The welfare implication of reversing Ghana's electricity tariff structure: Evidence from residential and non-residential customers

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- Ghana's electricity sector owes USD 1.9 billion in debt to independent power producers. Key to this indebtedness are commercial losses, political interference, and the cross-subsidisation of electricity tariffs from non-residential to residential customers.
- In September 2022, the Public Utilities Regulatory Commission partially reversed this subsidy by 36%. This brief presents findings from an assessment of this reversal, conducted one year after the reversal.
- The key findings are that higher-income households suffer more losses than lower-income households, and micro businesses have greater gains when the policy is scaled up to 70% and 100%, respectively.
- It is recommended that PURC gradually scale up the policy, bearing in mind key political economy-related questions.

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Overview of Ghana power's system

The goal of Ghana's power sector is to adequately supply power to meet the country's needs and to be a major net power exporter in the region. To achieve this, Ghana has developed an Integrated Power Sector Master Plan. This plan ensures a steady addition of adequate generation capacity and upgrades and modernises the transmission and distribution infrastructure in a timely and cost-effective manner (IPSMP, 2023).

The Government of Ghana aims to achieve universal electricity access by 2025. The country currently has an electricity access rate of 88.8% as at 2022, an increase of 3.8% from 2019 (IPSMP, 2023). However, the access rate in urban areas as of 2021 was 100%, while the rural areas stood at 72.9%. To achieve an access rate of 100% by the said date (2025), the government of Ghana participated in a World Bank-funded project, "Ghana Energy Development and Access Project (GEDAP)," which started in 2007. The project aimed at increasing the population's access to electricity and helping transition Ghana to a low-carbon economy by reducing greenhouse gas emissions. In addition, the government is also participating in the "Scaling-Up Renewable Energy Programme (SREP)" to increase overall energy access to at least 95% by the end of 2025 (IPSMP, 2023).

Ghana's electricity generation mix comes from three main sources: hydro, thermal, and renewable. These sources are supplied to both domestic and international (export) electricity markets. The domestic consumers are made up of residential, non-residential, and Special Load Tariff (SLT) customers. The SLT customers are divided into three categories: SLT low-voltage, SLT medium-voltage, and SLT high-voltage consumers. The Energy Commission is mandated by the energy sector.

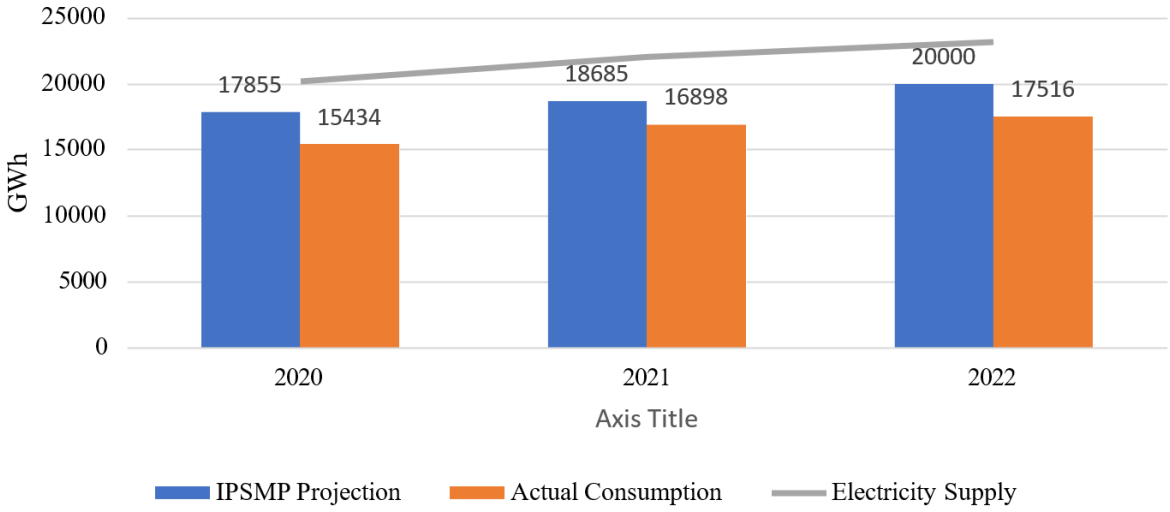
Law Act 541 (1997) forecasts electricity supply and demand for domestic and international markets. Ghana's electricity demand has surged over the years due to the increasing population and industrial consumers of electricity (IPSMP, 2023).

