of simulated scenarios on welfare, subsidies, transfers and total budget

		Welfare (per capita)	Poverty level (%)	Inequality (%)	Subsidies (US$m)	Transfers (US$m)	Total budget (US$m)
Baseline		65.22	53.60	0.4802	7.03	0.00	7.03
Scenario 1							
	level	65.23	53.84	0.4804	7.05	0.02	7.07
	% change	0.021	0.432	0.037	0.362		0.613
Scenario 2							
	level	65.11	53.89	0.4799	6.45	0.06	6.51
	% change	-0.168	0.533	-0.058	-8.122		-7.285
Scenario 3							
	level	65.22	53.84	0.4802	5.68	0.25	5.93
	% change	-0.000	0.434	0.004	-19.165		-15.590
Scenario 4							
	level	65.79	53.56	0.4817	15.35	0.00	15.35
	% change	0.882	-0.077	0.310	118.556		118.556

Sources: Authors' estimates using World Bank subsidy microsimulation model (SUBSIM) by Araar and Verme (2012)

Scenario 1 (modified IBT) increases subsidies marginally from the baseline due to the reduction in the marginal price of the third block, and therefore increases the total budget for the subsidy. The increase in the subsidy results in the marginal increases in welfare, poverty and inequality. The increase in welfare is due to the subsidy which effectively increases total real expenditure. The increase in inequality is a result of the poor targeting performance which results in disproportionate benefits accruing to the non-poor. Poverty increases because the number of subsidised units is reduced from 300 kWh in the baseline tariff schedule to 190 kWh in the Scenario, implying that the households who could not reduce their consumption were made worse off by the reduction in the subsidy.

In Scenario 4 (November 2020 IBT schedule), the welfare of households increases and poverty declines because the IBT scheme reforms actually significantly increase subsidies to all the electricity consumed. But because these subsidies disproportionately benefit the non-poor households, the result is a marginal increase in inequality by 0.3%. Since subsidies increase in this scenario, it means that the government also has to increase its budget by 119% to carter for the subsidies. Thus, the cost to the government increases by the amount of subsidies required. However, there are no compensating transfers that are required to offset poverty because the subsidies are enhancing welfare of the households and reducing poverty.

In all the Scenarios simulated, the level of changes in welfare, poverty and inequality are very marginal since the simulated reforms fail to produce progressive distributions of subsidies. This implies that the changing of the subsidy design by manipulating prices, consumption blocks and targeting are not very effective in making the subsidies pro-poor. Foster, Pattanayak and Prokopy, (2003) also observed that a modified IBT barely performs any better than the original one, indicating that it is difficult to improve targeting simply by playing around with the design of the IBT structure.

Overall the results show that all the subsidy designs simulated are regressive, thus emphasizing the importance of addressing the access factors, attempting other forms of subsidies which are not consumption subsidies and other targeting mechanisms which are not self-targeting. Kitson, Wooders and Moerenhout (2011), pointed that electricity sector subsidies in Sub-Saharan Africa are highly regressive because the vast majority of the poor in the region—many residing in rural areas or informal urban settlements—are not connected to electricity, the subsidies to residential services are captured largely by better-off urban households, and in some countries industries and commercial establishments capable of paying much more are charged subsidized prices. Consumption subsidies need to be accompanied by subsidies to the electricity utility companies that ensure expansion of the grid and subsidies to the households to connect to the grid.

Reform Option 2: Introduce connection subsidies

Connection subsidies rather than consumption subsidies may generate progressive distribution of subsidies since the main problem is limited usage among the poor due to poor connectivity to the national electricity grid. Angel-Urdinola and Wodon (2005) show that even if without data on the distribution of connection subsidies, there are three stylized simulations that can be performed to access the targeting performance of connection subsidies. The first scenario is to assume that connection subsidies are distributed in a similar manner as existing connections, which is a pessimistic assumption which favours households that are already better off, but realistic if access rates are very low. The second scenario is to assume that connections are distributed randomly among households who are currently not connected but have access. The last scenario is to assume that connections subsidies are randomly distributed among all households currently without access. In these three scenarios, the targeting performance of the connection subsidies can be simulated using household survey data with the following formulae, respectively.

$$\Omega^{C1} = \frac{A_p}{A_H} * \frac{U_{P/A}}{U_{H/A}} * \frac{R^C_{P/T}}{R^C_{H/T}}$$

$$\Omega^{C2} = \frac{A_p}{A_H} * \frac{(1 - U_{P/A})}{(1 - U_{H/A})} * \frac{R^C_{P/T}}{R^C_{H/T}}$$

$$\Omega^{C3} = \frac{A_p}{A_H} * \frac{(1 - A_p * U_{P/A})}{(1 - A_p * U_{H/A})} * \frac{R^C_{P/T}}{R^C_{H/T}}$$

Where Ω^C is the targeting performance of the connection subsidy and the other variables are as defined in Table 11.

Table 11: Input data for connection subsidies simulations

	Description of variables	
CC	Average cost-recovery price for connection (US$)	250
AH	Share of households with access in total household population	0.741
AP	Share of the poor households with access in total poor households	0.665
UH/A	Share of households using/uptaking electricity among those with access	0.432
Up/A	Share of poor households using electricity among the poor with access	0.117
RCP/T	Rate of subsidization for connections for the subsidized poor	0.8
RCH/T	Rate of subsidization for connections for the subsidized households	0.6
FCH/T	Average connection fee paid in the overall population (US$)	100
FCP/T	Average connection fee paid by the poor (US$)	50

Source: Authors' calculations from 2017 PICES data and ZERA data

The average connection fee in Zimbabwe is US$100 whereas the average cost of a connection is US$250. The connection fee between the poor and non-poor is the same. However, the study simulates a scenario where a larger subsidy is given to the poor such that the connection fee for the poor is US$50. The results for the simulation of connection subsidies indicates that connection subsidies are better targeted than consumption subsidies with a benefit incidence ranging between 0.33 to 1.9 (Table 12).

Table 12: Benefit incidence Simulations for connection subsidies

	Benefit Incidence indicator
Scenario A(Ω^{C1})	0.325
Scenario B (Ω^{C2})	1.859
Scenario C (Ω^{C3})	1.808

Source: Authors' calculations from 2017 PICES data and ZERA data

Thus the connection subsidies are potentially pro-poor and therefore may be more effective in ensuring that the poor benefit form subsidies. This is mainly attributed to the fact that the main problem why the poor are excluded in consumption subsidies is limited usage of electricity due to lower rates of connections among the poor. Therefore, improving connections by subsidizing the connection fees is a very effective way of ensuring that subsidies are pro-poor.

However, literature notes that the uptake of connections may be low even if the cost of connections is subsidized (Lee, Miguel, and Wolfram, 2020). This suggests that more needs to be done apart from giving subsidies and that there are other barriers to establishing connections apart from costs of connection. Some of the barriers inhibiting the rate of electricity connections in SSA and some initiatives towards reducing the barriers include the following.

- The high costs of connection which discourage the poor from connecting to the grid. Credit facilities have been offered in practice to encourage the uptake of connections. Attempts to reduce costs of connection have also been made through exploiting economies of scale by connecting many customers at once.

- Irregular and unpredictable income flows that affect the willingness to connect to electricity services. Prepaid metering and flexible bill payment mechanisms have been used in practice to resolve these challenges.

- Electricity connections via the traditional alternating current require minimum building standards which are not met by most of the dwellings of the poor. However, technologies such as ready boards have been used to help install electricity in substandard houses and also to avoid the costs for wiring which the poor may find difficult to meet. In addition, it has been recommended that building standards be consistent with the requirements for electricity installations. It may also be important to even have building standards in rural areas and such standards may need to consider future possibilities for electricity installations.

- Limited potential for productive use of electricity which lowers the potential demand for electricity and reduce potential revenues, increasing costs for the utilities providing electricity in unconnected areas. The importance of promoting productive use of electricity beyond uptake of connections through providing reliable electricity with capacity for productive use has been recommended in literature as a good practice. It is productive use which enhances demand for electricity and the capacity for the poor to pay for electricity (Blimpo, and Cosgrove-Davies, 2019).

Case studies on reducing barriers to electricity connections

Some lessons on reducing connection barriers may be drawn from recent projects that have been implemented across SSA which have made significant progress towards removing electricity connection barriers through national electrification strategies and international best practice that could be applied to the local context. In general, all infrastructure investments (high, medium and low voltage networks and users' connections) needed to deliver electricity service nationally are taken into consideration for such electrification projects. Additionally, if financing of electrification projects includes all infrastructure investments needed for service delivery, utilities do not need to collect money from new users. The cost of debt of investment projects are incorporated in Revenue Requirements (RR) of utilities, and allocated to tariffs paid by all customers, as it is done with investments to rehabilitate/upgrade existing assets.

The policy question pertaining whether or not to make a new consumer pay a connection charge/fee is a policy decision that needs to be taken by the Government. In cases of electrification projects financed by the World Bank, support is given to the Governments in defining those policy decisions, taking into consideration some key aspects such as ensuring consumer affordability; connecting all households in the area, eliminating the need for upfront payment for small consumers; and transfer of funds being collected through connection charge to a special purpose electrification fund that can finance access investment programs. Boxes 1 and 2 summarizes some of the good practices in Mozambique and Kenya on reducing connection barriers in electrification projects supported by the World Bank and other development partners.

Box 1: Overcoming connection barriers – The Case of Mozambique

The World Bank and other development partners are working with the government of Mozambique to increase electrification in the country through a project called Mozambique Energy for All (ProEnergia) Project. Some of the good practices implemented in the project to reduce connection barriers for the poor include the following.

- The financial burden on *Electricidade de Moçambique* (Electricity of Mozambique – EDM) from expanding access to the poor is reduced by making the government repay the costs and removing the costs on the balance sheet of EDM.
- To reduce the connection costs and maximize the number of connections per dollar, the electrification project uses new innovative procurement arrangements whereby economies of scale are reaped through bulk purchase of project materials and separate independent contracts for design, construction and installation services (this is a move away from Engineering, Procurement and Construction (EPC) contractors).
- The project finances all the electrification costs without requiring the customers to pay upfront connection costs.
- The project eliminates the costly, time consuming, piece meal approach which connects individual customers only after applying and paying a connection fee. This is done through connecting all the customers at once, hence reaping economies of scale.
- Ready boards are provided to households without physical conditions or means for inhouse wiring. This maximises the number of connections and enables economies of scale.
- A customer awareness program called was implemented to provide information to new customers about the different uses of electricity, connection types and costs to facilitate informed decisions which translate into increased demand for electricity and sustainability of connections.
- Leveraging cost effective technologies where possible to minimize connection costs. The project moves away from Aerial Bundled Conductors to bare conductors which are cost efficient while providing same level of service. Where applicable the project also uses single-wire earth return (SWER) technology instead of long distribution lines which have higher installation costs and technical losses. The project also uses smaller distribution transformers which have lower technical losses than the larger transformers usually used by EDM.

Source: World Bank (2019). Mozambique Energy for All (ProEnergia) Project (P165453). World Bank, Energy and Extractives Global Practice Africa Region.

Box 2: Overcoming connection barriers – The Case of Kenya

Kenya is regarded as one of the success cases of national electrification, achieving 50% electrification rate in 2016 from 23% in 2009 (World Bank, 2017). Kenya adopted the Last Mile Connectivity Program to accelerate electricity access in grid-connected areas by connecting all customers within the 600m radius of a transformer. The World Bank and other development partners and the government of Kenya are implementing the Off-grid Solar Access Project for Underserved Counties. Some of the good practices in these projects include the following.

