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Examining the Effectiveness of Electricity Billing System against the Mobile Phone Billing System in Active Mining Rural Communities in the Western Region of Ghana

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Abstract

This paper examines the effectiveness of the electricity billing and payment system and its probable contribution to energy losses vis-à-vis the billing and payment system deployed by the telecommunication companies in rural mining communities in the Western Region of Ghana. We used field observations, interviewed respondents with both openended and structured questionnaires and literature survey to validate our conclusion. This study firmed up the following facts: over 50

Index terms— electricity company of ghana, energy meters, illegal connections.

Abstract-This paper examines the effectiveness of the electricity billing and payment system and its probable contribution to energy losses vis-à-vis the billing and payment system deployed by the telecommunication companies in rural mining communities in the Western Region of Ghana. We used field observations, interviewed respondents with both openended and structured questionnaires and literature survey to validate our conclusion. This study firmed up the following facts: over 50% of Electricity Company of Ghana's (ECG's) legal customers in most mining rural areas do not pay commensurable electricity bills every month for the power used; a heap of power customers (47% of respondents) are unmetered and 26% of respondents used power freely. The study also revealed that most rural folks are capable of paying their electricity bills without any external interventions for the reasons imbued in their business activities for livelihoods and the sums of money disbursed on mobile phone recharge cards. Finally, the installed metering and payment system for electricity consumption contributes immensely to the ECG's non-technical losses. Weighing the current costs of electricity production, this study provides real and premier foundation for Introduction lectrical energy has become an indispensable part of life, and among others, it is the most limited resource in most developing countries. Grid capacities principally determine national levels of industrialization. The mammoth expectation is that, generated electricity must be securely transmitted and distributed efficiently without any illegal and free usage and also not at outrageous with limited levels of losses. Though the desired metering system for mitigating these illegal and free usages has not been done, much effort has not been put in place to curtail the free usage due to theft and pilferage, especially in the rural communities in Ghana.

As at 2006, the management of domestic and industrial electricity consumption in Ghana was based on manual meter readings, which are read at irregular intervals making it difficult to accurately estimate consumers' monthly bills. With this manual metering system, electricity consumption of all domestic appliances is amalgamated into one monthly bill, which did not allow for differentiation of electricity use within any specific or regular interval. By way of improving the system, most of these meters in the urban centres were recently replaced with the prepaid and or digital/electronic ones, which do not address the prevailing problems even in the urban centres entirely. On the other hand, almost all rural communities on the national grid use the electromechanical or the manual metering system. Aside monitoring illegal connections, accessing these communities for their meter readings, distributing their monthly electricity bills and getting all bills paid on time are major challenges for the ECG. ECG is the main electricity distribution company in Ghana.

Considering the increasing financial cost of power generation, transmission and distribution [1][2] in Ghana currently, this study examines the effectiveness of the electromechanical or manual metering and billing system against the flexible billing systems deployed by the telecommunication or cell phone service providers in Ghana.

An electricity meter is a device that measures the amount of electrical energy consumed by a residence, business, or an electrically powered device. The different types of electric meters used to calculate the household or commercial consumption of electricity [3], are Electromechanical Induction Meter or Standard Meter, Variable Rate Electric Meters, Prepayment Electric Meters, Solid State Electric Meters and Electronic Meters. With the electromechanical induction meter or standard metering system, a human interface meter reader notes the consumed unit of electricity shown on the meter and bills are later sent to the customer along with other statutory costs [4]. This is the main device in limbo as far as this paper is concerned.E Global Journal of Researches in Engineering ( ) F Volume XIV Issue V Version I [ ] ( ) 1 % 100 % × = t EnergyInpu ed EnergyBill t EnergyInpu Losses

1 II. Materials and Methods

Losses are indispensable part of power generation, transmission and distribution, but can be minimized if properly managed [5]. From Figure 1 and Equation 1, ECG classifies losses into technical and non-technical or commercial, even though their percentage compositions are unknown. Losses are any input energy that goes unbilled or unmetered [6]. But it is known that a larger percentage of the losses are nontechnical, which emanate from the consumers' end [7]. Among the common factors responsible for nontechnical losses are: energy pilferages and thefts, defective meters generating errors in meter readings, wrongful estimation of meter readings, un-metered or flat rated consumers, customers tampering with their meters, free power usage (for legally connected consumers), illegal connections, etc. [8]. As at 2011, 26.6% of the total power ECG purchased from the Volta River Authority (VRA) was wasted, with majority attributable to illegal connections to the national Grid and free power usage mostly in rural communities. The 26.6% losses estimated totalled to GH¢ 478.88 million (US$239.44 million) with a unit per cent loss valued at GH¢ 17.74 million (US$8.87 million) [7]. Inflation rate has almost tripled since 2011 affecting the cost of power generation and distribution. Consequently, losses incurred by ECG currently stands at 30% out of which, free power usage and other illegalities constitute 10% (approximately) [9]. Importantly, ECG was unable to bill over 100,000 customers connected to the national grid [10]. Again, 9,537 illegal electricity connections (by-passing the prepaid meters) were detected, constituting a GH¢ 18.23 million (US$9.115 million) loss of revenue to the nation [9].

2 Generation

3 Total Energy Losses

It has been estimated that ECG has over 1.4 million customers of which 17-20 percent are rural population. Electricity usage in the rural areas is estimated to be higher in the coastal (27%) and forest ecological zones (19%), than in the savannah areas (4.3%) of the country **??**11].

