The double-edged sword of CPU'S energy transition: impacts on municipal revenue and cross-subsidization

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Abstract:

South Africa is currently experiencing an energy crisis that has resulted in more frequent occurrences of load shedding, causing disruptions to the country's economy and daily life. The government has prioritized the just transition to address the climate challenge and they are using the elements of this to address the capacity challenge. This transition coincides with commercial power users (CPUs)[1] in municipal distribution networks transitioning to alternative forms of energy because of climate change commitments, rising electricity prices and/or loadshedding. If unmanaged, this has significant financial sustainability implications for municipal distribution utilities, particularly in terms of cross-subsidization for low-income households. To investigate the cross-subsidization impact of these CPUs' transitioning away from Eskom generation and towards embedded solar PV generation, this paper analyses data from 34 municipal cost of supply studies. Through an evaluation of the municipalities' NERSA Distribution Forms (D-forms), the paper considers the dynamic between an increase in Free Basic Electricity (FBE) customers and a decrease in CPUs' revenue contribution resulting from lower energy consumption. In the final instance, the study assesses policy and decision-making responses to address and manage the gap. By identifying the challenges and potential solutions, this study will contribute to a better understanding of the complex interplay between CPUs, municipalities, and low-income households in the context of South Africa's energy crisis.

1. Introduction

The concept of "energy transition" refers to the gradual movement away from using carbon as the main energy source in energy systems. On the same note, the word "Just" emphasises the importance of transitioning from carbon as an energy source in a manner that will not impact the society and livelihoods negatively[2]. Goal 7 of the United Nations Sustainable Development Goals states that countries should aim to provide energy that is clean, affordable and reliable for all. Countries such as South Africa find themselves in a situation where their electricity supply cannot meet the electricity demand, leading to an energy crisis. In a quest to mitigate this problem, renewable energy technologies have been recommended as a reliable solution to increase access to energy worldwide[2]. While the transition offers important opportunities, the technology disruption can present unanticipated challenges particularly for the most vulnerable in our societies.

[1] CPUs and DPUs are defined in section 2

[2] H. R. Bohlmann, J. A. B. M. Chitiga-Mabugu and R. Inglesi-Lotz, "Just Energy Transition of South Africa in a Post-COVID Era," *Sustainability,* pp. 1-28, 2023.

In South Africa, municipalities (including Eskom) are responsible for the distribution of electricity to different types of customers within their supply areas. The energy consumption of these customers usually varies depending on their energy needs, where domestic power users (DPUs) consume less energy than commercial power users (CPUs). CPUs are gradually reducing their reliance on municipalities for electricity because they are "greening" their operations, reducing their electricity bill and responding to loadshedding. This shift in CPUs behaviour is a concern for municipalities because these are customers that partly subsidize domestic customers and contribute significantly to municipal coffers. While middle income domestic customers could afford more 'cost reflective' tariffs, low-income customers cannot afford to pay the full cost of the service. This paper then investigates a potential challenge to municipal sustainability and interrogates the effectiveness of existing intra-municipal cross subsidies and government subsidies in the future municipal electricity distribution business. Finally, recommendations on who is responsible for carrying the cost of electricity provision in municipalities with unfavourable socio-economic conditions are tabled.

2. Commercial Power Users' Energy Transition

2.1. Definitions

The analysis done in this paper was conducted across 34 municipalities including representation from all five municipal categories which are defined as: A for metropolitan municipalities (2), B1 for secondary cities (9), B2 for large towns (4), B3 for small towns (17) and B4 for mostly rural municipalities (2).

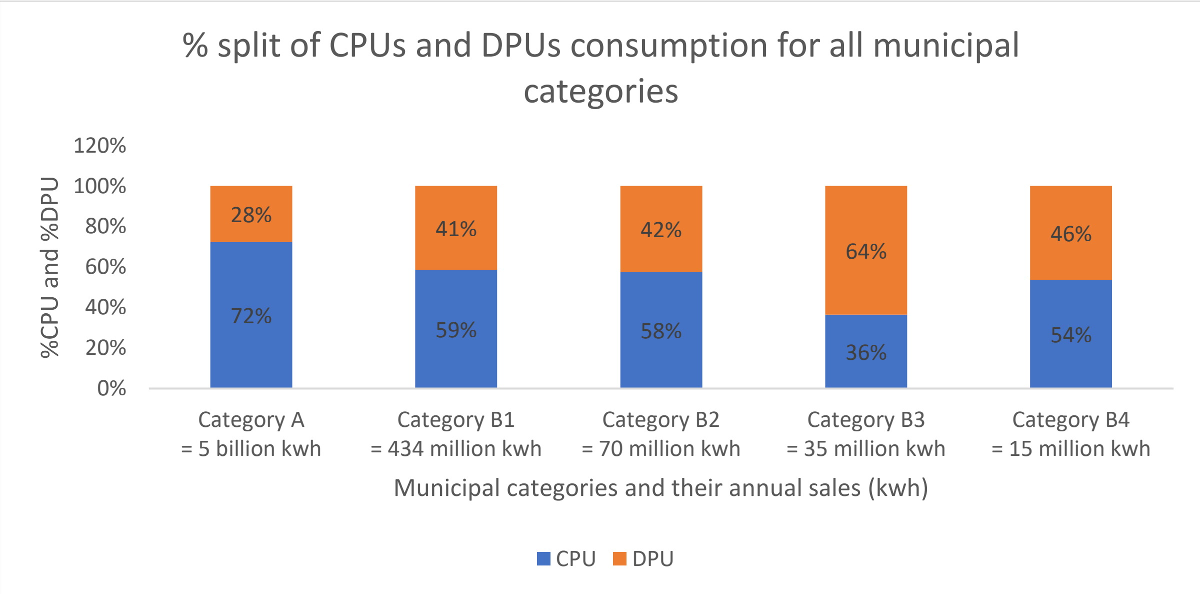

Figure 1: Consumption of DPUs and CPUs across different municipal categories

CPUs in this paper are defined as customers within the municipal electricity business who are consuming power for commercial purposes, these customers are generally consuming relatively more power than DPUs as can be seen in Figure 1 with an exception of category B3. In the 34 cost of supply (COS) studies that were investigated, these customers included: agriculture, mining & quarrying, manufacturing/industrial, commercial (prepaid) and commercial (conventional) customers. The DPUs in Figure 2 are customers in the municipal electricity business who are consuming power for domestic purposes. This category represents substantially more customers than CPUs but consume, per customer – and in most cases as a customer group - less power than CPUs. These customers are as follows: domestic (prepaid) and domestic (conventional) customers. The term "other users" is used to classify customers that the municipalities do not consistently recover revenue from (although they should[3]). These customers are: transport, other consumers, redistributors/resellers, electricity department, street lighting and sold to other municipal departments. DPUs represent both low-income and high-income domestic customers however this paper focuses more on the impact of CPUs' transition on the low-income domestic customers, who are the most vulnerable.

2.2. Methodology

The paper analyses the degree of cross subsidization between CPUs and DPUs by considering the degree to which the tariff (and related revenue/income) from each group is above or below what is deemed a 'cost reflective' tariff and related income. The COS studies used to establish this were conducted using the National Energy Regulator of South Africa (NERSA) endorsed simplified COS tool which follows the cost-plus methodology as per NERSA framework[4]. COS studies were developed for all of these municipalities for the 2020/21 financial year and their aggregated income breakdown can be seen in Figure 2.