- The Last Mile Connectivity Program reduced connection fees from US$343 to US$147
- The connection fees are paid in instalments to enable affordability among the poor
- A concessional debt by the donors to the Government of Kenya is being on-granted to Kenya Power and Lighting Company (KPLC) for electrification purposes, thereby keeping the debt off KPLC's books and enhancing the financial sustainability of KPLC.
- Deploying a wide range of electrification solutions and flexible business models helps to cater for a wide range of heterogenous population needs and characteristics, thus enabling high number of connections, low transaction costs and economies of scale.
- Comprehensive geospatial planning is important for identifying least cost electrification options (grid, mini-grid and solar home systems connections) that would lead to reduced costs, not only for connections but also for use of electricity.
- Private sector participation in electrification programmes are incentivised through the creative use of financing instruments to reduce risks through public private partnerships and use of public resources from development partners.

Source: World Bank (2017). Kenya: Off-grid Solar Access Project for Underserved Counties. World Bank, Energy and Extractives Global Practice, Africa Region.

Reform Option 3: Non-tariff based subsidy reforms (non-simulated)

Simulated models based on tariff based subsides consumer have shown a weakness of not being optimal. The observed intuitive rationale for such an outcome is that there is need to compliment these reforms with other non-tariff based reforms for tariff based subsidy reforms to be effective. Non-tariff subsidy reforms are critical in addressing the targeted performance incidence of tariff subsidies. In Zimbabwe there are many incidences of power theft[29] and access to subsidies power by deemed strategic sector and big players with no accruing benefits. Also, the structure of transfer pricing on part of public institutions and entities accessing power is not clear. There is need for reforms on classification of large and strategic consumers of power as well as recasting of the existing subsidy model. For example, government could move entirely or in part from input based power subsidy to out based power subsidy for large consumers such as industry and agriculture. The government could then implement a targeted subsidy system on these critical sectors.

Reform Option 4: Integrating supply side subsides (Non-simulated)

Whilst the study focused on consumption subsidies, the optimality of the reform policy agenda is not complete without supply side reforms. Consumptions subsidies viewed in isolation are not the sole conduit for power subsidies for poverty alleviation. The burden of subsides to the part government cut across supply and consumption subsidies. These subsidies impair the financial health of the energy suppliers, deter investments in the energy sector, and impose large fiscal costs where they are provided by governments (Kitson, Wooders and Moerenhout, 2011). Subsidies can be reformed by reducing costs as well as increasing revenues and stakeholder analysis and distributional analysis are important for designing suitable reform programs (Kitson, et al, 2011)

The power generating and distributing company is carrying the burden of consumption subsidies and this has affected their operational viability. The operational challenges faced by public power companies (ZPC and ZETDC) reflect elements of the companies carrying the burden on state power-subsides. ZESA is faced with serious revenue collection challenges as the majority of customers are failing to settle their bills on time. Attempts have been made in the past years review tariff structures to have pricing of power that is towards full cost recovery, while at the same time preserving price subsidies for low income households. ZESA, has also instituted demand side management (DSM) programs[30] with a view to reducing energy consumption and improving its operational performance. The effectiveness of these measures is, however, weighed down by the inefficient subsidy scheme the country is implementing.

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[29] Although heft penalties were introduced to curb vandalism and theft of electricity infrastructure there is still room to consider other effective measures as well.

[30] ZESA managed to implement the pre-paid meter program, upgrade of the existing billing system, and enforcement of the disconnection policy for seriously delinquent accounts.

With a quantity target approach used in current subsidy model, if supply is restricted or tariff increases, it would imply that majority of people will consume in the first block which is highly subsidized. The poor would then be excluded by crowding out given that they exhaust their resources on alternative sources of power and would not be able to afford electricity. Such a structure would the affect the power company, ZESA, in that most of its power ends up being consumed at below cost, not because consumers are not willing but supply is limiting consumption.

The inclusion of supply side subsides is on the notion that supply of power is a major determinant of the effectiveness and target performance of consumption subsidy matrix. ZESA's regular request for tariff review should be a trigger to also consider supply side subsidy reforms. Zimbabwe is currently facing power deficit and this impact on availability of power to household, and often ZESA resort to shedding power for extended periods. The effective generation and technical subsides that accrue to ZPC/ZETDC might not be adequate to cover the loss incurred through loss incurred through subsidies power generation costs and margin losses. Many Sub-Saharan African countries are characterized by weak institutions, poor quality of electricity service delivery typified by frequent outages, and weak social protection systems that pose serious challenges to the design and implementation of subsidy reform (Kojima, *et al,* 2014).

PART V: CONCLUSIONS AND RECOMMENDATIONS

The political economy of energy subsides globally, more-so in Africa, dictates that governments cannot do away with subsidies. Although the underlying objective of subsidies is often to protect the poor, the major weakness of subsidies regimes in Africa is that of low incidence of benefit and high error of exclusion and inclusion. For decades, electricity tariffs in Zimbabwe have been well below the efficient cost of electricity supply, but there is a general outcry on the high cost of electricity, mostly by the poor. The study established that existing electricity subsidies scheme in Zimbabwe is not pro-poor, implying it has high level of exclusion of the poor and low target performance due to low access, uptake and connections of poor households against the non-poor. Simulation of possible subsidy options reveals that increasing access to electricity by the poor remains critical in ensuring high incidence of benefit by the poor. A few conclusions can be drawn from these findings:

Conclusions

Are electricity subsidies in Zimbabwe benefiting the poor as opposed to other households?

The study established that overall the electricity subsidy disproportionately benefits the non-poor. The poor households that are connected have a relatively better rate of subsidization than all the households combined, pulling up the targeting performance of subsidies and reducing the regressive-ness of the subsidy. With proper reforms and structuring of subsidies, there is huge potential of having electricity subsidies reducing poverty among the poor. Energy is required by households for many reasons, including for cooking, lighting, heating, transport and production. In the past, most households in urban centres, resorted to using alternative sources of energy outside national grid when there was no supply. In recent years, the shrinking of incomes of most households increased the number of households that needed subsidised energy. Supply side constraints that inhibits consistent electricity supply, against high demand, is also making use of alternative energy sources inevitable. Given the quantity target approach used in Zimbabwe under the existing IBT tariff schedule, the poor are crowded out by the non-poor, who are then forced to consume subsidised level of power due to supply side challenges. The low uptake of electricity also excludes the poor form benefits from electricity subsides. As such, with consumption subsidies, it is the poor who are technically subsidising the non-poor due to limited connectivity and uptake of electricity. This notwithstanding, it does not discount the fact that electricity subsidies are capable of alleviating poverty. There is huge potential of electricity subsidies being able to ease the burden of the poor, albeit in appropriate structure and form.

Are the electricity subsidies reducing poverty or not in Zimbabwe and is it design or access issues that is influencing the targeting performance?

Poverty reduction takes collective effect of measures towards addressing a number of social ills in people, including low incomes, limited access to food, shelter, water, utilities and basic human care, being loved and accepted. Electricity subsides have the potential of reducing poverty in Zimbabwe. Subsidies help the poor in accessing affordable electricity, thereby reducing their demand for alternative and relatively cheaper energy that is not efficient. The study establishes that the major challenge in Zimbabwe is limited access to electricity by the poor than the structural design of the subsidy scheme. All the subsidy designs simulated are regressive, thus emphasizing the importance of addressing the access factors and attempting other forms of subsidies which are not consumption subsidies. Given that usage/uptake and quantity consumed are the main drivers of poor targeting performance, the study concludes that consumption subsidies alone are not an effective instrument in trying to improve the lives of the poor through electricity subsidies. Consumption subsidies need to be complemented by connection and supply side subsidies.

Should the government continue to use electricity subsidies as a tool for poverty alleviation and why? What alternatives are there?

Governments have been using subsidies to alleviate poverty amoung the poor in many sectors, including in food, transport, education and energy. Electricity subsides could potentially have a high impact in alleviating poverty in Zimbabwe. The decision, therefore, should not be about whether subsidies should continue to be used as tool of alleviating poverty or not, rather it should be on how to reform the subsidies in order to optimize their effectiveness in alleviating poverty. The study results suggest that improving subsidy targeting performance potentially reduces the burden of the subsidy on the fiscus with minimum costs on welfare, poverty and inequality. The low target performance of electricity subsidy in Zimbabwe was found to be due to low uptake, subsidy structural design, which then shifts the benefit incidence from the poor towards the non-poor. What is also limiting the efficacy of subsidies in reducing poverty is also the imbalance in the distribution of the burden of the subsidies. An effective subsidy model should not burden the power company, despite it being a government owned and providing a utility service to households, a structure which threatens the operational viability of the provider. Cross subsidization that occurs across consumers of varying income levels and sectoral consumers of power is optimised if there is consistent supply of power. Access to subsidised electricity reduces the burden of investing in alternative sources of energy among households. It also supports development by the poor through economic activity, attraction of investment in rural communities that have access to power. Carrying out subsidy reforms could enhance the effectiveness of the existing power subsidies in alleviating poverty.

Also, as the findings noted, the major issue which limits the poor from benefiting from subsidies is low access to electricity. The deduction, therefore, is that for any electricity subsidies models to be effective, it should be or include elements of enhancing connection to and use of electricity by the poor. However, any increase access with no corresponding increase in generation capacity has negating effects on subsidy performance. As such, tariff-based reforms are not adequate, rather they need to be complemented by non-tariff reforms, such as connection subsidies and enhancement of supply side reforms.

Recommendations

The subsidy model, policy measures and aspects for further research recommended in this study are based on the evaluation of different simulated and observed (non-simulated) subsidy reforms that are required in electricity power subsidies. The recommendations also factored the subsidy burden, power generation and distribution inefficiencies and resultant cost currently being incurred by the power generating entities.

Optimal subsidy model.

Simulations produced two policy reform options, the reconfiguration of the IBT tariff schedule and introduction of connection subsidies. Four scenarios came out of tariff reschedule reform. The simulated subsidy scheme scenarios indicate that while changing the subsidy design may improve the targeting performance, this does not cause the consumption subsidy schemes to be pro-poor. The third scenario considers a shift from IBT schedule to volume differentiated tariff (VDT) schedule with subsidies paid only for consumption of up to the average consumed by the poor. Another simulated policy reform is on connection subsidies, with a benefit incidence ranging between 0.325 to 1.86, projected to generate progressive distribution of subsidies than consumption subsidies since the main problem is access to electricity. Simulations of different scenarios indicted that all the subsidy designs proposed are regressive, thus emphasizing the importance of addressing the access factors and attempting other forms of subsidies which are not consumption subsidies. Connection subsidies are potentially pro-poor and therefore may be more effective in ensuring that the poor benefit from subsidies. It should, however, be noted that the with the macroeconomic crisis, expanding connections might not sufficient by itself to help the poorer segments of the population given the decline in their purchasing power of incomes[31]. Non-simulated reforms include non-tariff reforms which include measures to address power theft and absence of penalties for non-payment of electricity. The redesigning of the supply side subsidies is also critical in supporting consumption subsides reforms.

Given the above possible reforms, the study recommends a hybrid subsidy targeting model that combines elements of simulated tariff based and non-tariff-based reforms. The recommended model combines consumption and connection subsidies, based on household income, differentiated using geography and supported by supply enhancing power subsidies *(The Household Income-Differentiated and Supply Enhanced Power Subsidy Model).* Targeting based on geographical location or housing characteristics can reduce the extent of subsidy leakage, increasing the share of subsidy expenditure that reaches the poor (Foster, Pattanayak and Prokopy, 2003). Although targeting criteria has the effect of excluding household that are genuinely poor, error of exclusion, but this can be addressed by inclusion of connection/infrastructure development subsides, which covers connections as well as development of network infrastructure by poor households.