Electricity consumption

For instance, electricity demand increased from 8.2% in 2020 to 9.5% in 2021, as shown in Figure 1 below. In 2022, electricity demand increased by 3.7% relative to 2021. These are relatively lower than the projected electricity consumption for this period by the integrated power sector master plan. Similarly, juxtaposing the projected and actual electricity demand with

production data shows that production has often outpaced demand (excluding exports). But why is Ghana still facing an electricity crisis in recent times?

FIGURE 1: Projected and actual electricity demand profile for Ghana (2020-2022)



Source: Authors' computation using data from Energy Commission, 2023

Electricity sources

Ghana obtains its electricity from three main sources in addition to imports. The hydro production has steadily increased from 7,252 per Gigawatt hour (GWh) in 2019 to about 8,213 GWh in 2022. This is about a 13.25% increment within a three-year period. That of thermal has increased by 36.1%, renewable energy (RE) sources increased by 169.23% and that of imports declined by 70.9%. Thermal power generation is the major energy source for Ghana's electricity generation mix, about 59.4% of the total generated in 2019 to about 63.8% in 2022. The country also has the potential to scale up its renewable generation mix to increase the power supply in Ghana in order to help reduce future power crises. Table 1 below shows the detail electricity supply.

TABLE 1: Electricity supply

	2019	2020	2021	2022
Hydro	7,252	7,293	7,521	8,213
Thermal	10,885	12,820	14,408	14,810
RE Sources	52	57	122	140
Imports	127	58	44	37
Total	**18,316**	**20,228**	**22,095**	**23,200**

Source: Energy Commission's National Energy Statistics, 2023

Electricity transmission

The electricity supplied through generation and imports is transmitted through the transmission network. The transmission network covers most areas in Ghana and extends to neighbouring countries such as Cote d'Ivoire, Togo and Burkina Faso. As at 2021, its total length is approximately 6303.9km, and this is expected to increase by the end of 2022, with a total transformer capacity of 8064 megavolt-amperes (MVA) in 2021. Table 2 shows the power transmitted and the losses recorded from 2019-2022.

TABLE 2: Total energy and transmission losses

	2019	2020	2021	2022
Transmitted (GWh)	17,887	19,717	21,466	22,478
Losses on Transmission (GWh)	843	888	1,076	922
% Losses on transmission	4.7	4.5	5	4.1

Source: Energy Commission's National Energy Statistics, 2023

Reversing Ghana's electricity tariff structure

From Table 2, power transmitted over the period has surged from 17,887 GWh in 2019 to 22,478 GWh in 2022. This represents a 25.7% increase in electricity transmitted. However, the transmission losses per annum averaged 4.6% over

the period. These transmission losses, at times, exclude the distributional losses from the Electricity Company of Ghana (ECG) and Northern Electricity Development Corporation (NeDCo), which are much higher and contribute to the challenges in revenue generation. These losses, in addition to operational losses from the electricity distributors, make them unable to honour their debt obligations with independent power producers, and this has significantly affected the power supply in recent times.

After emerging from the power sector crisis in 2015, the electricity sector is keen to reform the sector, and one of the major problems the sector faced was its inability to raise enough revenue to honour its debt obligations (AGI, 2019). This was necessitated due to a lack of cost-reflective pricing of electricity tariffs and high commercial losses, among other things. The general practice in Ghana has been that the non-residential sector (Industry) has been cross-subsidising for the residential sector, and this has been affecting micro-, small- and medium-sized enterprises' (MSMEs) performance due to the high cost of production. This tariff structure implies that the MSMEs and other industries tend to pay more per kWh of electricity consumed relative to the residential users in a similar band. This practice has several challenges, which include:

- It creates inefficiencies in the group receiving the subsidy.
- It creates unfairness in the electricity sector between the user groups (those with low-cost subsidies and those with high costs).
- It increases the cost of production for firms, which could impact competitiveness.