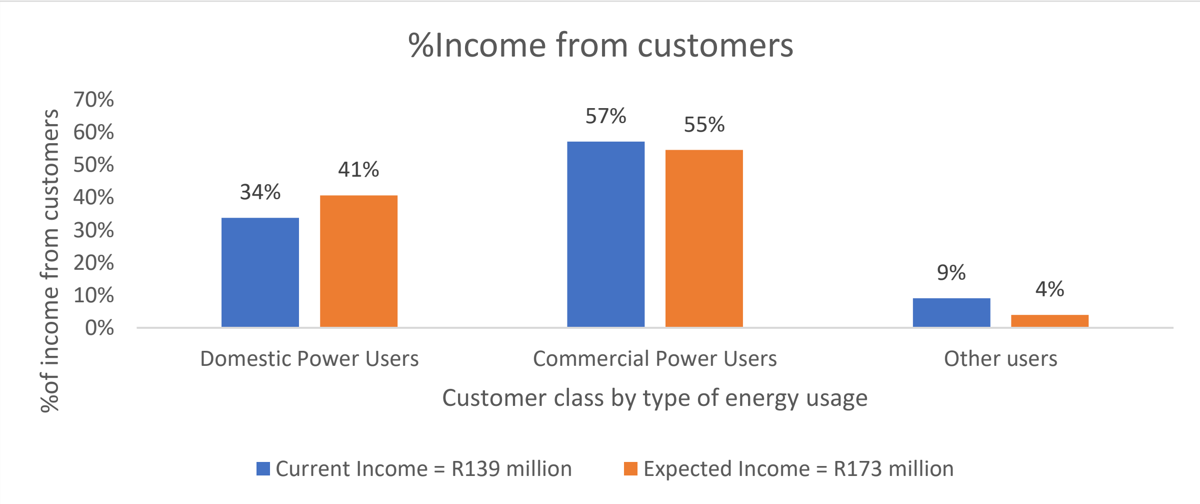

Figure 2: % of income coming from different customer classes by the type of energy usage

CPUs run energy intensive operations and the electricity bill is a significant portion of their operational expenditure. Before the surge of renewable energy technologies, commercial power users were relying only on the municipalities and Eskom generation for their energy purchases. It is a national priority that municipalities support CPUs in their quest for energy security by making sure municipal council approved embedded generation processes are in place and unbundled electricity tariffs. Over and above significant contributions to municipal revenue, these businesses drive the municipal economies. The transition to renewable energies provides multiple energy source options for commercial power users. If unmanaged, this however poses a threat to financial sustainability of the municipality as their main contributors of revenue will now buy less power or even no power at all from them. Of critical importance is that they will still continue to use the grid.

Figure 2 shows that for both the current tariffs and cost reflective tariffs, CPUs are contributing 57% (R79 million) to municipal revenue and 55% (R95 million), respectively. Other users are not contributing significantly to the municipal revenue and this paper will focus more on the interplay between CPUs and DPUs. The DPUs' aggregated contribution from cost reflective tariffs is 41% (R70 million) and 34% (R47 million) from current tariffs. The overall revenue received using cost-reflective tariffs is higher at R173 million compared to revenue received using current tariffs at R139 million. What is significant is that, although cost reflective tariffs generate more revenue, DPUs are required to contribute more to municipal revenue by paying for fixed and variable components of their costs. In this purely cost

[3] Municipalities are encouraged to meter all their customers and charge appropriate tariffs to recover costs incurred as a result of supplying electricity to all customers. This also includes municipal customers such as the electricity department and other departments.

[4] https://www.sseg.org.za/cos/.

reflective setup, CPUs would pay less because of the absence of cross subsidies. This shows that cross-subsidization already exists and moving towards cost reflective tariffs is not feasible in these socio-economic conditions. If CPUs are critical in bringing in cross subsidies, the metros are ok, but the low level of CPU in Category B 3 municipalities may contribute to inability to pay Eskom bill as can be seen in Figure 1.

3. Impact on Municipal Revenue

As commercial power users diversify their energy purchases, the municipalities will experience a reduction in their costs, sales and revenue. This is because their main revenue contributors will now be consuming less and less power from their grid. This may eventually lead to sustainability risks if their tariffs are not cost reflective, i.e., if they are not recovering their fixed charges. In this context, fixed charges are all the costs incurred to maintain the electricity grid network of the municipality while variable charges are all the costs incurred to buy energy in kilowatt hours (kwh) from Eskom to supply its customers. The variable charges depend on the customers' electricity consumption, where an increase in electricity consumption means an increase in Eskom bulk electricity purchases for the municipality. The fixed charge remains constant regardless of a change in the customer's electricity consumption.

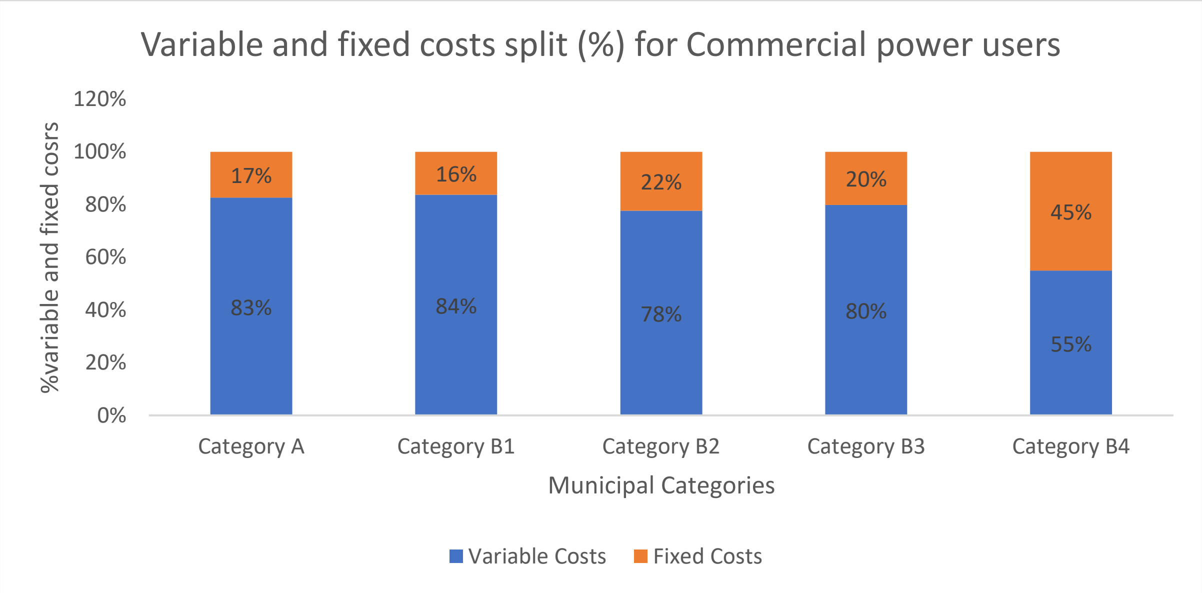

Figure 3: Variable vs Fixed charges for commercial power users across different municipal categories

Figure 3 shows a graphical representation of the proportion of variable and fixed costs for commercial power users. From the graph, it is clear that for all the municipal categories, charges are composed of both variable and fixed costs. For the sustainability of the municipality's electricity business, both fixed and variable costs from their commercial power users must be recovered. Variable costs are driven by energy consumption, which makes them pass through costs if there is no surplus levied on them. As long as the municipality is able to recover fixed costs and associated subsidies and surpluses, its sustainability is almost certain[5]. Category B4 stands out as it has more fixed cost split than other municipal categories with 45% (fixed costs) and 55% (variable costs) split. This is possibly an indication of the electricity infrastructure in rural municipalities with long overhead cables and customers who consume minimal electricity. The big percentage contribution of bulk purchases in total electricity department costs of towns or cities can be attributed to the high energy consumption customers concentrated in close proximity to each other, i.e., central business districts.

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[5] The sustainability of the municipal electricity business does not only depend on correct tariff structures but also reducing energy losses. A cost of supply study can help municipalities to better manage their business by allocating enough budget to resources and maintenance of the distribution grid.