[31]The current macroeconomic situation creates affordability concerns for a significant portion of the customer base, and hence there is a need for pragmatism in subsidy reform, at least in the short-term.

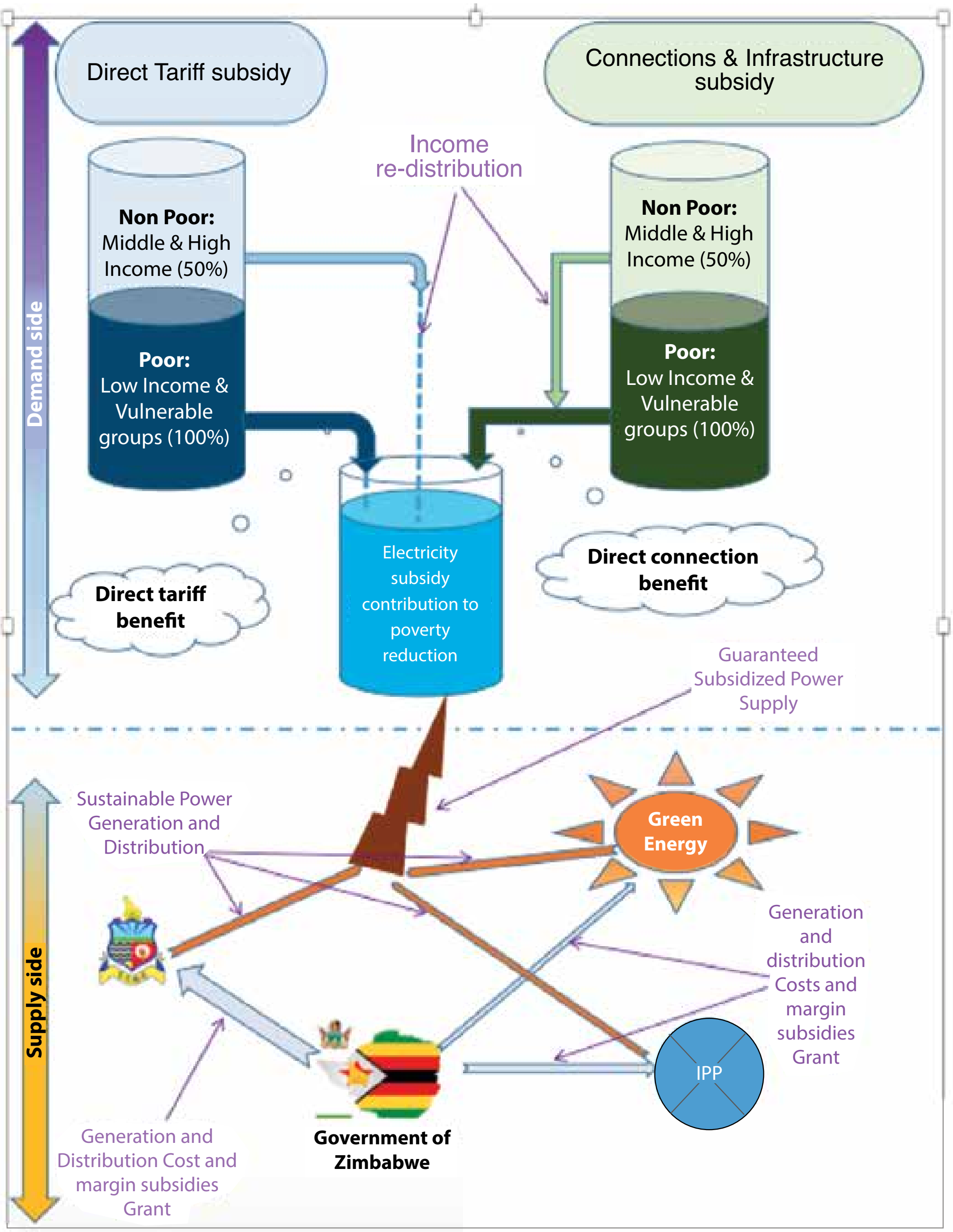
The proposed subsidy model could adopt a reviewed tariff schedule (Scenario 2), which seemingly optimizes the incidence of benefit and have minimal welfare loses among the simulated scenarios subsidy. These proposed IBT schedule reforms should then be complimented by infusing elements geographical targeting. In other words, the reform would then be supported by differentiating customers along income lines using the geographical location. ZESA will classify the customers in poverty classes using place of residence as a dummy criterial for determining whether a household is poor nor not. The model is then expanded to include enhancement of supply side subsidies, by transferring the burden of subsidy from ZESA or power producers to central government (Figure 12).

The Household Income-Differentiated and Supply Enhanced Power Subsidy Model

The model is a fusion of consumption, connections and supply side subsides- based on income levels of household consumers. For purposes of this model, household income classification is not determined by the actual income by households but on a generalized assumption that on average people settle in areas/communities which reflect their income status. For example, most low-income households usually live in highly populated areas and as income increases the level of population density that households live in is reduced. The income differentiation will then be based on existing settlement patterns/neighborhoods or geographical zoning, largely indicative and defined by income levels[32]. Power subsidies are then indexed to levels that are structured along income classes (Figure 12). For example, vulnerable groups and low-income groups could be classified as poor and would get 100% of subsidy rate whilst non-poor (Middle and High income) would enjoy 50% of subsidy rate.

[32]Ideally targeted subsides must have been allocated on the basis of actual income, 'means targeting', however income is a dynamic variable in most households and it becomes practically difficult to estimate incomes with accuracy (Foster, Pattanayak and Prokopy, 2003). As such, the study relies more on observable indicators or "proxies" for poverty, in this case the characteristics of the neighborhood.

Figure 13: Household Income-Differentiated and Supply Enhanced Power subsidy model



- The geographic zoning of households according to their locations which proxy their income status would be used as targeting mechanism for subsidy beneficiaries. The zoning could be based on local authority classification. Those in low income (high density) areas would be regarded as the poor targeted for a relatively higher level of subsidy, while those in medium income (medium density) areas would be targeted as medium income earners who benefit from a lesser subsidy level and those in high income (low density) areas would be regarded as non-poor and therefore may be considered as non-eligible for the subsidy. The model could then apply a special subsidy on case basis for vulnerable groups, which could include, the elderly.

- A similar subsidy system would then be applied on costs incurred by consumers for connections and development of power network infrastructure.
  - The proposed connection and network infrastructure model would then have a proportional subsidy paid to households that finance connections and development of the infrastructure depending on their geographic classification. Subsidy could come in form of power credits that are awarded to the household.
  - With connection subsidy--- access in enhanced given that the poor are then allowed to recover the cost of installations through power credits.

- The supply side of the model involves:
  - Government paying the subsidy amount, equivalent to the cost of power generation, distribution and margin lost due to demand side, to ZESA (ring-fenced subsidy).
  - This would ensure that it is the central government and not ZESA which carries the burden of the subsidy.
  - The same should go for private power producers who feeds into the national grid—IPPs—which should receive a compensation for the cost-plus margin's subsidy from Government. This would ensure uniform tariff on power and a guaranteed supply as IPPs would get a market return split between a direct purchase and Government subsidy Grant.
- The proposed model works with the following assumptions:

  - ZESA can configure its consumer accounts database system into zones for subsidy differentiation. Local Authorities databases are robust and could be integrated and mapped with the ZESA consumer billing system.
  - ZESA can monitor the positioning of prepaid meters particularly to detect when meters are used outside the designated zone.
  - ZESA can separate its billing zones from its network distribution zones.

The upside of the proposed model is that it optimises on electricity subsidies by incorporating a number of different types of power subsidies, for the benefits of the poor consumer, the electricity producer(s) and the government. To the poor household, there is income redistribution through higher charges for high income households and heavy users, whilst the power companies' income is enhanced through transfer of burden of subsidy to central government, as well as through charging efficient pricing without disadvantaging the poor.

The model also assist the power supplier in containing excessive use of subsidised power, power theft and reduction of error of inclusion where the benefits of subsidised power accrue to the non-poor. The model potentially reduces the burden of subsidies on part of government as non-poor consumers would not carry the full benefit of the subsidy as is currently the case. Implicitly, to government, the model ensures efficient distribution of benefits of subsidy, without burdening the power producer. The downside, however, is that the success of the proposed electricity reforms is highly dependent on how the political economy of power subsidies in Zimbabwe is capable of absorbing the disruptions that comes with the reforms.

Policy reforms:

The above analysis prompts for a few specific policy reforms that could be implemented:

1. The reconfiguration of the IBT tariff schedule to include an efficient cost of supply tariff for consumption beyond an average consumption for the poor. An additional block, for consumption beyond a threshold, say 1000kWh, meant to enforce efficient consumption by penalizing consumption mostly for commercial use done under household connections should be included.

2. Introduction of connection and power infrastructure development subsidies in order enhance access, connection, and uptake of power. This can be achieved through introducing power credits for a portion of the value of the connection or infrastructure based on income levels

3. Restructuring of supply-side subsidies, incorporate them in the consumption subsidy model.

Overall, it remains critical to point out that the above findings, simulations, conclusions, and recommendations are based on a partial equilibrium analysis which considered individual consumption behaviors contained in PICES data. The analysis is, therefore, restricted to assessing direct financial subsides that accrue upon consumption of electricity, excluding the indirect subsidies and costs that the poor realistically incurs. For example, costs borne by ZESA are funded by the fiscus which in turn is financed in part through taxation. The subsidy burden might indirectly be transferred to the poor through high level of taxation. The study, therefore, recommends further research that focuses on a general equilibrium analysis of the effect electricity subsidies, which incorporates indirect costs such as taxation paid by the poor, as well as supply-side subsides. A holistic analysis would give a more realistic perspective of real incident of benefits (or costs) of electricity subsidies to the poor. Finally, the paper assesses the efficacy of the existing subsidies in alleviating poverty. However, policy makers should also emphasis on economic efficiency of subsidies in addition to making them pro-poor. Implicitly, the major objective for policy makers should be to have an electricity pricing policy that ensure economic efficiency of resource use and ensuring financial viability of the power producers. Consistent with this recommendation, further studies should also include subsidies to non-households, mostly on commercial. The data on cost of service for Zimbabwe by the World Bank (Figure 5) shows that agricultural subsidies are extremely important and significant and that any sustainable program of subsidy management needs to consider these. A comprehensive study on total subsidies for both household and non-household sectors in Zimbabwe could inform an economically efficient subsidy regime in the energy sector.

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ANNEX 1: METHODOLOGY

Incidence analysis of electricity subsidies

The process of subsidy analysis typically begins with static incidence analysis (Araar and Verme, 2012). This will be used to examine the current distributional status of subsidies across households without considering any reform to the subsidy. It will give insights on whether subsidies are pro-poor or pro-rich and whether subsidies affect the level of poverty and inequality or not. Through static incidence analysis the study will give insights on the total cost of the subsidy to the government, who benefits from the existing subsidies and to what extent they benefit. The analysis will also give insights on the targeting performance of the subsidy, hence its effectiveness on poverty reduction and income redistribution. Static incidence analysis provides the baseline upon which to evaluate simulated subsidy reforms. The approach developed by Komives et al (2005), Angel-Urdinola and Wodon (2005) and Ore et al (2017) will be used in conducting incidence analysis.