As a result of these challenges, the energy sector regulator, Public Utilities Regulatory Commission (PURC), in August 2022, decided to reverse 36% of the cross-subsidisation on the amount of tariff that the firms used to absorb for the residential and made the residential customers to now pay for it. This policy took effect in September 2022.

Project aims and objectives

The PURC intends to scale up the policy but wants to evaluate the effect of the initial 36% reversal of the tariffs on the residential and non-residential customers' welfare to guide their policy direction. Specifically, the project aimed to:

- Assess the welfare implications of the 36% partial reversal of electricity tariffs on both residential and non-residential customers and the size of the welfare.

- Determine the customers who are most affected by the policy change.
- Explore the welfare implication of scaling up the reversal rate to 70% and 100% to inform policymakers on the implication of various reversal rates on welfare and advise the course of action.

Data source and analytical approach

Data source

The data used for the study are both administrative data from PURC on energy prices and primary data collected from the field over one month (18 September 2023 – 18 October 2023). This was roughly one year after the policy reversal took place. This was to allow for policy assimilation, in which, by this time, the impact of the policy would have been fully appreciated. Data was collected from seven administrative regions of Ghana. Five of these were from the Electricity Company of Ghana operating Area (Greater Accra, Ashanti, Central, Volta and Western Regions) and two from the Northern Electricity Development Cooperation (NeDCo) operating areas (Bono East and Northern Regions).

Analytical approach

The study utilises 63 Enumeration Areas, which include 25 rural EAs and 38 Urban EAs. The target residential data was 1260 households, and that of the non-residential target was 635 firms. Overall, the study elicited a response rate of 82.14%, representing 1035 households, but only 1024 household data were fully completed and used for the study. It is worth noting that individual-level data was obtained alongside household-level data. For the firm-level data, we elicited a response rate of 82% representing 520 firms; again, only 504 firms were suitable for the analysis.

The study utilises the Exact Affine Stone Index (EASI) demand estimates to undertake the welfare analysis of consumers through the consumer surplus measure. This helps to assess the change in electricity prices after a 36% reversal policy relative to electricity prices before the policy while keeping utility constant. This is what we call “the cost-of-living index” (Karimu et al., 2022).

This cost-of-living index is made up of two parts. The first part reflects changes in price due to the stone index, and the second part captures the substitution effect of a price change due to the policy introduced (Lewbel & Pendakur, 2009). This allows us to evaluate the distributional effects of welfare in terms of

those who gain positive welfare, those whose welfare has not changed and those who experience a loss in welfare. Based on this, we simulated the welfare of the current reversal of 36% to 70% and 100%, respectively. This helps us assess which percentage reversals produce the most positive net welfare.

Assessing the impact of electricity tariff reversal on customer welfare

We document the impact of the reversal of the electricity tariff structure in Ghana by considering the impact of the partial reversal undertaken by the Public Utilities and Regulatory Commission implemented in September 2022. Here, we document the findings of the 36% reversal by the PURC and consider the impact of scaling up the reversal to 70% and 100% to assess the welfare gains or losses.

Partial reversal (36%)

On the basis of the analysis carried out. Emphasis was made on the partial reversal of the electricity tariffs for residential and non-residential and their groups based on income and firm structure. The key findings are:

- The residential customers experienced a welfare loss. The loss is equivalent to about 2.3% of their average monthly electricity budget, about GH¢4 (US$ 0.29)[1] per month on average. This loss was higher among higher-income households compared to low-income households. The loss is due to the partial reduction in subsidy the residential customers experienced, who now must absorb the cost ceded by the non-residential clients.
- The non-residential clients also experienced a welfare loss of 0.13% of their monthly electricity budget share, equivalent to GH¢0.845 (US$ 0.06). Micro firms experienced a greater percentage of the loss of their budget share, about 0.3%, compared to medium firms, 0.04%.