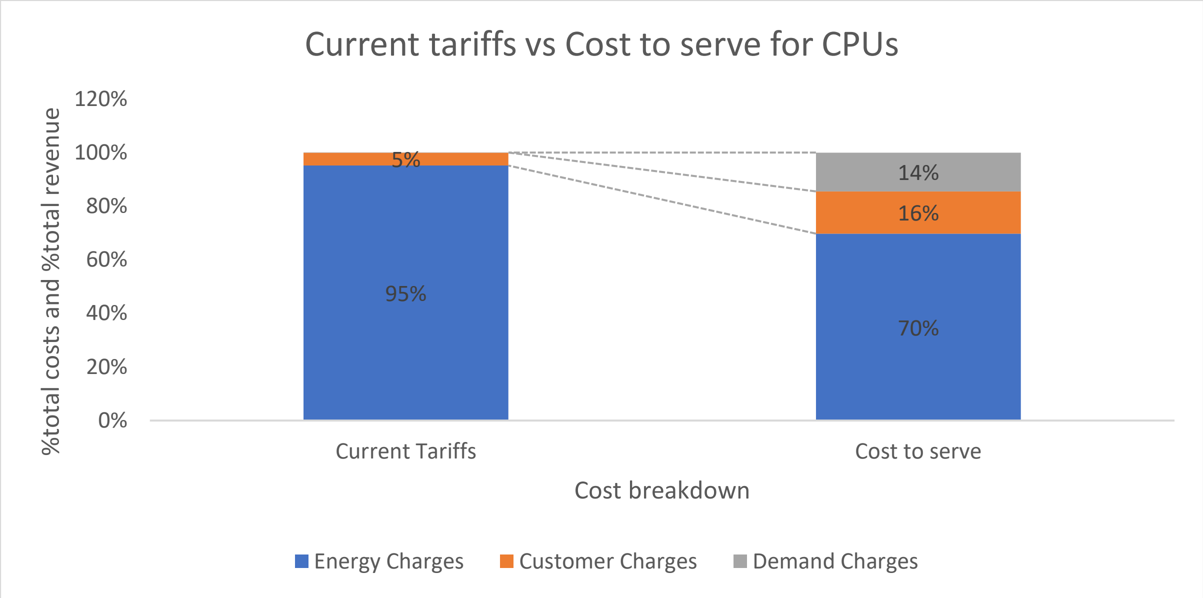

Figure 4: cost to serve vs current rates for commercial power users

The energy charges in Figure 4 above refer to the cost incurred for purchasing energy (kwh) from Eskom, the customer charges refer to cost incurred for servicing customers such as billing and metering, and demand charges refer to the cost incurred to build and maintain the electricity network infrastructure. Figure 4 above is a graphical representation of the aggregated cost breakdown of the municipalities' cost to serve their commercial power users vs the cost breakdown of the tariffs that they charge their commercial power users. The cost to serve commercial power users consists of energy costs, demand costs and customer-related costs while the tariffs that they charge their commercial customers consist mainly of energy charges at 95% (R66 million), with customer charges being at 5% (R3 million) and the demand charges are negligible at 0,003% (R9 378). This is a clear indication that their tariffs are not cost reflective and this introduces volumetric risk. This risk manifests as commercial power users purchasing less electricity from the municipality and the municipality's inability to recover fixed costs that are normally recovered through variable charges.

4. Impact on Cross-Subsidization

The electricity pricing policy has defined the tariff design principles to ensure that tariffs are fair both to customers and licensees. The policy allows for the cross-subsidy of tariffs across customer categories in order for licensees to recover their costs. One of the principles in the policy vouches for the low-income households to have access to electricity provision through lifeline tariffs for low levels of consumption of electricity[6]. Cross-subsidization in this paper refers to the over-recovery of costs from some customers to compensate for the under-recovery of costs from other customers.

The inclusivity of low-income households outlined in the electricity pricing policy, places the municipalities in a position where commercial power users must cross-subsidise the domestic power users (both low-income and wealth domestic customers) and under-recovering commercial customers. However, for the sustainability of the municipality, all customers must contribute to both fixed and variable charges. The challenge with achieving this is that domestic power users hardly contribute to the fixed costs of the municipality. Low-income households are within the chosen customer categories. It was assumed that cost to serve FBE customers are similar to those of other DPUs because of their location on the electricity network and general customer behaviour. Analysis and findings of DPUs as defined in the paper can be extrapolated to FBE or low-income customers.

[6] DEPARTMENT OF MINERALS AND ENERGY , "ELECTRICITY PRICING POLICY," 2008.

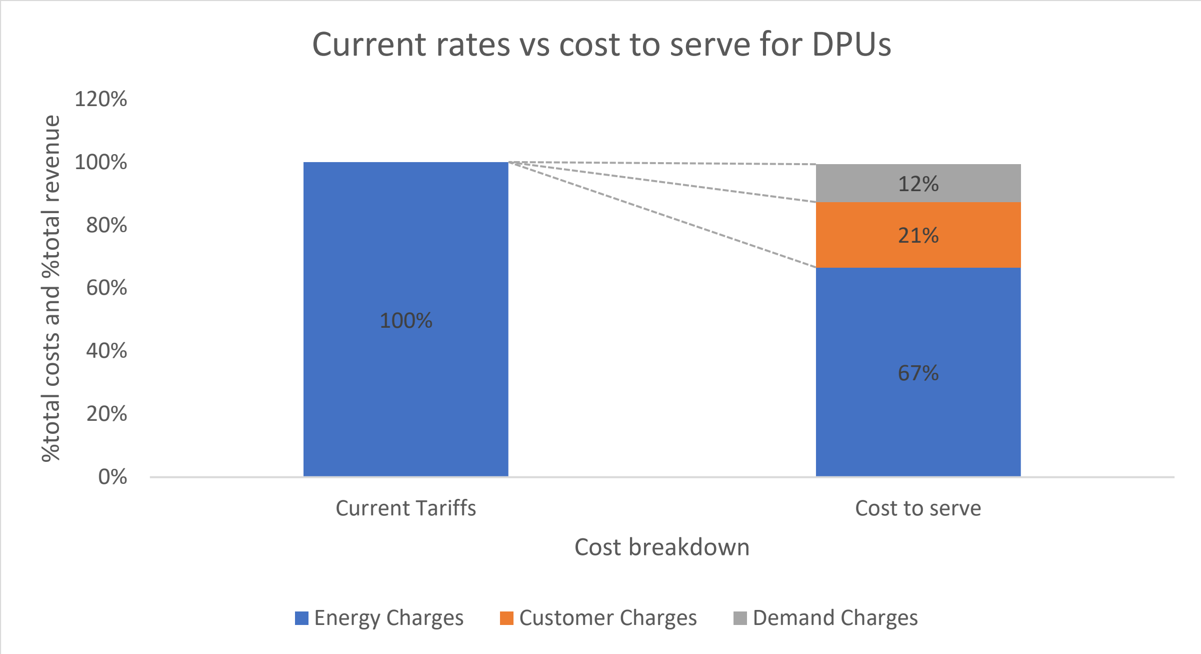

Figure 5: Cost to serve vs current rates for domestic power users

Figure *5* above shows that the current tariffs are only charging energy charges to the DPUs, but the cost to serve consists of energy, customer and demand charges. DPUs only recover energy costs; however, their customer and demand costs still need to be recovered for municipal financial sustainability. This places a burden on commercial power users to cross-subsidize the domestic power users for the municipalities to recover their full costs. With the commercial power users reducing their energy purchases from the municipality, there is an identified "gap" in the subsidization of domestic power users that won't be recovered. This becomes particularly alarming when the cost structures of both domestic power users and commercial power users are not cost reflective as the municipality will be at a great volumetric risk. Additionally, if fixed components of a domestic power user are subsidized through commercial power user variable charges, there will be a decrease in cross-subsidy as these commercial customers source their electricity from alternative means. This will leave an unfunded gap, resulting in under-recoveries for the municipality.

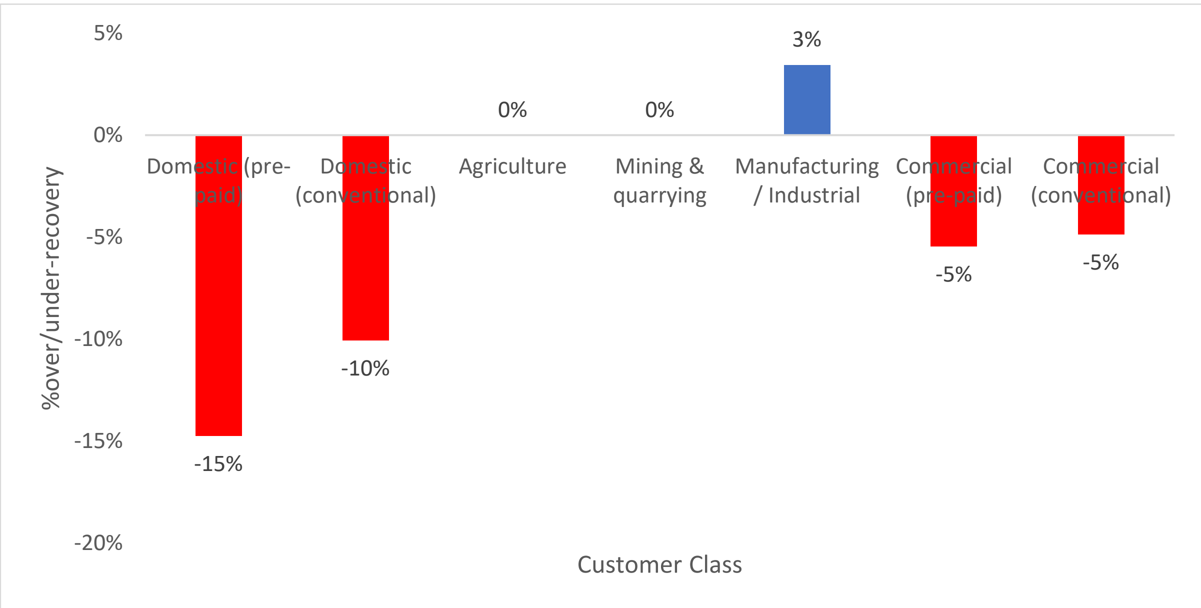

Figure 6: Over and under-recovery of all customer categories

Figure 6 above shows the customer categories where municipalities are over-recovering and the customer categories where they are under-recovering their costs. From Figure 6, it can be noted that the over-recovery of aggregated costs of combined municipalities using current tariffs is not enough to cross-subsidize DPUs. This is evident when looking at the manufacturing/industrial customer category solely over-recovering by 3% (R4 million) and other customers under-recovering. Of-course this aggregated analysis is purely indicative and may not fully represent all individual municipalities but merely illustrates the dependency on commercial customers for cross-subsidies. A more granular look is demonstrated in Annexure A and shows a variation of under/over recoveries per municipal category. Notably, DPUs need to be cross-subsidized as they are under-recovering and this places a burden on CPUs to cross subsidize them for the municipality to recover its full costs. If the CPUs purchase electricity from alternative renewable energy sources, it will reduce this over-recovering of costs that is used to offset the under-recovery of costs from DPUs.