Identifying which households get the subsidy and how much they get

In order to identify the households who receive a subsidy and those that do not receive it, as well as to measure the level of subsidy received, the study follows the approach similar to that used by Ore et al (2017). These steps are as follows:

a) The electricity expenditure in the household survey includes ancillary charges and fees such as the 6% rural electrification levy. These ancillary charges and fees are removed from the expenditure so as to get the expenditure which is reflective of the actual electricity consumed. Failure to remove these charges and fees would lead to the over-estimation of the quantity of electricity consumed. The electricity prices given by ZETDC in the tariff schedule exclude the rural electrification levy but when consumers are paying for electricity not all the amount goes to the actual kWh consumed as the 6% is deducted to go towards the levy. A simplifying assumption is made that all households did not have debts that they were paying for in their current bills[33]. Including payment of arrears in the current bill will lead to overestimation of current consumption. However, information on arrears is not available in the household survey, hence this simplifying assumption of no arrears.

b) To calculate the quantity of electricity consumed by each household, the tariff schedule that existed during the time of the reported expenditure by the household is applied to the expenditure obtained from step (a). Residential electricity pricing in Zimbabwe is

[33] This assumption is reasonable because most of the electricity in Zimbabwe is prepaid and there has been about 7 years since pre-paid meters were installed. During these 7 years we expect that all households should have cleared their arrears.

based on the IBT scheme, therefore when household ***h's*** total expenditure on electricity falls within the first block, the quantity consumed $kWh_{h,1}$ is estimated easily by dividing its electricity expenditure $e_{h,1}$ which falls within the first block by the tariff p_1 applicable to the first block as follows:

$$kWh_{h,1} = \frac{e_{h,1}}{p_1} \qquad (1)$$

However, if household ***h's*** total electricity expenditure falls in any other consumption block b outside the first consumption block, then the quantity consumed $kWh_{h,b}$ will be obtained by deducting the maximum possible expenditure in the previous consumption block e_{b-1} from the households total electricity expenditure e_{h-b} and dividing the outcome by the tariff p_b which is applicable to the consumption block that the household belongs. Then add all the maximum quantities of the consumption blocks *j* which precede the consumption block b where the household's total consumption belongs. The formula is as follows:

$$kWh_{h,b} = \frac{e_{h,b} - \bar{e}_{b-1}}{p_b} + \sum_{j=1}^{b-1} Q_j \qquad (2)$$

The same reasoning behind the formula is applied in any other tariff schedule such as VDT. As an example, consider an IBT schedule with three blocks and a household h who spends US$40 on electricity per month as depicted in Table 1 below.

Table A1.1: Example tariff structure

Block number *b*	Consumption block (min-max) kWh	Max. consumption per block *Q*	Applicable Tariff (US$/kWh) *p*	Max. possible exp. per block $e_{h,b}$
1	0-50	50	0.10	5
2	51-200	200	0.16	24
3	201 and more	>200	0.20	>24

c) Clearly, the household's expenditure is greater than US$24 and therefore its consumption block should be b=3 where it consumes more than 200kWh. Therefore the household's total quantity consumed for the month given an expenditure of US$40 will be calculated as follows:

[(US$40-US$24)/US$0.20] kWh + 200kWh + 50kWh = 330kWh

d) The unit average price of electricity faced by each household is obtained by dividing electricity expenditure obtained in step (a) by the quantity of electricity consumed obtained in step (c).

The average cost of generating, transmitting and distributing electricity to residential consumers, assuming efficient operations, will be obtained from Zimbabwe Electricity Distribution and Transmission Company (ZETDC). Alternatively, it will be calculated by dividing the total residential electricity sales revenue of ZETDC by the total number of kWh sold, after imposing the assumption that revenues and expenses of ZETDC are balanced and that ZETDC faces the same average cost for all residential consumers.

e) The financial value of the subsidy for each household is calculated by subtracting from the average cost of generating, transmitting and distributing electricity obtained from step (d) the unit price of electricity paid by the household obtained in step (c) and multiplying that by the total quantity of electricity consumed obtained from step (a). This approach of calculating the financial value of a subsidy received by the households is called the price-gap approach. The financial value of the subsidy is important in understanding how subsidies affect the use of public funds and the financial health of the utilities provider and is an appropriate measure of the cost to the government or the utility of providing the subsidy (Komives et al, 2005).

f) If the subsidy obtained from step (e) is positive, then that particular household received a subsidy and if on the other hand it is negative then that particular household did not receive a subsidy but rather cross-subsidized other households.

Calculating subsidy targeting performance indicators

After getting the financial value of the subsidy for each household, the study will rank households according to their income levels. A poverty line will then be decided on in order to decide which households are poor and which ones are non-poor. Since the PICES data to be used is for 2017, the household poverty datum line for 2017 reported by Zimstat will be used to generate a binary indicator showing the poverty status of the households. With the financial value of the subsidy for each household and the indicator for poverty status, three dimensions of subsidy targeting performance will be measured. These dimensions are: (i) benefit incidence, (ii) beneficiary incidence and (iii) subsidy material value (or subsidy depth).

The benefit incidence informs how well the subsidy instrument targets the poor vis-à-vis the other households (i.e. pro-poorness of the subsidy). It is the share of subsidy benefits received by the poor divided by the share of the household that are poor. A value of 1 means the subsidy is neutral; a value greater than 1 means subsidy is progressive (benefits the poor more than the rich); and a value of zero means none of the poor benefits. The beneficiary incidence shows the extent of subsidy miss-targeting, measured by the error of exclusion (i.e. the proportion of the poor who do not receive a subsidy) or the distribution of the subsidy beneficiaries across income quintiles. The material value of the subsidy shows the significance of the value of the subsidy received by the poor, thus informing about the generosity and impact of the subsidy on the poor. It is measured by the average value of the subsidy received by poor households as a percentage of their average income.

Decomposing subsidy targeting performance

The three dimensions of subsidy targeting performance described above do not show the drivers of the performance of the subsidy. Therefore the study follows the approach by Angel-Urdinola and Wodon (2005) to decompose the benefit incidence into access and subsidy design factors that influence the overall performance of the subsidy. This will inform the policy makers about the potential areas of reform in the short- and long-term to enhance the impact of the subsidy on poverty reduction. The approach decomposes benefit incidence into five factors: (i) access to the grid (i.e. the grid is in the neighbourhood of the household), (ii) uptake or rate of connections to the grid by households that have access to the grid, (iii) targeting, (iv) rate of subsidization, and (v) quantity consumed. Factors (i) and (ii) are access factor while factors (iii) to (v) are subsidy design factors. Mathematically, the benefit incidence is decomposed as follows:

$$Benefit\ incidence = \frac{A_P}{A_H} * \frac{U_{P/A}}{U_{H/A}} * \frac{T_{P/U}}{T_{H/U}} * \frac{R_{P/T}}{R_{H/T}} * \frac{Q_{P/T}}{Q_{H/T}} \qquad (3)$$

where $\frac{A_P}{A_H}$ the ratio of the share of poor households that have potential access to electricity to the share of all households with potential access to electricity; $\frac{U_{P/A}}{U_{H/A}}$ is the ratio of the uptake rate among the poor to the uptake rate among all the household (i.e. the ratio of the shares of poor to all households that actually use electricity because the decide to connect to the grid); $\frac{A_P}{A_H} * \frac{U_{P/A}}{U_{H/A}}$ is the ratio of the actual connection rate among the poor to the actual connection rate among all households (i.e. the ratio of the share of poor households that are connected and use electricity to the share of all households that are connected and use electricity); $\frac{T_{P/U}}{T_{H/U}}$ is the ratio of the share of poor households with access and connection who are targeted and actually receive a subsidy to the share of all households with access and connection who are targeted and actually receive a subsidy; $\frac{R_{P/T}}{R_{H/T}}$ is the ratio of the average rate of subsidization for the poor to the average rate of subsidization of all households[34]; and $\frac{Q_{P/T}}{Q_{H/T}}$ is the ratio of average quantity of electricity consumed by the poor subsidy recipients to the average quantity of electricity consumed by all households who are subsidy recipients.

[34] $R_{H/T} = 1 - E_{H/T}/(Q_{H/T} * C)$ where C is the average total cost of service a consumer, EH/T is the average expenditure on the utility, in this case electricity and $Q_{H/T}$ is the average quantity of electricity consumed by the subsidy recipient.

Subsidy reform simulations

The simulation of electricity subsidy reforms in the study is based on the standard economic consumer's choice model suggested by Araar and Verme (2012). They show that electricity subsidy reform simulations can be done using less information such as a household budget survey showing household total expenditure/income, expenditure on electricity, a poverty line, own-price elasticity of electricity, and tariff schedules for electricity. They show that from the standard economic consumer's choice model the formulae for estimating real changes in household welfare and government revenue due to electricity subsidy reforms are as follows:

Estimating welfare changes due to subsidy reform

The study will simulate the impact of subsidy reforms. The variables used to evaluate the different kinds of reforms are: (a) the impact of the reform on household welfare; (b) the impact of the reform of government revenues; (c) the size of cash transfers that would be required by the government offset poverty as a result of the reform; and (d) the impact on the government budget. The simulation of subsidy reforms will be based on the marginal and Cobb-Douglas function approaches of modelling consumer behaviour as suggested by Araar and Verme (2012). The approaches estimate change in household welfare as change in total household expenditure due to a change in the price of the subsidized product. Under the marginal approach, change in welfare is derived as follows: suppose e is total household expenditure, p is price, q is quantity consumed, ' denote post-reform values, subscript 1 denote subsidized product and subscript 2 denote bundle of all other products consumed. Therefore total expenditure before subsidy reform is given by:

$$e = p_1 q_1 + p_2 q_2 \qquad (4)$$

The post-reform subsidy expenditure is given by:

$$e' = p_1' q_1 + p_2 q_2 \qquad (5)$$

The change in expenditure is given by subtracting post subsidy expenditure (equation 4) from expenditure before subsidy reform (equation 5) as follows:

$$e - e' = q_1(p_1 - p_1') \qquad (6)$$

Equation (6) can be re-written as follows:

$$\Delta e = q_1 \Delta p_1 \qquad (7)$$

Equation (7) is equivalent to the expression below (after multiplying the RHS by p_1/p_1):

$$\Delta e = e_1 dp_1 \qquad (8)$$

where ***dp*** is relative price change **($\Delta p_1/p_1$)** and **Δ*e*** is interpreted as a decrease in welfare in the case of price increase and an increase in welfare in the case of a decrease in price of a product. This method of defining welfare change has the advantage that it applies with any behavioural response of households such as changing quantities consumed of a subsidized product or substituting the subsidized product with other products. In other words, the estimated household welfare change will remain the same no matter how a household choose to reorganise their consumption due to the change in price of the subsidized good (Araar and Verme, 2012). In the case of electricity where there is multiple pricing (e.g. using the IBT or VDT schemes), welfare change is estimated by:

$$\Delta e_h = -\sum_{b=1}^{B} e_{1,h,b}\, dp_{1,b} \qquad (9)$$

where b represents consumption blocks and h represents households; the summation across households indicates the total welfare change for all households. The marginal approach is suitable for small to moderate changes in prices. Its use on large price changes tend to over-estimate the change in household welfare. Therefore the Cobb-Douglas function approach is used to avoid the pitfall of the marginal approach when price change is high. Thus for multiple pricing of electricity where consumer behaviour is modelled using a Cobb-Douglas function, the change in household welfare is given by:

$$\Delta e_h = e_{1,h}\left(\frac{1}{\prod_{m=1}^{M}(\varphi_{m,h})^{\alpha_{m,h}}} - 1\right) \qquad (10)$$

where $\boldsymbol{\varphi_{m,h}}$, is the average weighted post-reform price of household ***h*** for good ***m*** and $\boldsymbol{\alpha_{m,h}}$ is household h's expenditure share of good m. The operator $\prod_{m=1}^{M}$ means the product of average weighted prices raised to the power of the respective expenditure shares of the goods ***m=1*** up to ***m=M.***

Estimating changes in quantities consumed of the subsidized electricity

It is important for policy makers to know the estimates of changes in the quantities of the subsidized good as a result of subsidy reform. This informs policy makers on the impact of the reform on the production of the subsidized good. It also informs the policy makers on the impact of the reforms on government revenues since the reduction in consumption of the subsidized good results in reduced government spending on the subsidized good. However, the estimates of changes in quantities consumed require knowledge of the demand function and the price-elasticity of the subsidized good. The basic formula used in the study to estimate the changes in the quantities of electricity consumed due to subsidy reform is given by:

$$\Delta q_1 = q_1 dp_1 \varepsilon_1 \qquad (11)$$

where ε_1 is the own-price elasticity of the subsidized good taking values between -1 and 0, and other variables are defined as in the equations above. A simplifying assumption is made that all households behave equally so that the total impact on quantities consumed is just the sum of the changes in quantities consumed across all households. The own-price elasticity of electricity is obtained from estimates in literature of similar countries as Zimbabwe and the results will be presented taking into account the lower and upper bound of elasticities.