Scaling-up reversal to 70% and 100%

- The residential customers have an average welfare loss of GH¢27(US$ 1.9) per month for the 70% and GH¢40 per month (US$ 2.9) for the 100% scale-up. This percentage loss is higher for

[1] We use an official exchange rate of US$1 to GH¢14.

the higher income earners, which range from GH¢14 to GH¢21, compared to the low-income households, which ranged from GH¢5 to GH¢6.5.

- Non-residential customers, in contrast to that of residential customers, experienced a gain of GH¢35(US$ 2.5) for the 70% and GH¢100(US$ 7.1) for the 100% scale-up. This gain is much more pronounced for the micro-firms, ranging from GH¢11 (US$0.79) to GH¢33(US$2.4) relative to the medium firms' gain, which range from GH¢6 (US$0.43) to GH¢19. Again, this gain is anticipated to lead to cost reductions for firms, which in turn should promote business expansion and job creation that will benefit households who experience losses in their welfare.

Discussion and recommendations

Ghana has an ambitious plan to expand electricity access to all segments of the population by 2025. The aim is to reach an electricity access rate of 95% by the end of 2025 and, if possible, 100% by 2030. This led the government to engage in the World Bank-funded Ghana Energy Development and Access Project (GEDAP) and Scaling-Up Renewable Energy Programme (SREP). However, the major players in the power sector are the independent power producers. The government is highly indebted to these producers to the tune of USD 1.9 billion as at June 2023. This threatens the regular power supply and is caused by the lack of cost-reflective tariffs, transmission, operational losses and cross-subsidisation of electricity tariffs.

Policymakers believe that cross-subsidisation has been a major challenge to revenue generation by the distributors, Electricity Company of Ghana and Northern Electricity Development Cooperation. Key to cross-subsidisation in Ghana is that non-residential customers subsidise residential customers, leading to high operational costs among the MSMEs in Ghana.

The Public Utilities Regulatory Commission (PURC), in August 2022, decided to reverse 36% of the cross-subsidy from non-residential customers to residential customers in a bid to reduce the cost burden on businesses. This policy came into effect in September 2022, and a year later, the policy was matured to be assessed. Therefore, this study aimed to assess the impact of the policy on the welfare of residential and non-residential electricity consumers in Ghana. Based on the findings, it would provide recommendations on whether to scale up or terminate the policy.

The study finds that the 36% partial reversal of tariffs leads to a welfare loss of GH¢4 (US$0.29) per month on average for residential and GH¢0.845 (US$0.06) per month for the non-residential. Higher-income households have a higher loss in welfare as compared to lower-income households, depicting the distributional impact of higher income on lower-income households. This will make higher-income households efficient in the utilisation of electricity since their costs are likely to go up. Additionally, low-income households will also be circumspect in the utilisation of electricity because small changes in out-of-pocket payment for higher electricity tariffs will greatly affect other essential consumption such as food and healthcare. Also, micro-businesses suffer loss in welfare, but their effect is quite low because it has improved over what they used to pay because a portion of their electricity bills has been ceded to the residential users.

The scaling-up of the reversal to 70% and 100% would lead to welfare loss for households of an average of GH¢27 (US$1.93) for 70% reversal and GH¢40 (US$2.86) for 100% reversal, respectively. Again, higher-income households suffer more losses than low-income households. This loss means that higher-income households will have to tighten their belts to pay more for electricity should the policy be scaled up.

Finally, on average, the 70% scale-up will offer a gain of GH¢35 (US$2.5) per month for non-residential customers and GH¢100 (US$7.14) per month for 100% scale-up. This is more beneficial for micro-businesses than for medium-sized businesses. It is good for cost reduction and eventual expansion of these businesses. Their expansion is expected to create new jobs for households to compensate them for the loss in their welfare.

Based on these key findings, it is recommended that for PURC to draw out the full benefits of the policy, they would have to gradually implement the scaling-up of the reversal. However, this policy reversal may have key political economy-related implications which may raise important questions. Some of these questions include:

- Are there measures to deal with the political economy issues that contribute to the inefficiencies in the sector?
- How should commercial losses, which have cost implications, especially in the residential sector, be reduced?
- How can those losing out from the reversal policy be addressed?
- Will a competitive distribution sector help?

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