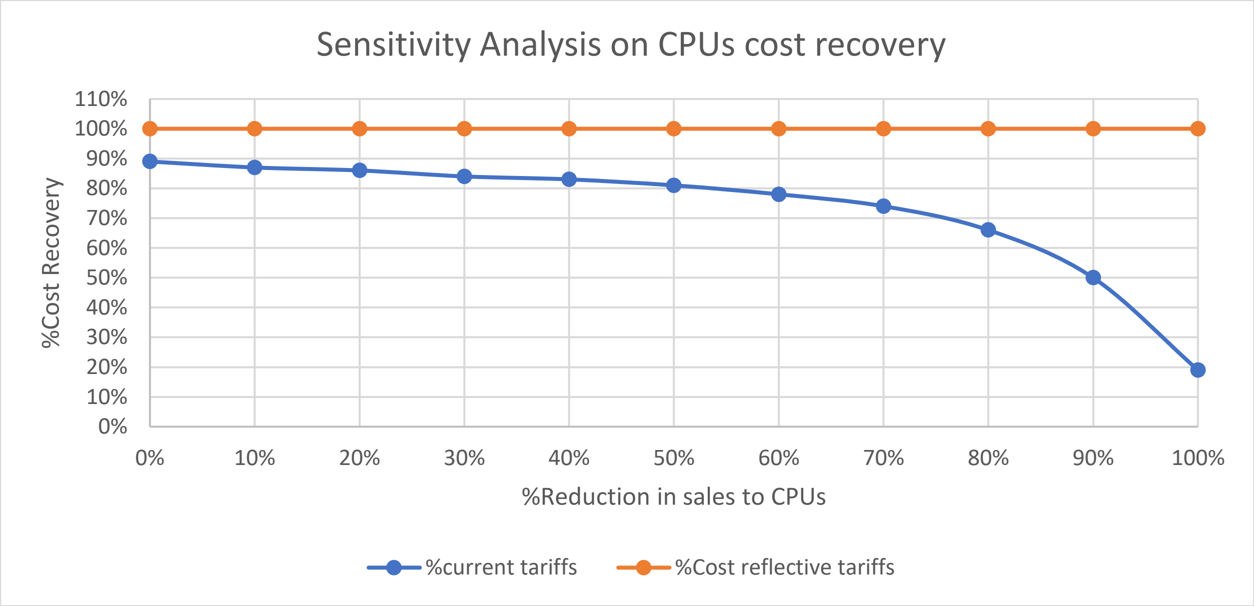

Figure 7: Sensitivity analysis of CPUs on cost recovery

From Figure 7 above, it can be noted that with the current tariffs, the cost recovery of CPUs will massively reduce as the CPUs are reducing their consumption on the municipal grid and only making 19% cost recovery when the CPUs are not consuming anything from the grid. This poses a great threat to the financial sustainability of the municipality. However, with the cost-reflective tariffs, the municipalities are able to recover all their costs from CPUs and therefore the cost recovery will be 100% regardless of whether the CPUs are reducing their consumption or not.

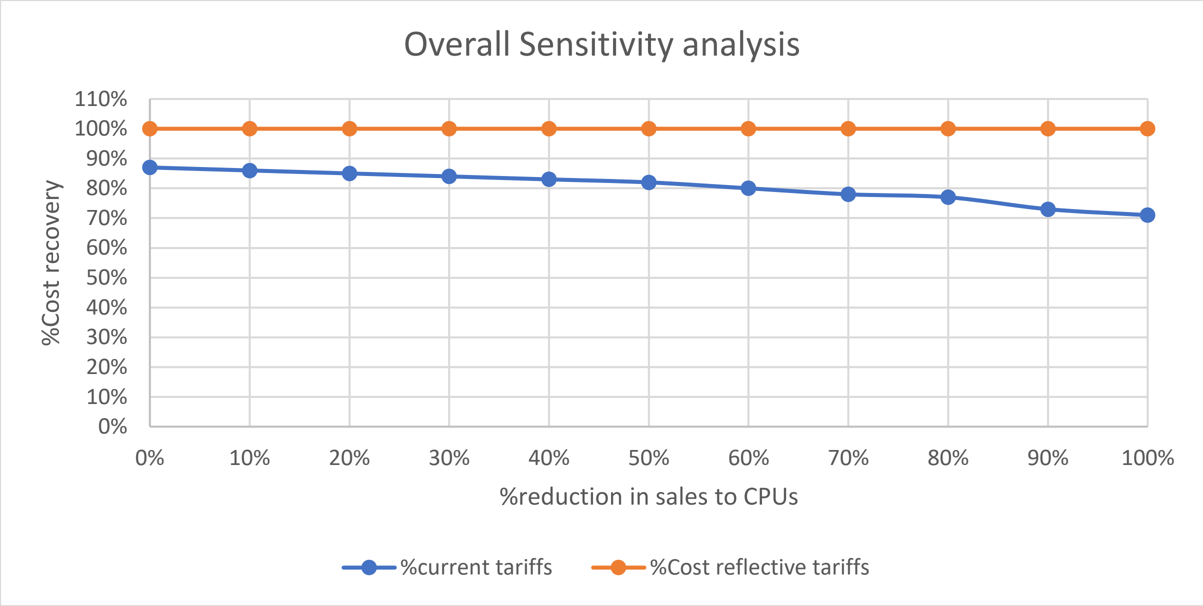

Figure 8: Sensitivity analysis on total cost recovery

Figure 8 above is a graphical representation of a sensitivity analysis for municipalities, outlining the impact on the percentage total costs recovered by municipality as the CPUs reduce their consumption from the municipal grid. This big picture aggregated graph incorporates a decline in sales volumes to CPUs but assumes sales will remain constant for DPUs and other customers. The 71% total aggregated cost recovery seen when energy sales to CPUs have decreased to their minimum, indicates that a significant portion of revenue should be recovered from DPUs and other customers. This emphasises that greater reliance will be placed on DPUs and other customers to sustain the municipality. However, DPUs are normally customers who are less likely to afford electricity. The cost reflective tariffs on the other hand allow the municipalities to recover 100% of their costs, regardless of whether CPUs are reducing their consumption on municipal grid or not.

5. Free Basic Electricity (FBE) Analysis

The reduction in consumption of CPUs from the municipal grid attracts attention to the most vulnerable domestic users and the municipal indigent subsidy policy through the free basic electricity (FBE) provision. In many municipalities, the lowest income categories don't meet the cost to serve them and the gap is covered by CPUs' revenue.