Estimating changes in expenditure on the subsidized good due to price changes

The general formula for the change in the nominal expenditure of the subsidized good k, for household h, for consumption which falls under block b, after ***dpk*** price change in the block is given by:

$$\widetilde{\Delta e_{k,h,b}} = \sum_{b=1}^{B} e^{0}_{k,h,b} dp_{k,h} (1 + \in_{k,h})$$

where $\widetilde{\Delta e_{k,h,b}}$ is the nominal change in expenditure after the price change, $e^{0}_{k,h,b}$ is the initial expenditure, $\in_{k,h}$ is the price elasticity of household h on good k.

Estimating changes in government revenues due to subsidy reform

The change in nominal government revenue for a multiple priced good such as electricity is given by:

$$\widetilde{\Delta r} = \sum_{h=1}^{H} \sum_{b=1}^{B} e^{0}_{k,h,b} dp_{k,b} (1 + \in_{k,h} \left(1 + dp_{k,b}\right))$$

where $\widetilde{\Delta r}'$ is the nominal change in government revenue, $e^{0}_{k,h,b}$ is the initial expenditure of household h on subsidized good k consumed in the consumption block b, $\boldsymbol{dp_{k,b}}$ is the proportion of price change of good k in the consumption block b and $\in_{k,h}$ is the price elasticity of subsidized good k for household h. When the interaction between the quantity and price changes are taken into account, the nominal government revenue would be given by:

$$\widetilde{\Delta r} = \sum_{h=1}^{H} \sum_{b=1}^{B} e^{0}_{k,h,b} dp_{k,b} (1 + \in_{k,h})$$

However, Araar and Verme (2012) note that the interaction between price and quantity changes should be neglected using the first order approximation rule. In addition, the interaction converges to zero when the price change is relatively small.

Estimating transfers to offset increase in poverty as a result of subsidy reforms

To estimate the transfers for compensating the increase in poverty after subsidy reform, the households who were initially non-poor and become poor as a result of the reform are identified. The total amount of transfers to all households to ensure that poverty level does not change is calculated by multiplying the difference between the poverty line and the per capita household expenditure after the reform by the household size and the household weights.

Estimation of inequality before and after the subsidy reform

Inequality is estimated on the distribution of total household expenditures before and after the subsidy reforms using the Gini coefficient.

Time horizon for simulations

Medium term is the time horizon considered in the study for the reasons highlighted by Araar and Verme (2012) that it is the more realistic time horizon for developing countries. The short-term horizon assumes that the household maintains its consumption of the subsidized good by increasing expenditure through savings, which is unrealistic for developing countries were disposable incomes are very low. The long-term horizon assumes knowledge of households' life-cycle behavioural attitudes of savings and investment and requires know of current savings behaviour, which increases data requirements and complicates the analysis. In addition, medium-term effects are more likely to affect the political cycle and social instability than short-term and long-term effects.

Inflation adjustments

A consumer price index (CPI) which imply the price change of the subsidized good only as given by the Laspeyres index is as follows:

$$(1 + \pi_k) = (1 + dp_k)^{\alpha_k}$$

where $\boldsymbol{\pi_k}$ is increase in average price of the subsidized good k and α_k is the average share in total expenditure of the subsidized good k. When α_k is relatively small, π_k tends to zero and therefore its impact can be ignored, which is the case with most subsidized goods. In the first period before a price change, the average price is normalized to 1. The CPI is used to deflate nominal values into real values.

Subsidy reform simulation scenarios considered

The study will get clues on possible reforms from literature and the review of the current subsidy regime to inform potential reform strategies. Interviews will be conducted with relevant stakeholders to decide on the plausible reforms they would like to consider for Zimbabwe. The selected reform options will then be simulated. Some potential reforms identified from literature include the following:

- Increasing in electricity price e.g. different price changes across different blocks of the IBT or VDT schemes;
- Changing the targeting strategy e.g. means-tested targeting;
- Changing the subsidy scheme e.g. IBT versus VDT or a combination of both;
- Changing the structure of the IBT or VDT e.g. changing the number of blocks;
- Changing the margins of each block in the IBT or VDT schemes in order to change the number of consumers in the blocks; and
- Whether to issue subsidies on consumption or on connection.

ANNEX 2: ZETDC IBT SCHEDULES

Annex 2.1: June 2020 IBT Schedule

ZIMBABWE ELECTRICITY TRANSMISSION & DISTRIBUTION COMPANY

ZETDC ADDS ANOTHER LOW COST BAND TO THE STEPPED TARIFF

The Zimbabwe Electricity Transmission and Distribution Company (ZETDC) is pleased to announce the introduction of a lower priced tariff band in order to better improve the customer experience, with the new tariff band being a positive response to customer requests for lower priced Units beneath the premium band effective 12th June 2020.

The Domestic Stepped Tariffs with the new band are as follows:

Domestic Prepayment Tariff	
Consumption Band	**Cost (Price) per Band**
(i) 0 - 50 kWh	$26 (@ 52c/kWh)
(ii) 51 to 200 kWh	$172 (@ $1.14/kWh)
(iii) 201 to 300 kWh	$ 312 (@$3.12/kWh) (new tariff band)
(iv) From 301 kWh	(@ $4.88/ kWh)

The tariffs above include 6% Rural Electrification Levy

In every calendar month, customers are allocated 50 units at a lifeline tariff rate of $0.52 costing $26, including levies. The next 150 kWh (51 to 200 kWh) in the same calendar month being charged at $1.14 cost $172, including levies.

The new tariff band consisting of 100 kWh, which stretches from 201 to 300 kWh, will therefore cost $312.00, including levies.

Any additional purchase in excess of 300 kWh within the same calendar month will still be charged at a rate of $4.88/kWh, including levies.

In addition, the customer perception that power is cheaper at the beginning of the month is **NOT CORRECT**, and was leading to very high transaction volumes at the beginning of each month, resulting in the significant slowing down of the vending system. The 300 Units are enjoyed once a month when customers make the first Token purchase of units on **ANY DAY** during any calendar month, therefore it is **NOT TRUE** that electricity is cheaper when purchases are done within the first five days of the month.

In response to the high month-end demand for prepaid tokens by customers, the power utility is in the process of upgrading the Electricity Token Vending system to ensure that it operates efficiently.

ZETDC introduced the domestic stepped tariff in August 2019 to encourage consumers to use electricity efficiently and to make power affordable to low consumption households. The stepped tariff has different prices for various consumption bands. Higher consumption attracts a higher tariff and customers are thus advised to buy electricity that is sufficient to their monthly needs.
In order to assist customers, prepayment vouchers indicate how the units purchased are charged and the bands to which they belong, in compliance with the provisions as set by the Regulator.

PUBLIC RELATIONS (12/06/2020)

For more information contact us on:
Website : www.zetdc.co.zw
Email : pr@zetdc.co.zw
: marketing@zetdc.co.zw
Twitter : @ZetdcOfficial
Facebook : @ZetdcOfficial
WhatsApp ONLY : +263 784707470

Annex 2.2: Oct 2019-March 2020 IBT Schedule

ELECTRICITY TARIFFS - EFFECTIVE 3 OCTOBER 2019

It is hereby notified that the Zimbabwe Energy Regulatory Authority has, in terms of section 53 of the Electricity Act [Chapter 13:19], approved the following prices for the supply of electricity to customers with effect from 3 October, 2019.

Domestic Metered Customers

Conventional Meter		E1.1
a) Fixed Monthly Charge		$6.08
b) Energy charge per kWh	(i)1st 50 kWh	$0.41
	(ii) 51 to 200 kWh	$0.91
	(iii) Balance	$3.87

Prepayment Meter	Standard E1.2.1	Stepped E1.2.2
(i) 1st 50kWh	$1.81	$0.41
(ii) 51 to 200kWh	$1.81	$0.91
(iii) Balance	$1.81	$3.87

Domestic Load Limited E1.3

Amperage	1.0 Amp	2.5 Amp	5.0 Amp	7.5 Amp	10.0 Amp	15.0 Amp	22.5 Amp	30.0 Am
a) Fixed Monthly Charge	$6.08	$6.08	$6.08	$6.08	$6.08	$6.08	$6.08	$6.08
b) Fixed Amperage Charge	$12.31	$18.79	$29.60	$40.40	$51.20	$72.81	$98.29	$115.23

Public Lighting

	Metered E2.1	Unmetered E2.2
a) Fixed Monthly Charge	$37.21	n/a
b) Energy charge per kWh	$1.84	n/a
c) Monthly charge per watt of installed capacity of luminaire	n/a	$0.59

Mining, Industrial, Commercial & Pumping Works

Low Voltage Supply E3.1, E4.1	
a) Fixed Monthly Charge	$37.21
b) Energy charge per kWh	$2.00

Mining, Industrial, Commercial & Pumping Works Customers - Maximum Demand

	0.4kV Supply E3.1.04 ,E4.1.04	11kV Supply E3.2.11, E4.2.11	33kV Supply E3.2.33, E4.2.33	Secondary Distribution E6.1
a) Fixed Monthly Charge	$37.21	$37.21	$37.21	$37.21
b) A monthly capacity charge per unit of demand	$109.85	$95.40	$69.98	$44.80
c) An interruptable demand charge	n/a	n/a	n/a	$33.60
d) On-Peak Energy charge per kWh	$2.24	$2.24	$2.24	$2.24
e) Standard Energy charge per kWh	$1.20	$1.20	$1.20	$1.20
f) Off-Peak Energy charge per kWh	$0.69	$0.69	$0.69	$0.69

Agricultural Customers

	Low Voltage E5.1	0.4kV Supply E 5.1.04	11kV Supply E5.2.11	33kV Sup E5.2.33
a) Fixed Monthly Charge	$37.21	$37.21	$37.21	$37.21
b) A monthly capacity charge per unit of demand	n/a	$50.05	$43.47	$31.88
c) An interruptable demand charge	n/a	n/a	n/a	n/a
d) On-Peak Energy charge per kWh	$0.91	$1.02	$1.02	$1.02
e) Standard Energy charge per kWh	$0.91	$0.55	$0.55	$0.55
f) Off-Peak Energy charge per kWh	$0.91	$0.31	$0.31	$0.31