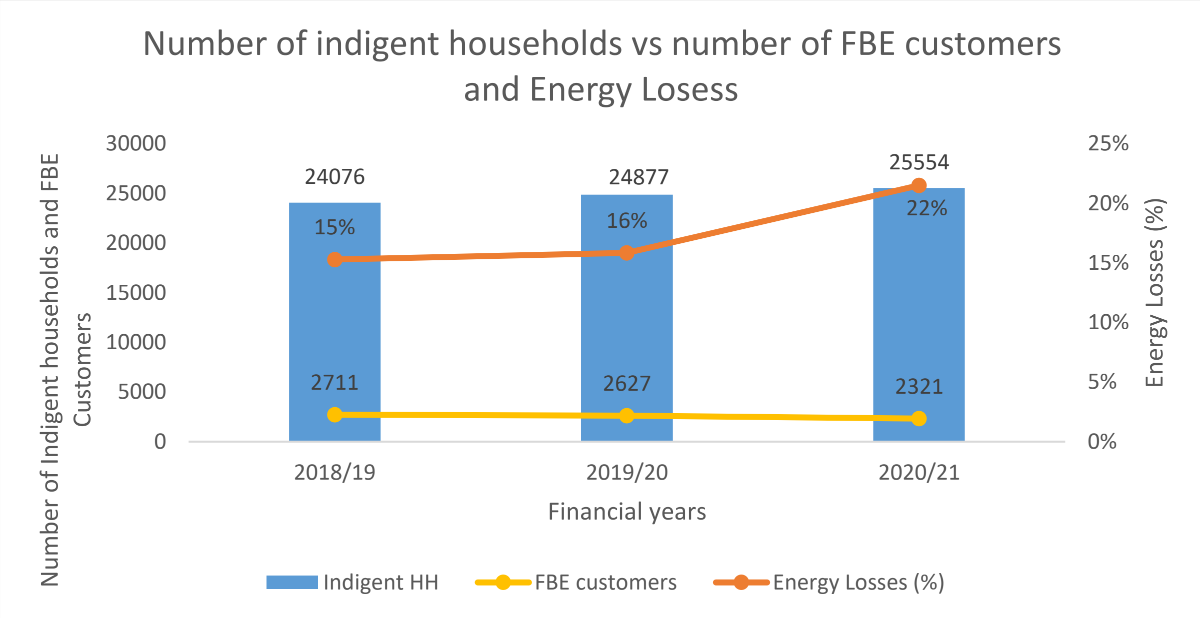

Figure 9: Free Basic Electricity analysis over 3 years

Figure 9 above shows that over the past 3 years, the % indigent household receiving FBE has been reducing and energy losses have been increasing. This can be seen by Figure 9 as number of indigent households increasing over the years while the number of people registered for FBE subsidy has been declining. Therefore, the revenue lost due to rising energy losses will have to be recovered through other customers to recover all the municipalities' costs. However, this inverse relationship could also mean that the data around the number of indigent households and energy losses could be recorded incorrectly and also this is an aggregated trend and may not be true representation for all individual customers.

What can be deduced from this graph is that municipalities are facing a multitude of challenges such as the double-edged sword we are investigating, the high energy losses or lost revenue, and not enough indigent households receiving the FBE grant, or sufficient support to legally acquire energy to meet their basic household needs. Cost reflective tariffs can only solve a fraction of these problems. The energy transition is causing CPUs to reduce their dependency on the municipality by purchasing energy from alternative energy sources. As they reduce their dependency, their contribution to cross-subsidies also decreases and that challenges municipalities to source funds that will close the cross-subsidy vacuum elsewhere. Hence debates in the industry have been emerging that allude to a need to increase FBE from 50kWh to 100kWh[7].

[7] T. P. R. o. S. Africa, "South Africa's Just Energy Transition Investment Plan (JET IP)," 2023-2027.

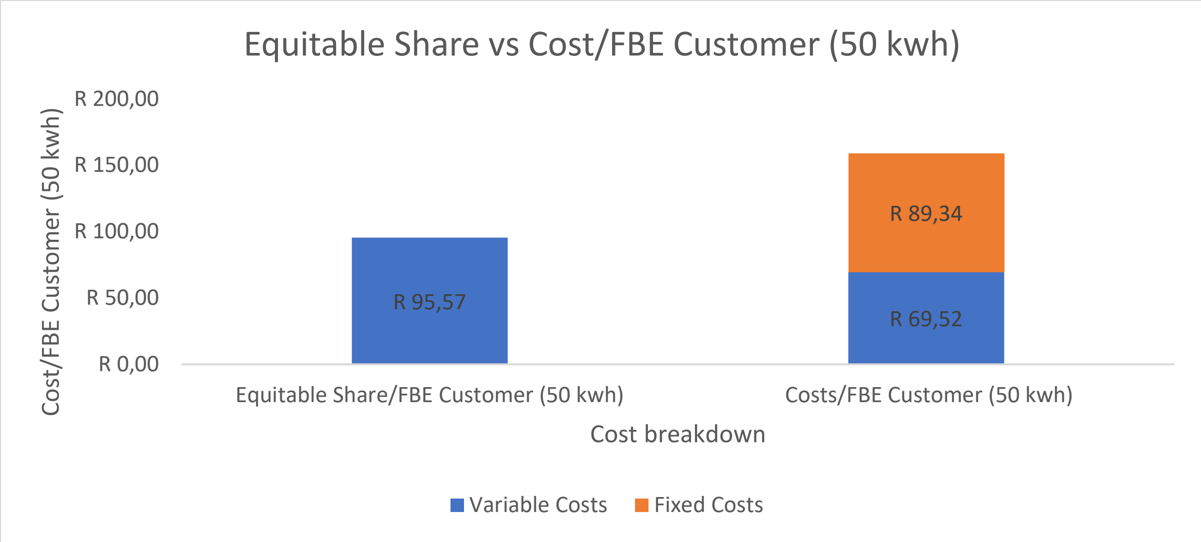

Figure 10: True cost of supplying FBE customer vs Equitable share

We have already seen in sections above that there is a cross-subsidy risk within municipalities and these municipalities are also under-recovering. Next thing is to acknowledge FBE as an important grant that assists customers who cannot afford. But the question is how effective is this grant in doing that?

Figure 10 above is a graphical representation of how much it really costs to serve FBE customers with 50 kwh as compared to the National Treasury allocation of the equitable share per households. The equitable share subsidizes an individual FBE customer with R95,57 per month and when using the overall variable costs of R1,39/kwh this is equivalent to 69 kwh of electricity subsidized per month (in fact it is 50 units plus some maintenance). The monthly costs to serve an individual FBE customer per month are R89,34 fixed costs and R69,52 variable charges for 50 kwh as informed by our COS studies. The equitable share (R95,57) is able to cover 60% of the costs (R89,34 + R69,52) to serve an FBE customer with 50 kwh, however the remaining 40% plus the remaining month's consumption has to be cross-subsidized by CPUs.

The grant should subsidize the fixed component of FBE cost because indigents do not pay fixed charges and CPUs are already subsiding DPUs on the energy charge and because of this it seems that municipalities also serve only a small proportion of customers who qualify for FBE (indigents) as a way to manage this gap. Therefore, a municipal business where electricity is accessible to all and does not drive investment away from local municipalities because of exorbitant fixed charges on CPUs is required.

6. Policy Considerations

As noted above, the transition of CPUs to alternative sources of energy significantly impacts municipal electricity utility revenue sustainability, in general, and more specifically as it pertains to cross-subsidization. This raises several policy considerations and complexities for municipalities, with considerations on whether to raise electricity prices to cost reflective tariffs, reduce subsidies, find alternative revenue sources, or some combination thereof.

The 2008 South African Electricity Pricing Policy[8] aims to balance social equity, economic growth, and environmental goals. It introduces an Inclining Block Tariff (IBT) to standardize residential energy charges across suppliers, with the charge dependent on the customer's income and average monthly electricity consumption. The tariff structure is designed to be progressive, offering lower rates to low-consumption households while generating surpluses from higher-consuming ones for cross-subsidization.

[8] Government Notice 1398 in Government Gazette 31741 of 19 December. 2008.

Concerning electricity tariffs, South Africa's Constitution (Act 108 of 1996) authorizes municipalities to generate their own revenue by levying taxes and service charges including electricity tariffs. At the national level, the Electricity Regulation Act (Act 4 of 2006) mandates NERSA to regulate prices and tariffs charged by licensees. Municipalities are further empowered to set municipal tariffs under the Municipal Finance Management Act (Act 56 of 2003) and Municipal Systems Act (Act 32 of 2000). This creates a complicated and frequently disputed power dynamic between NERSA and local municipalities, resulting in a multifaceted relationship between the regulations that govern both electricity and public finance.

It is worth noting that the Constitution, under Section 227, entitles municipalities to an equitable share of nationally raised revenue, also known as the Local Government Equitable Share (LGES). The LGES aids in providing essential services like water, sanitation, electricity, and waste removal for impoverished households, while also covering administrative costs for financially weaker municipalities. In the context of energy provision, municipalities administer the LGES in the form of FBE, with qualifying households receiving a specified amount of FBE, as noted in section 5 above. Beyond FBE, there are also other subsidized energy plans available such as the Lifeline tariffs for households that meet the qualifying criteria. Most municipalities have indigent policies that outline the price of subsidies, qualifying criteria and the payment for services, if at all.

The effectiveness of these policies is determined by how well local governments set tariffs and manage electricity distribution. Failures in implementation amplify existing challenges, often creating worse outcomes for the communities involved. Therefore, municipalities confront a complex dilemma: raising tariffs could trigger economic backlash and exacerbate affordability issues, whereas rethinking cross-subsidization could compromise other services. Similarly, municipalities cannot over rely on either the LGES or cross-subsidies funded through CPUs.

The existing electricity provision and subsidization framework is fraught with financial, operational, and policy-related challenges. These complexities call for a comprehensive review and potential overhaul to balance revenue sustainability, social equity, and environmental goals.

7. Conclusion

The just energy transition of commercial power users poses a huge threat to the municipal revenue and cross-subsidisation of domestic power users under current tariff regimes especially if the municipalities do not have embedded generation tariffs in place. The lack of cost reflective tariffs in municipalities to mitigate the volumetric risks associated with commercial power users reducing the consumption of power from the municipal grid puts the municipality at the great risk of losing their revenue. On the other hand, the reduction in sales to commercial power users will reduce the available over-recovery of costs that was previously used to cross-subsidize the domestic power users.

There is an increase in indigent households qualifying to be registered in the municipalities indigent support programs through FBE provision. This has created a gap in cross-subsidization that will cripple the municipalities' electricity distribution business because there is no clear direction of how this gap will be filled. It is proposed that municipalities structure their tariffs of commercial power users to recover both variable and fixed costs. This will ensure that even if the commercial power users reduce their consumption, the municipalities won't be at any volumetric risk of losing their revenue. However, the challenge with achieving this is that with cost reflective tariffs, DPUs will have to contribute a little bit more while CPUs are contributing a little bit less, and this is not feasible for low-income DPUs due to affordability issues.

Additionally, cross-subsidies that are recovered through variable charges must be recovered through fixed charges and the FBE grant must increase to cover the fixed costs of indigent customers. The CPUs' reduction in energy purchases from the municipality is inevitable and cost structures that maintain cross-subsidies are encouraged. Complexities exist in the practical implementation of these recommendations from a business operations and policy perspective. To address these complexities, a comprehensive review and potential overhaul is obligatory.