Institutions (Government, Municipal, Mission Schools, Hospitals and Clinics)

	Low Voltage E4.3	0.4kV Supply E 4.3.04	11kV Supply E4.3.11	33kV Supply E4.3.33
a) Fixed Monthly Charge	$37.21	$37.21	$37.21	$37.21
b) A monthly capacity charge per unit of demand	n/a	$109.85	$95.40	$69.98
c) An interruptable demand charge	n/a	n/a	n/a	n/a
d) On-Peak Energy charge per kWh	$2.00	$2.24	$2.24	$2.24
e) Standard Energy charge per kWh	$2.00	$1.20	$1.20	$1.20
f) Off-Peak Energy charge per kWh	$2.00	$0.69	$0.69	$0.69

PREPAYMENT TARIFFS

Low Voltage	Energy charge per kWh
Agricultural	$0.91
Mining, Industrial, Commercial, Institutions	$2.00

Notes

i) The rates are exclusive of the 6% Rural Electrification Levy and 15% VAT. In terms of Statutory Instrument 168 of 2012, electricity charges for Domestic customers are zero rated for VAT and in terms of Statutory Instrument 215 of 2005, fixed charges on Commercial and Domestic electricity are zero rated for VAT.

ii) Maximum Demand (MD) customers are urged to peak during off-peak periods. For a customer who attains MD during off-peak, the applicable MD is the one attained during the peak or standard period.

iii) Time of Use periods:

	Hour																							
Day of Week	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Sunday / Holiday	O	O	O	O	O	O	O	S	S	S	S	S	S	S	S	S	S	P	P	P	S	S	O	O
Week-day	O	O	O	O	O	O	O	P	P	P	P	P	S	S	S	S	S	P	P	P	P	S	O	O
Saturday	O	O	O	O	O	O	O	P	P	P	P	S	S	S	S	S	S	P	P	P	S	S	O	O

Time of Use	
Peak	(red)
Standard	(yellow)
Off-Peak	(green)

iv) All customers are encouraged to use power efficiently.

(v) These prices will be reviewed monthly.

R.T. Katsande
Acting Managing Director

Source: ZETDC

NOTICE OF 2020 ELECTRICITY TARIFF INDEXATION

The Zimbabwe Electricity Transmission and Distribution Company (ZETDC) has adjusted the electricity tariffs by 19.02%. This is in accordance with the Tariff Award of 2 October 2019, which approved impler monthly tariff indexation formula, that takes into account the movement of macroeconomic fundamentals such as exchange rate and inflation, for changes above 10%. Below are the tariffs that will be applicabl March 2020.

Domestic Metered Customers

Conventional Meter	E1.1
a) Fixed Monthly Charge	$7.24
b) Energy charge per kWh (i)1st 50 kWh	$0.49
(ii) 51 to 200 kWh	$1.08
(iii) Balance	$4.61

Prepayment Meter	Standard E1.2.1
(I) 1st 50kWh	$2.15
(ii) 51 to 200kWh	$2.15
(iii) Balance	$2.15

Domestic Load Limited E1.3

Amperage	1.0 Amp	2.5 Amp	5.0 Amp	7.5 Amp	10.0 Amp	15.0 Amp	22.5 Amp
a) Fixed Monthly Charge	$7.24	$7.24	$7.24	$7.24	$7.24	$7.24	$7.24
b) Fixed Amperage Charge	$14.65	$22.36	$35.23	$48.08	$60.94	$86.66	$116.98

Public Lighting

	Metered E2.1	Unmetered E2.2
a) Fixed Monthly Charge	$44.29	n/a
b) Energy charge per kWh	$2.19	n/a
c) Monthly charge per watt of installed capacity of luminaire	n/a	$0.70

Mining, Industrial, Commercial & Pumping Wo

Low Voltage Supply E3.1, E4.1	
a) Fixed Monthly Charge	
b) Energy charge per kWh	

Mining, Industrial, Commercial & Pumping Works Customers - Maximum Demand

	0.4kV Supply E3.1.04 ,E4.1.04	11kV Supply E3.2.11, E4.2.11	33kV Supply E3.2.33, E4.2.33	Secondary Distribution E6.1
a) Fixed Monthly Charge	$44.29	$44.29	$44.29	$44.29
b) A monthly capacity charge per unit of demand	$130.74	$113.54	$83.29	$53.32
c) An interruptable demand charge	n/a	n/a	n/a	$39.99
d) On-Peak Energy charge per kWh	$2.67	$2.67	$2.67	$2.67
e) Standard Energy charge per kWh	$1.43	$1.43	$1.43	$1.43
f) Off-Peak Energy charge per kWh	$0.82	$0.82	$0.82	$0.82
g) Reactive Energy charge per KVArh	$0.195	$0.195	$0.195	$0.195

Agricultural Customers

Low Voltage E5.1	0.4kV Supply E 5.1.04	11kV Supply E5.2.11	3
$44.29	$44.29	$44.29	
n/a	$59.57	$51.74	
n/a	n/a	n/a	
$1.08	$1.21	$1.21	
$1.08	$0.65	$0.65	
$1.08	$0.37	$0.37	
n/a	$0.195	$0.195	

Institutions: (Government, Municipal, Mission Schools, Hospitals and Clinics)

	Low Voltage E4.3	0.4kV Supply E 4.3.04	11kV Supply E4.3.11	33kV Supply E4.3.33
a) Fixed Monthly Charge	$44.29	$44.29	$44.29	$44.29
b) A monthly capacity charge per unit of demand	n/a	$130.74	$113.54	$83.29
c) An interruptable demand charge	n/a	n/a	n/a	n/a
d) On-Peak Energy charge per kWh	$2.38	$2.67	$2.67	$2.67
e) Standard Energy charge per kWh	$2.38	$1.43	$1.43	$1.43
f) Off-Peak Energy charge per kWh	$2.38	$0.82	$0.82	$0.82
g) Reactive Energy charge per KVArh	n/a	$0.195	$0.195	$0.195

PREPAYMENT TARIFFS

Low Voltage	Energy charge p
Agricultural	$1.08
Mining, Industrial, Commercial, Institutions	$2.38

Notes

i) The rates are exclusive of the 6% Rural Electrification Levy and 15% VAT. In terms of Statutory Instrument 168 of 2012, electricity charges for Domestic customers are zero rated for VAT and in terms of Statutory Instrument 215 of 2005, fixed charges on Commercial and Domestic electricity are zero rated for VAT.

ii) Maximum Demand (MD) customers are urged to peak during off-peak periods. For a customer who attains MD during off-peak, the applicable MD is the one attained during the peak or standard period.

iii) Reactive energy charge will be applied when the customer's power factor is less than 0.90. This is with effect from 1 January 2020.

iv) Time of Use periods:

	Hour																							
Day of Week	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Sunday / Holiday	O	O	O	O	O	O	O	S	S	S	S	S	S	S	S	S	S	P	P	P	S	S	O	O
Week-day	O	O	O	O	O	O	O	P	P	P	P	P	S	S	S	S	S	P	P	P	P	S	O	O
Saturday	O	O	O	O	O	O	O	P	P	P	P	S	S	S	S	S	S	P	P	P	S	S	O	O

Time of Use

Peak
Standard
Off-Peak

v) All customers are encouraged to use power efficiently.

(v) These prices will be reviewed monthly.

Eng. R.T. Katsande
Acting Managing Director

Source: ZETDC

Annex 2.3: 2017 IBT Schedule

Electricity Tariffs - Effective SEPTEMBER- DECEMBER 2014

It is hereby notified that the Zimbabwe Energy Regulatory Authority has, in terms of section 53 of the Electricity Act [Chapter 13:19], approved the following prices for the supply of electricity to customers with effect from 1 September, 2014.

Domestic Metered Customers

Conventional Meter	E1.1
a) Fixed Monthly Charge	$0.00
b) Energy charge per i (i)1st 50 kWh	$0.02
(ii) 51 to 300 kWh	$0.11
(iii) Balance	$0.15

Prepayment Meter	Standard E1.2.1	Stepped E1.2.2
(i) 1st 50kWh	$0.10	$0.02
(ii) 51 to 300kWh	$0.10	$0.11
(iii) Balance	$0.10	$0.15

Domestic Load Limited E1.3

Amperage	1.0 Amp	2.5 Amp	5.0 Amp	7.5 Amp	10.0 Amp	15.0 Amp	22.5 Amp	30.0 Amp
a) Fixed Monthly Charge								
a) Fixed Amperage Charge	$4.64	$7.08	$11.14	$15.21	$19.28	$27.41	$37.01	$43.39

Public Lighting

	Metered E2.1	Unmetered E2.2
a) Fixed Monthly Charge	$0.00	n/a
b) Energy charge per kWh	$0.11	n/a
c) Monthly charge per watt of installed capacity of luminaire	n/a	$0.03

Mining, Industrial, Commercial & Pumping Works

Low Voltage Supply E3.1, E4.1	
a) Fixed Monthly Charge	$0.00
b) Energy charge per kWh	$0.12

Mining, Industrial, Commercial & Pumping Works Customers - Maximum Demand

	11kV Supply E3.2.11, E4.2.11	33kV Supply E3.2.33, E4.2.33	Secondary Distribution E6.1
a) Fixed Monthly Charge	$0.00	$0.00	$0.00
b) A monthly capacity charge per unit of demand	$5.54	$4.07	$2.60
c) An interruptable demand charge	n/a	n/a	$1.95
d) On-Peak Energy charge per kWh	$0.13	$0.13	$0.13
e) Standard Energy charge per kWh	$0.07	$0.07	$0.07
f) Off-Peak Energy charge per kWh	$0.04	$0.04	$0.04

Agricultural Customers

	Low Voltage E5.1	11kV Supply E5.2.11	33kV Supply E5.2.33
a) Fixed Monthly Charge	$0.00	$0.00	$0.00
b) A monthly capacity charge per unit of demand	n/a	$5.54	$4.07
c) An interruptable demand charge	n/a	n/a	n/a
d) On-Peak Energy charge per kWh	$0.12	$0.13	$0.13
e) Standard Energy charge per kWh	$0.12	$0.07	$0.07
f) Off-Peak Energy charge per kWh	$0.12	$0.04	$0.04

Institutions: (Government, Municipal, Mission Schools, Hospitals and Clinics)

	Low Voltage E4.3	11kV Supply E4.3.11	33kV Supply E4.3.33
a) Fixed Monthly Charge	$0.00	$0.00	$0.00
b) A monthly capacity charge per unit of demand	n/a	$5.54	$4.07
c) An interruptable demand charge	n/a	n/a	n/a
d) On-Peak Energy charge per kWh	$0.12	$0.13	$0.13
e) Standard Energy charge per kWh	$0.12	$0.07	$0.07
f) Off-Peak Energy charge per kWh	$0.12	$0.04	$0.04

PREPAYMENT TARIFFS

	Energy charge per kWh
Low Capacity	$0.12

Notes

i) The rates are exclusive of the 6 % Rural Electrification Levy and 15% VAT. In terms of Statutory Instrument 168 of 2012, electricity charges for Domestic customers are zero rated for VAT and in terms of Statutory Instrument 215 of 2005, fixed charges on Commercial and Domestic electricity are zero rated for VAT.

ii) Maximum Demand (MD) customers are urged to peak during off-peak periods. For a customer who attains MD during off-peak, the applicable MD is the one attained during the peak or standard period.

iii) Time of Use periods:

	Hour																							
Day of Week	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Sunday / Holiday	O	O	O	O	O	O	O	S	S	S	S	S	S	S	S	S	S	P	P	P	S	S	O	O
Week-day	O	O	O	O	O	O	O	P	P	P	P	P	S	S	S	S	S	P	P	P	P	S	O	O
Saturday	O	O	O	O	O	O	O	P	P	P	P	S	S	S	S	S	S	P	P	P	S	S	O	O

Time of Use	
Peak	(red)
Standard	(yellow)
Off-Peak	(green)

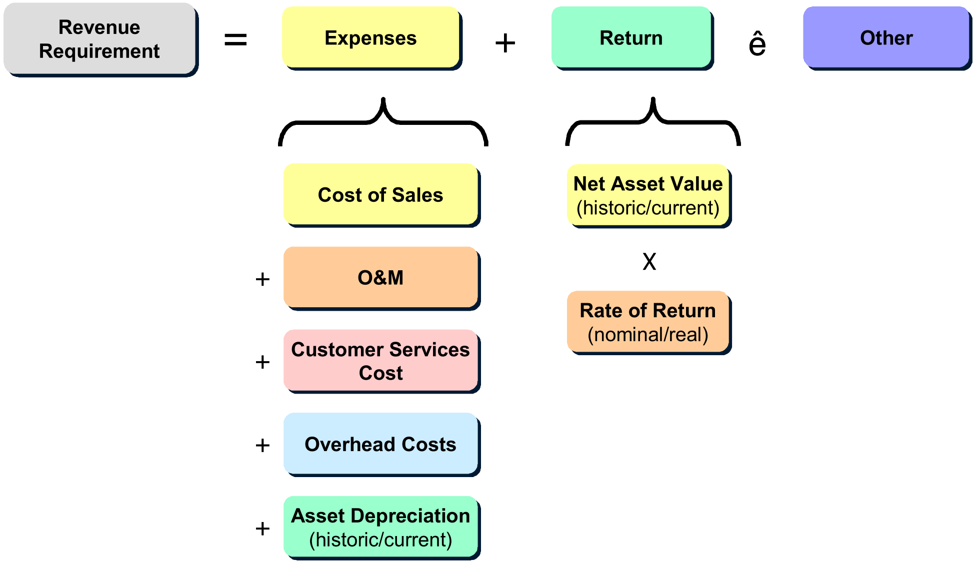
iv) All customers are encouraged to use power efficiently.

J.M. Chinembiri
Managing Director

Source: ZETDC

Annex 3: Additional Information Figures and Tables

Figure A3.1: Rate of return methodology of electricity pricing



Source: ZERA

Table A3.1 : ZESA cost of generating power

		2014	2016	2017
a	ZPC Operating expenditure ($)	474,274,829.00	374,083,080.00	357,385,965.00
b	ZETDC operating expenditure ($)	1,016,071,091.00	945,102,753.00	861,620,936.00
c	Total Costs ($)	1,490,345,920.00	1,319,185,833.00	1,219,006,901.00
d	Total revenue (US$)	799,922,819.10	732,221,918.90	759,501,686.50
e	Units Sold (kWh)	8,254,000,000	7,318,000,000	7,913,000,000
f	Implied average cost of supply US$/kWh (c/e)	0.1806	0.1803	0.1541
g	Implied average price US$/kWh (d/e)	0.0971	0.1004	0.0966

Source: ZETDC and ZPC

Table A3.2: Selected generation, transmission and plant O&M efficiency indicators

Transmission efficiency indicators			
Indicator	**benchmark**	**present level**	**regional level**
operating costs	2.5% - 5% of gross asset value	15%	5% common
losses	3% - 5% of energy transmitted	4%	4%-5% common
Thermal power plant efficiency indicators			
Iindicator	**year of commission**	**current thermal efficiency**	**target thermal efficiency**
Hwange	1983-87	26.10%	>30%
Harare	1955-58	14.70%	>20%
Munyati	1946-57	16.50%	>20%
Bulawayo	1947-57	16.70%	>20%
Plant O&M efficiency indicators			
Indicator	**current (US$/kWh/ year) based on reliable capacity**	**target (US$/kWh/ year) on reliable capacity1**	
Hwange	131.2	<75	
Harare	566.3	<125	
Munyati	255.9	<125	
Bulawayo	323.7	<125	
Kariba	11.2	<15	
Energy availability factors			
Indicator	current	target	
Hwange	60%	>80%	
Harare	61%	>80%	
Munyati	41%	>80%	
Bulawayo	37%	>80%	
Kariba	95%	>90%	

Source: ZERA Cost of Supply Study, 2013
Note: 1. recommended target based on international benchmark

Annex 4: Comparative Statistics and Analysis using 2017 PICEs Food Line (Extreme) Poverty

Figure A4.1: Electricity access, connection and uptake, 2017

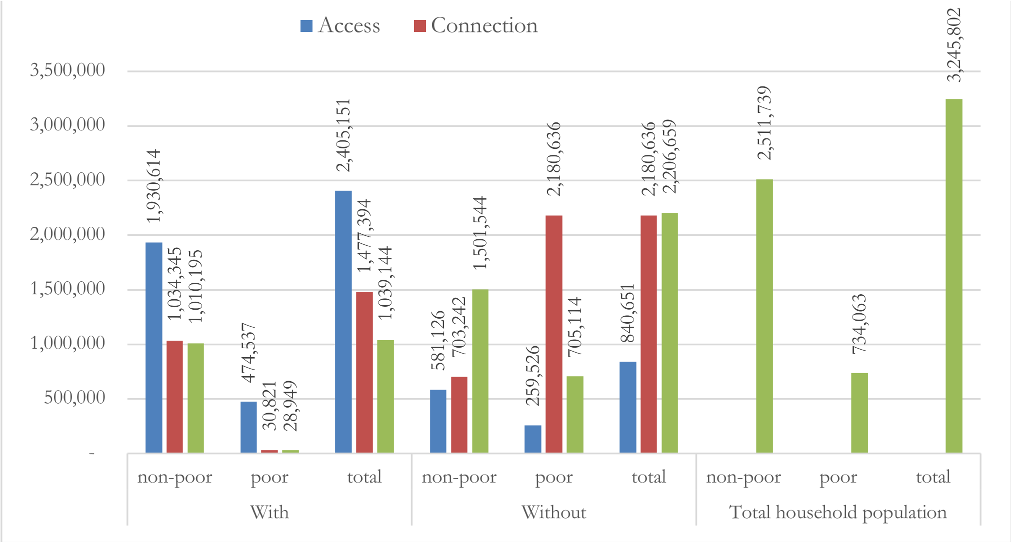


Table A4.1: Electricity consumption, prices and subsidies in Zimbabwe, 2017

	non-poor	poor	total
Quantity consumed (kWh) per month	232,985,827.46	3,410,081.16	236,395,908.62
Average quantity consumed (kWh) per month	230.6344673	117.7981839	227.4910699
Electricity expenditure (US$) per month	22,208,164.88	245,953.41	22,454,118.29
Average electricity expenditure (US$) per month	21.98403368	8.496239216	21.60829019
Average electricity price (US$/kWh) per month	0.0953	0.0721	0.0950
Average unit subsidy (US$) per month	0.0650	0.0851	0.0653
Cost recovery price (US$/kWh)	0.124	0.124	0.124
Subsidy recipients	1,010,195	28,949	1,039,144
Subsidy (US$)	6,848,511	176,897	7,025,407
Average subsidy (US$)	6.90	6.11	6.88
Income all households (US$) per month	1,329,253,595.83	26,421,652.76	1,355,675,248.59
Average income - all households per month	529.216346	35.99371418	417.6702878
Average income - households with uptake per month	904.75	34.28	883.29
Average income - households with access but no connection	153.6044844	33.12211698	113.7110838
Subsidy over electricity expenditure (%)	30.84	71.92	31.29
minimum subsidy received by beneficiaries	(80.05)	5.31	(80.05)
minimum electricity consumed by households	47.00	58.00	47.00
minimum average price of electricity (us$/kwh)	0.0200	0.0324	0.0200
minimum total expenditure on electricity	0.94	1.88	0.94
maximum subsidy received by households	8.66	8.66	8.66
maximum quantity of household electricity consumption	3713.334	392	3713.334
maximum total expenditure on electricity	540.50	42.30	540.50
maximum average price of electricity	0.1456	0.1079	0.1456

Figure A4.2: Indicators of subsidy performance for the 2017 IBT schedule

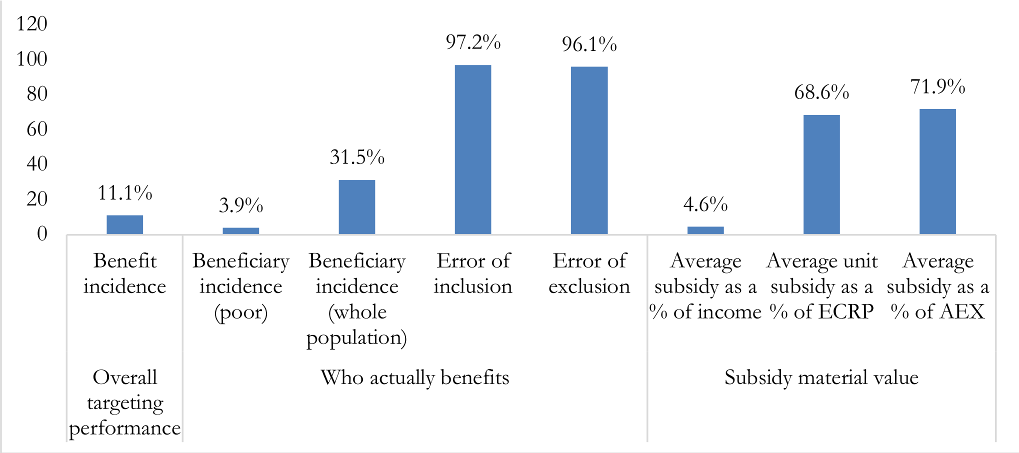


Table A4.2: Description and values of the components of the benefit incidence indicator

Symbol	Description	Value
Ω	Benefit incidence	0.111
SH/H	Average subsidy benefit in the entire population	2.164
SP/P	Average subsidy benefit among the poor (US$)	0.241
C	Average cost-recovery price of electricity (US$)	0.12
BH	Probability of receiving a subsidy in the whole population (i.e. beneficiary incidence)	0.31
BP	Probability of receiving a subsidy among the poor (i.e. beneficiary incidence)	0.04
AH	Share of households with access in total household population	0.74
AP	Share of the poor households with access in total poor households	0.65
UH/A	Share of households using/up-taking electricity among those with access	0.43
UP/A	Share of poor households using electricity among the poor with access	0.06
TH/U	Share of households subsidized among those with access, connection and targeted	0.98
TP/U	Share of poor subsidized among the poor with access, connection and targeted	1.00
RP/T	Rate of subsidization for the subsidized poor	0.42
RH/T	Rate of subsidization for the subsidized population	0.26
QP/T	Average quantity of electricity consumed by the poor	117.80
QH/T	Average quantity of electricity consumed by the households using electricity	214.03
EH/T	Average expenditure on electricity in the population using electricity	19.66
EP/T	Average expenditure on electricity among the poor	8.50
AH * UH/A	Actual connection rate to the electricity grid for all households	0.32
Ap * UP/A	Actual connection rate to the electricity grid for the poor	0.04