Annexure A

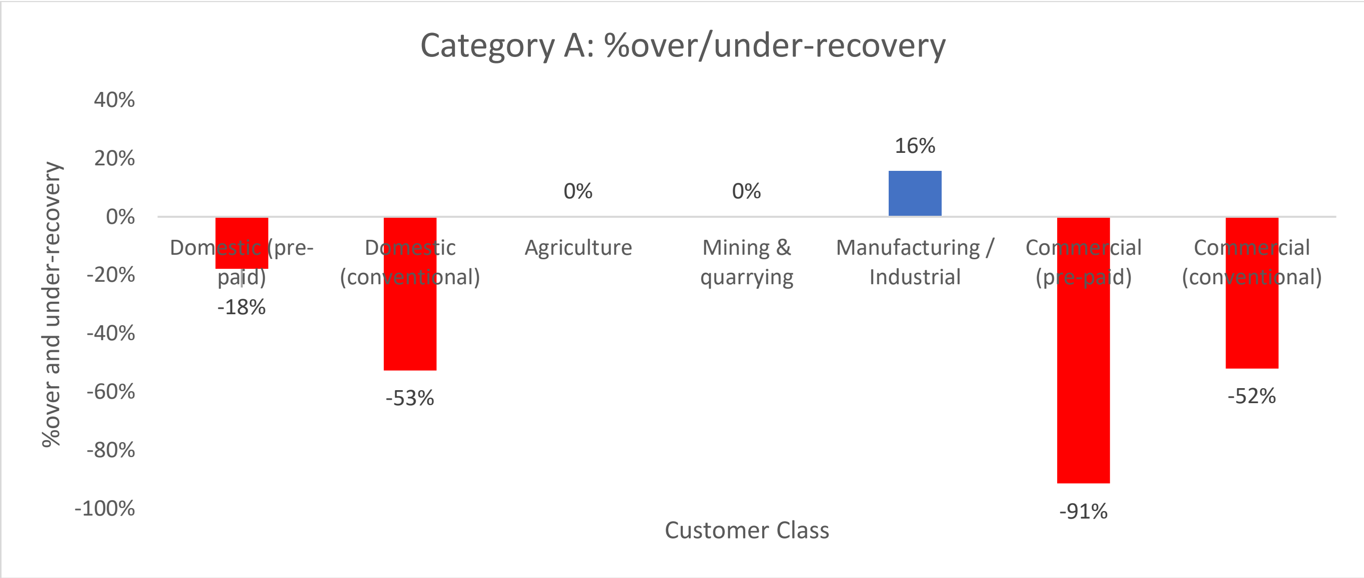

Figure 11: %over/under-recovery for Category A municipalities

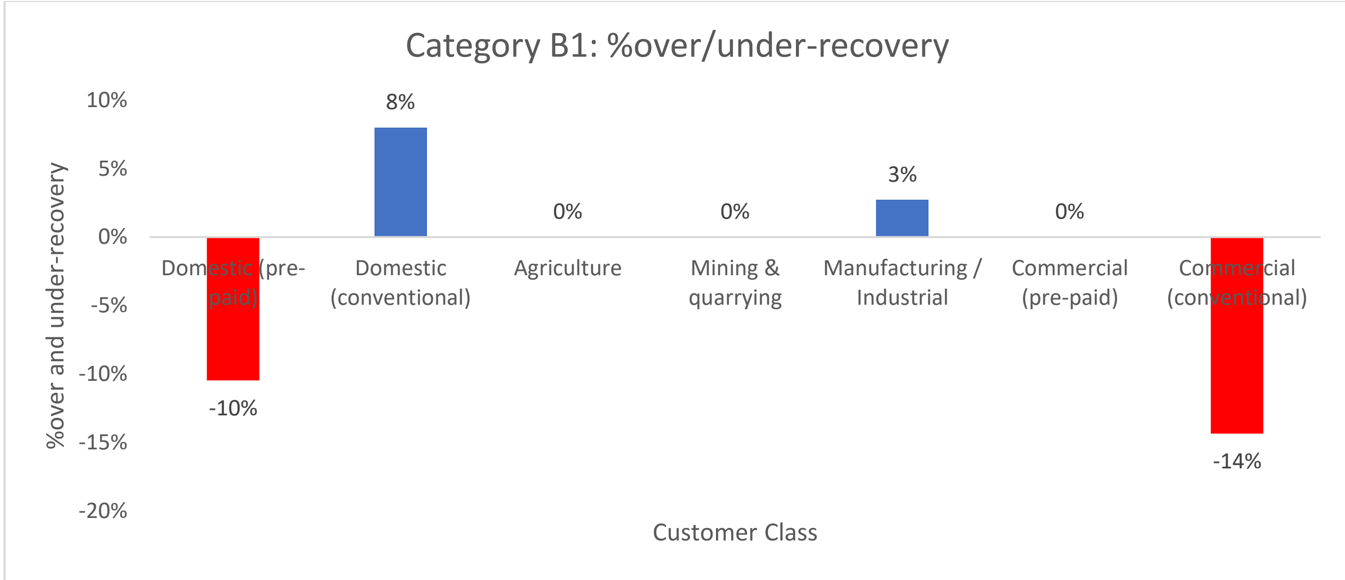

Figure 12: %over/under-recovery for Category B1 municipalities

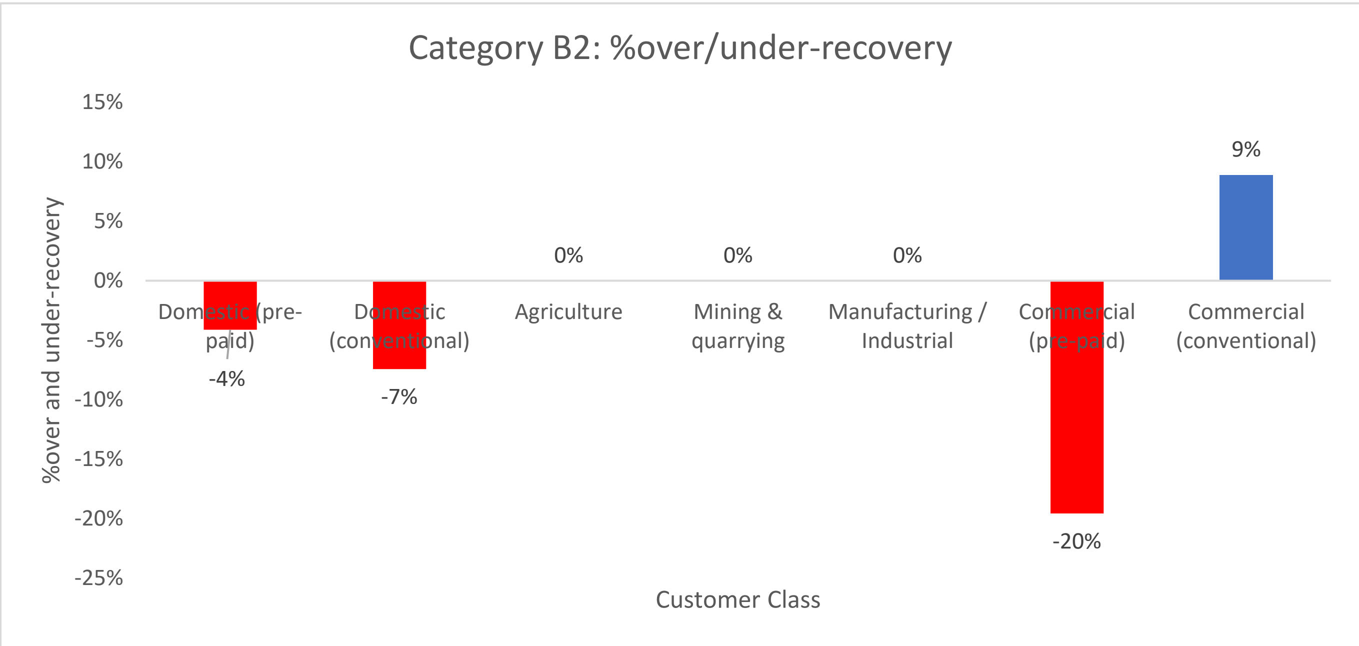

Figure 13: %over/under-recovery for Category B2 municipalities

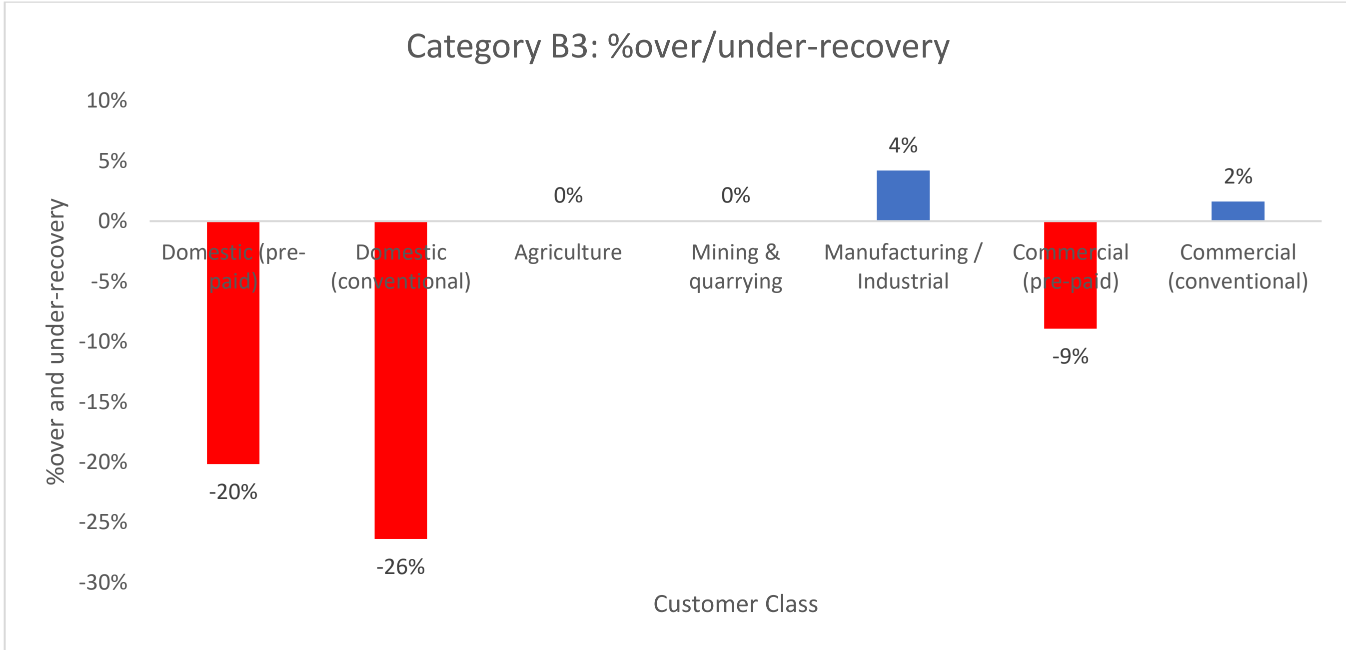

Figure 14: %over/under-recovery for Category B3 municipalities