Table A4.3: Decomposition of Determinants of Subsidy Performance

	share of households with access (A)	share of households with uptake or usage (U)	share of households the subsidized (T)	rate of subsidization (R)	average quantity consumed kwh/month (Q)
poor households	0.646	0.061	1.000	0.418	117.798
all households	0.741	0.432	0.983	0.259	214.031
ratio (poor to all)	0.872	0.141	1.018	1.614	0.550

FigureA4.3: Determinants/drivers of subsidy targeting performance

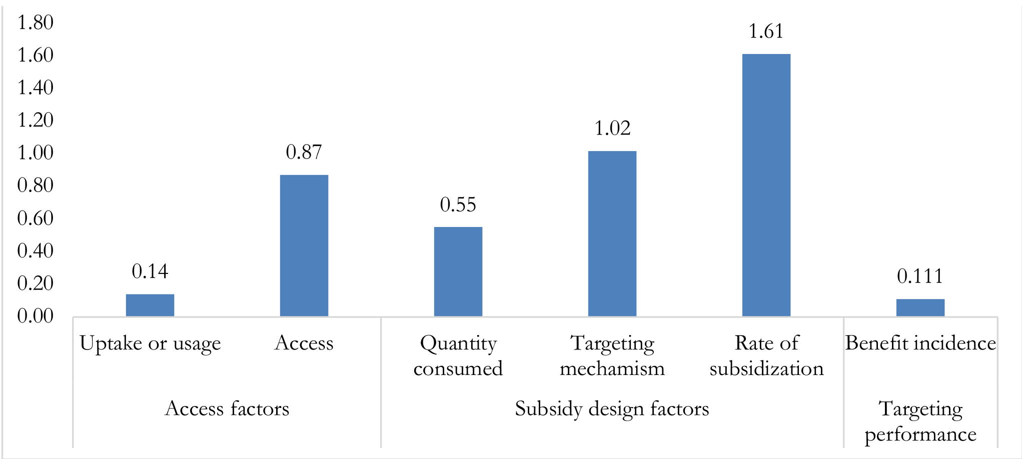
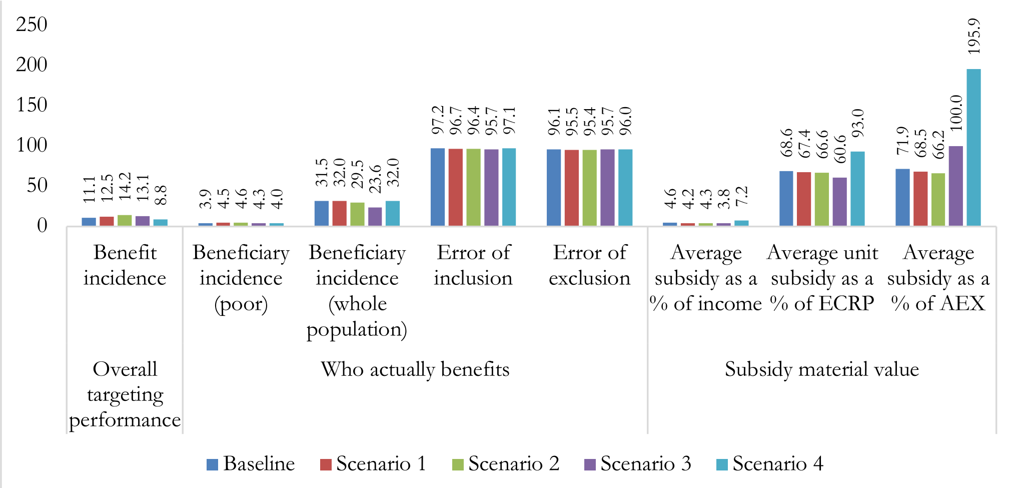


Figure A4.4: Targeting performance of simulated scenarios



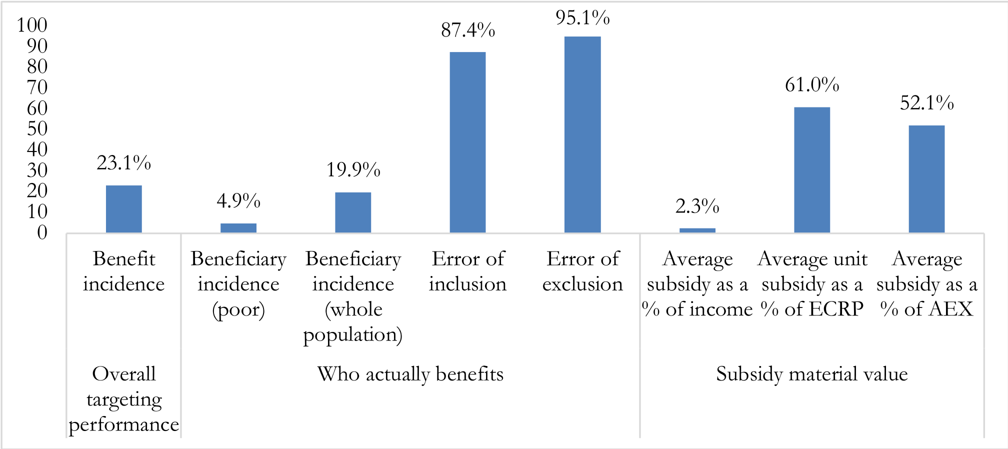
Annex 5: Comparative Statistics and Analysis using 2017 PICEs Sample Data – Lower Bound Poverty Line

Table A5.1: Electricity access, uptake, consumption, prices and subsidies in Zimbabwe, 2017

	non-poor	poor	total
total no. of households in the sample	14,686	15,469	30,155
total no. of households with access	10,993	9,904	20,897
total no. of households with uptake/use	5,298	752	6,050
total no. of households connected to the grid	5,298	752	6,050
total no. of households not connected to the grid	9260	14684	23944
total no. of households with access but not connected to the grid	5568	9119	14687
total no. of households not using electricity from the grid	9388	14717	24105
total value of subsidies (us$)	36,403.47	4,905.02	41,308.49
total expenditure on electricity (us$)	101,275	9,411	110,686
subsidy as a % of total electricity expenditure	35.9	52.1	37.3
total income of all households	8,764,445	983,690	9,748,135
total income for households with uptake (us$)	6,006,123	209,554	6,215,675
total quantity of electricity consumed (kwh)	1,170,330	115,455	1,285,784
average quantity of electricity consumption (kWh)	220.90	153.53	212.53
average price of electricity (us$/kwh)	0.086	0.075	0.085
average subsidy received (us$)	6.95	6.52	6.90
average total expenditure on electricity (us$)	20.62	12.52	19.61
average income for households with uptake (us$)	1133.66	278.66	1027.38
average income for households with access but no connection (us$)	208.93	48.47	109.30
average expenditure on electricity as a % of average income	1.8	4.5	1.9
minimum subsidy received by beneficiaries	0.61	0.61	0.61
minimum electricity consumed by households	47	58	47
minimum average price of electricity (us$/kwh)	0.0200	0.0324	0.0200
minimum total expenditure on electricity	0.94	1.88	0.94
maximum subsidy received by households	8.66	8.66	8.66
maximum quantity of household electricity consumption	3713	611	3713
maximum total expenditure on electricity	541	75	541
maximum average price of electricity	0.15	0.12	0.15

Source: Authors' own calculations from 2017 PICES data set

Figure A5.1: Indicators of subsidy performance for the 2017 IBT schedule



Source: Authors' own calculations from 2017 PICES data set

Notes: ECRP=efficient cost recovery price of electricity per kWh. AEX=average expenditure on electricity

Table A5.2: Description and values of the components of the benefit incidence indicator

SYMBOL	DESCRIPTION	VALUE
Ω	Benefit incidence	0.231
SH/H	Average subsidy benefit in the entire population	1.370
SP/P	Average subsidy benefit among the poor (US$)	0.317
C	Average cost-recovery price of electricity (US$)	0.12
BH	Probability of receiving a subsidy in the whole population (i.e. beneficiary incidence)	0.20
BP	Probability of receiving a subsidy among the poor (i.e. beneficiary incidence)	0.05
AH	Share of households with access in total household population	0.69
AP	Share of the poor households with access in total poor households	0.64
UH/A	Share of households using/up-taking electricity among those with access	0.29
UP/A	Share of poor households using electricity among the poor with access	0.08
TH/U	Share of households subsidized among those with access, connection and targeted	0.99
TP/U	Share of poor subsidized among the poor with access, connection and targeted	1.00
RP/T	Rate of subsidization for the subsidized poor	0.34
RH/T	Rate of subsidization for the subsidized population	0.27
QP/T	Average quantity of electricity consumed by the poor	153.53
QH/T	Average quantity of electricity consumed by the households using electricity	204.74
EH/T	Average expenditure on electricity in the population using electricity	18.49
EP/T	Average expenditure on electricity among the poor	12.515
AH * UH/A	Actual connection rate to the electricity grid for all households	0.201
AP * UP/A	Actual connection rate to the electricity grid for the poor	0.049

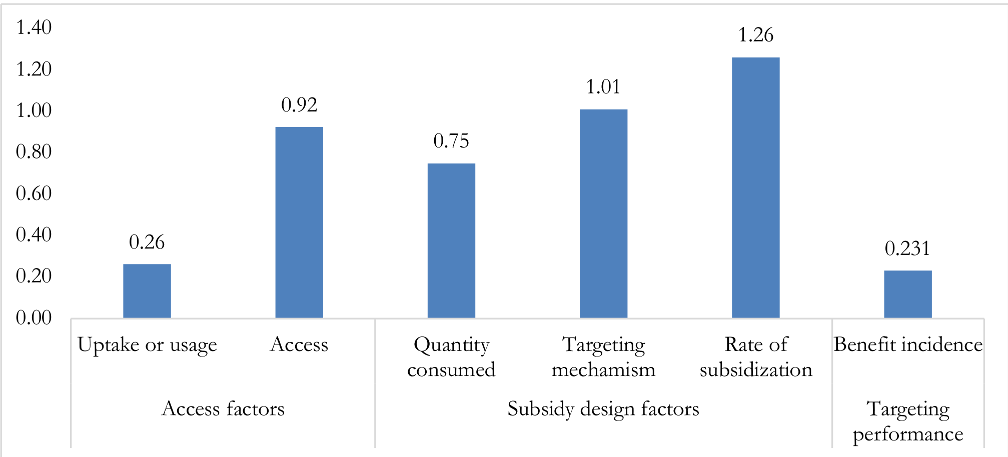
Source: Authors' computations from the PICES household survey data sets, 2017

Table A5.3: Decomposition of Determinants of Subsidy Performance

	share of households with access (A)	share of households with uptake or usage (U)	share of households the subsidized (T)	rate of subsidization (R)	average quantity consumed kWh/month (Q)
poor households	0.64	0.08	1.00	0.34	153.53
all households	0.69	0.29	0.99	0.27	204.74
ratio (poor to all)	0.92	0.26	1.01	1.26	0.75

Source: Authors' calculations from PICES 2017 data sets based on framework by Angel-Urdinola and Wodon 2005a.

Figure A5.2: Determinants/drivers of subsidy targeting performance



Source: Authors' calculations from PICES 2017 data sets

Zimbabwe Economic Policy Analysis and Research

55 Mull Road, Belvedere, Harare, Zimbabwe
P. O. Box CY 244
Causeway, Harare
Tel: +263 242 778 423 / 785 926/7
Fax: +263 242 778 415
Email: administration@zeparu.co.zw

www.zeparu.co.zw