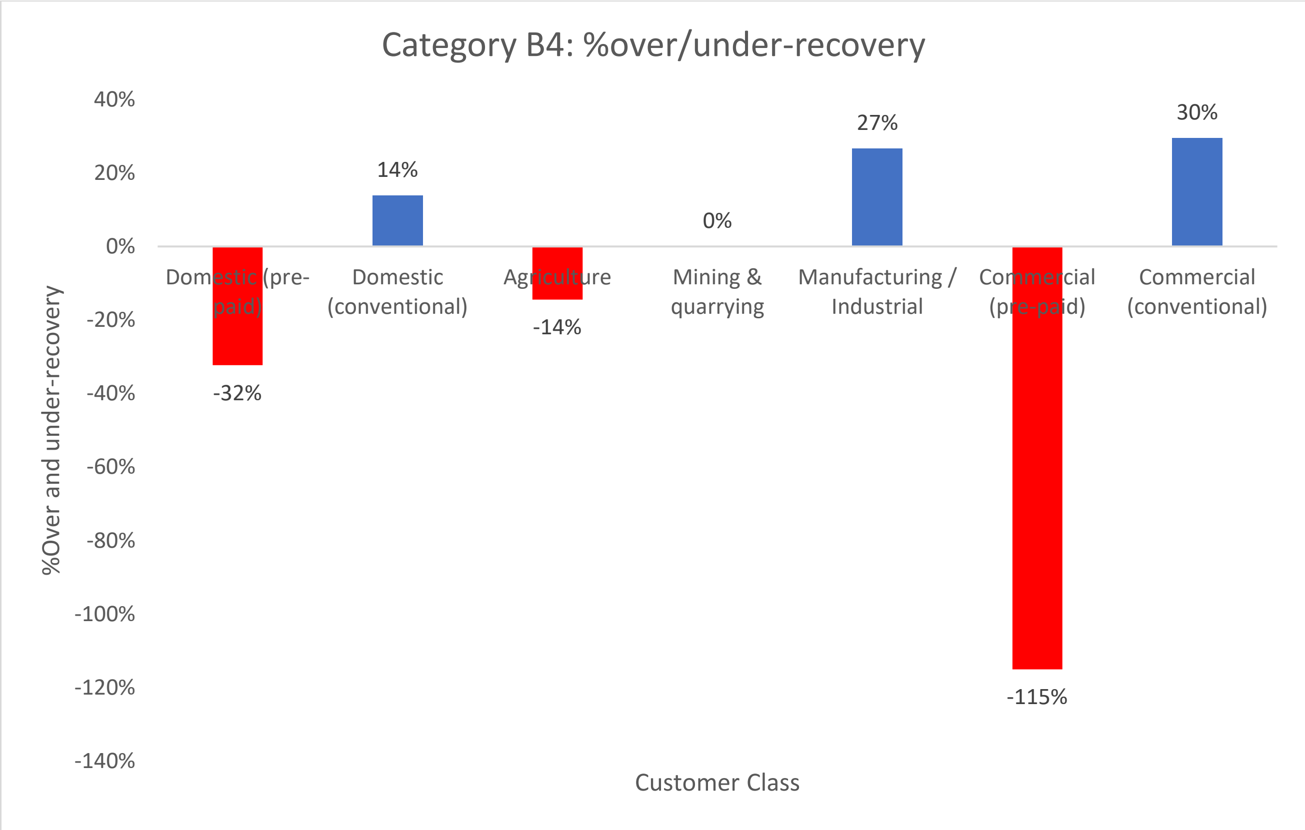

Figure 15:%over/under-recovery for Category B4 municipalities

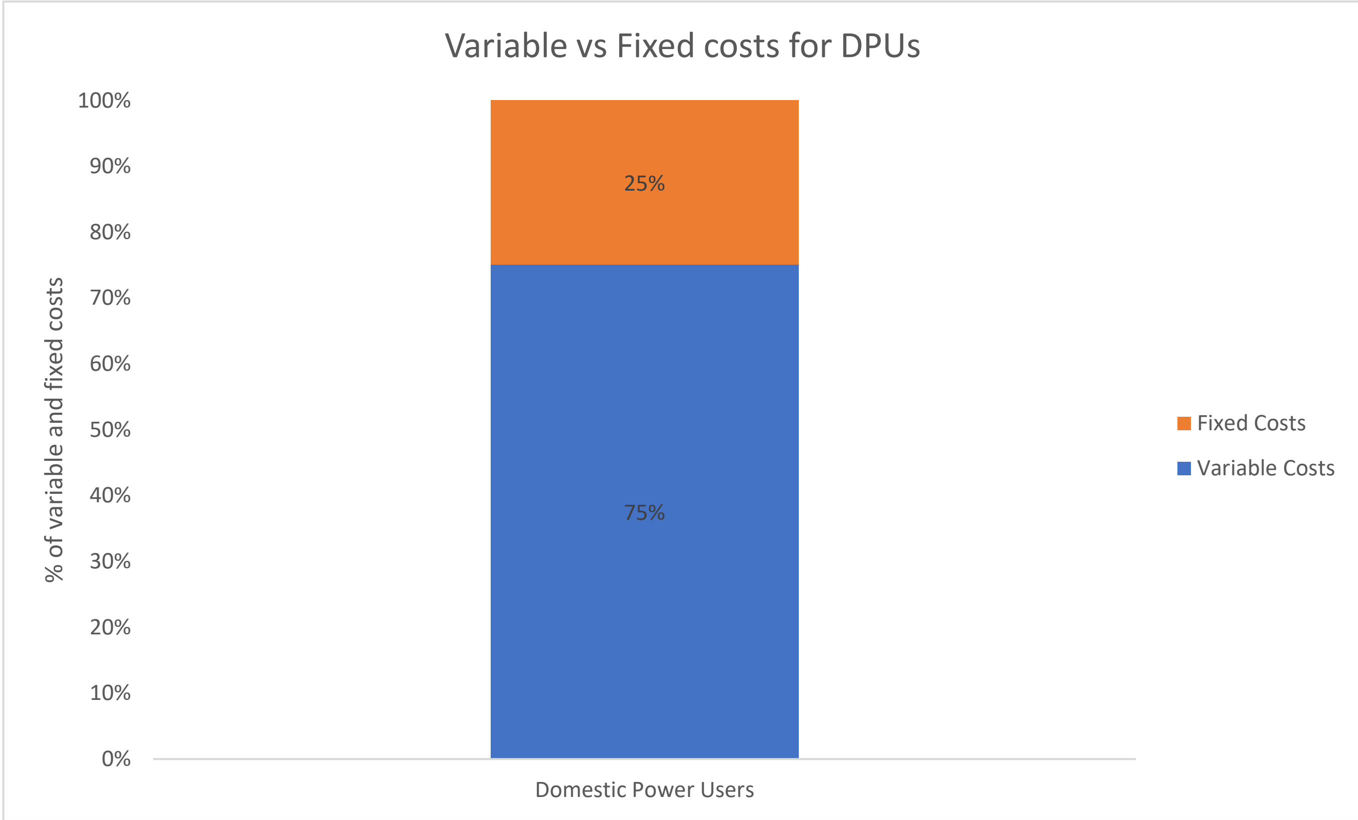

Figure 16:Variable vs Fixed costs for DPUs

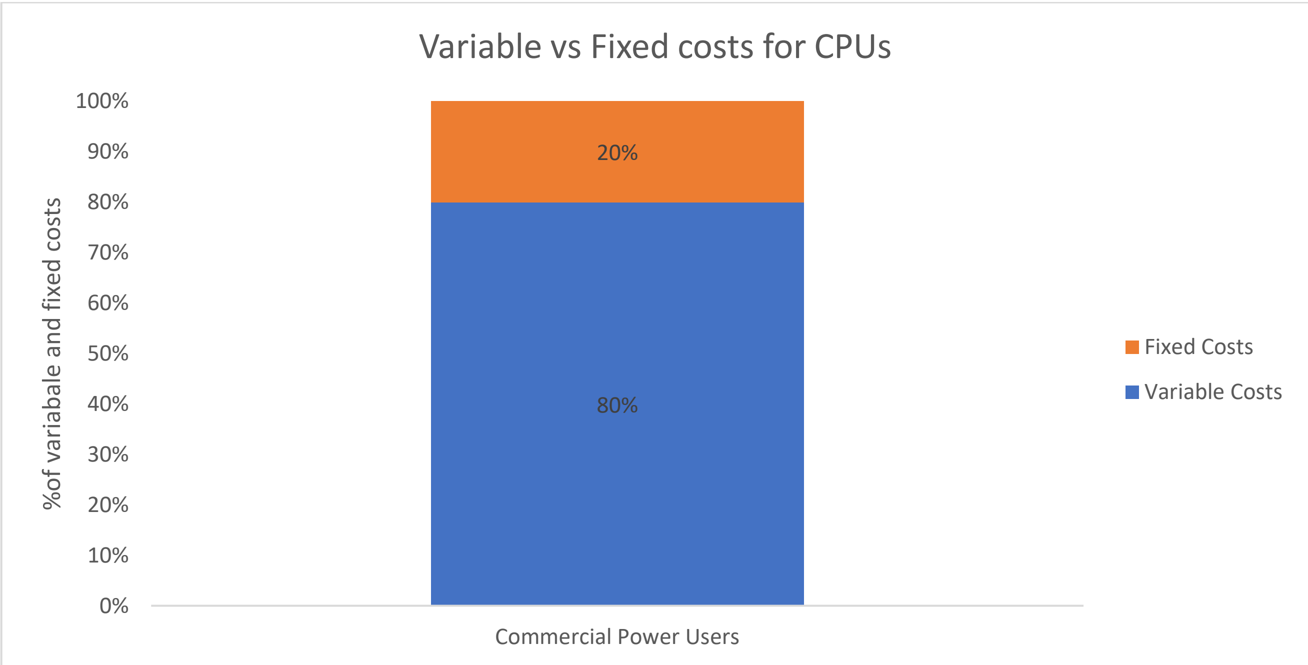

Figure 17: Variable vs Fixed costs for CPUs

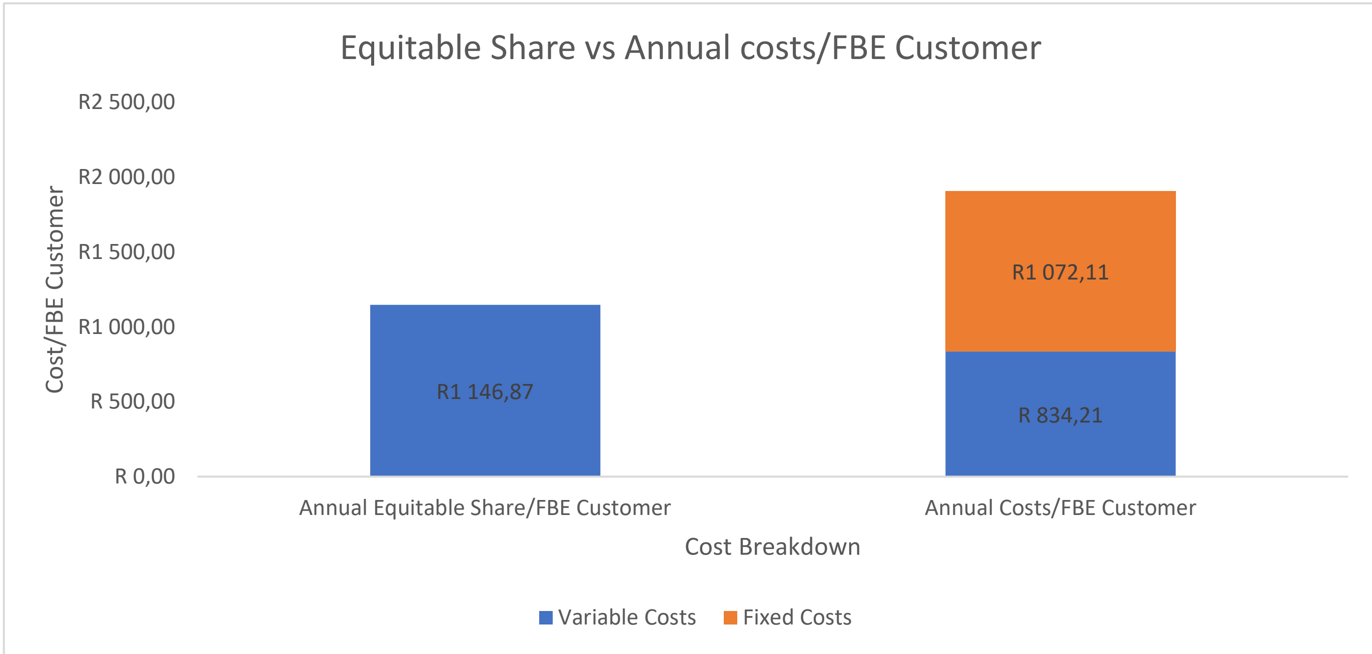

Figure 18: Equitable share vs annual costs/FBE Customer