This study sets out to investigate the probable losses attributable to free power usage (being it theft or pilferage or illegal connections) in some active mining rural communities. Thus, we investigate the extent to which, these communities vigorously exploit electricity without paying the due bills. With this basis, the effectiveness of the metering and billing system in use will be examined vis-à-vis the billing system deployed by telecommunication companies in the country. We targeted the communities along the forest and coastal ecological zones, since they form the majority of ECG's rural customers.

In this paper, we used qualitative approach to address the research problem. The authors adopted a literature survey as secondary data source. Primary data was collected using questionnaire, interviewing and field observations to conclusively examine the situation. In terms of grid power usage, there is no significant difference between the urban centres and the densely populated rural communities especially those along the coastal and the forest belt due to "galamsey" (illegal mining) and small scale mining (legal) activities. 421 respondents from these communities were interviewed.

4 III.

5 Results and Discussions a) Respondents' Bio Data

This part of the questionnaire considered respondents' sex, age, education levels, sources of income, years lived in their respective communities and their dependence on the national electricity grid. Out of the 421 respondents interviewed, 76% were males while 24% were also females. 94% were between 18-60 years, Global Journal of Researches in Engineering ( ) F Volume XIV Issue V Version I 2% below 18 years and 2% above 60 years. Also, 29% lived in the communities in less than five years ago, while 71% have lived in the communities for at least five years. Their highest education levels were tertiary (39%), secondary (36%), basic (21%) and no schooling (4%). Figures 2 and 3 illustrate respondents' sources of livelihood and dependence on the national electricity grid respectively. In principle, Figure 3 represents the breakdown of the percentage of respondents who are legally and illegally connected to the national electricity grid.

6 b) Electricity Billing and Payment System

This section examines how monthly bills are estimated, how often respondents pay their electricity bills, annual average bills often paid, consequences of not paying electricity bills on time and at all and electricity usage. Figure 4 summarises the outcome for this section.

Typical of present mining rural communities, there are no slums in terms of electrical appliances and their usage. Generally, there is no much difference in the domestic and commercial usage of electricity between these mining rural communities and the urbanized areas. Commercially, inhabitants of these communities use electricity in support of their businesses such as refrigeration of drinks, water, foodstuffs, fishes and meats. Other commercial or business usages of electricity include fabrication and building of mine support equipment (example Tromel Gold recovery Plants), foodstuffs milling operations, dress making operations, electronic appliance and repairs operations, hair dressing saloons operations, fuel stations operations, etc.

These commercial usages of electricity brings substantial amounts of money to the inhabitants involved in these businesses, but unfortunately results in significant non-technical losses to power generation companies due to lapses in the metering and billing systems of such communities.

From Figure 4, it is realised that 21% of the inhabitants interviewed use electricity without being metered and billed at all. Due to the free power usage by these inhabitants, they are not instigated to use electricity astutely and efficiently, which further aggravates the issue of non-technical losses. For other 26% of inhabitants interviewed, who are billed at a flat rate also contributes substantially to the non-technical losses as they might use electricity above the rate they are to pay. Even with the 53% legally metered inhabitants, there is no certainty that they all pay their bills.

Under the frequency of electricity bill payment from Figure 4, 26% of inhabitants interviewed do not pay electricity bills at all, 57% inhabitants pay once in three months (ECG officials come at every three month intervals) and only 17% of the inhabitants pay every month.

About 50% of the inhabitants interviewed pay less than GH¢ 50 (US$19.10) for their electricity usage annually, which is equivalent to GH¢ 4 (US$1.53) a month. This is virtually like not paying at all since street light and Government levy charges on electricity is about GH¢ 2 (US$0.76) per month. About 45% of the inhabitants pay between GH¢ 50-100 (US$19.10-38.17) for their electricity usage annually, which is about GH¢ 4-8 (US$1.53-3.05) a month. Examining these domestic and commercial (or business) usages of electricity and the resulting bills paid in these communities, we noticed inefficiencies in electricity metering, billing and payment systems constituting non-technical losses.

As to the repercussions of not paying the electricity bills, 82% of the respondents received no punishment or confrontation from ECG officials, 7% were warned and 11% disconnected. Again, this clearly shows extreme degree of non-technical losses emanating from most rural mining communities doing serious economic activities. This section probed whether or not respondents used cell phones, how long they have used cell phones and their abilities to pay the resultant bills. Figure 5 presents the result displaying in both frequencies and percentages. Telecom prepayment networks restrict subscribers' access to making phone calls if they run out of units. Customers are therefore compelled to economise the usage of their units and use them when and if necessary. Amidst current global economic crisis, folks in the rural communities are still busy acquiring cell phones and pay the concomitant bills as they go.

It can be realised from Figure 5 that, about 98% of the inhabitants interviewed owned a mobile phone or more and were active users as well. Out of respondents representing this 98%, 46% of them actively started using the cell or mobile phone in less than 5 years, 26% had been active mobile phone users within 5-10 years and 28% had been active mobile phone users for over 10 years.

It was realised from this investigation that, only 5% of the inhabitants interviewed spent less than GH¢ 500 (US$190.84) on mobile phone recharge cards per year or GH¢ 42 (US$16.03) per month. A significant number totalling 73% spent between GH¢ 500-1000 (US$190.84-381.68) per year or GH¢ 42-84 (US$16.03-32.06) per month and the remaining 22% spent over GH¢ 1000 (US$381.68) per year or GH¢ 84 (US$32.06) per month. This clearly proves that, the inhabitants in these mining rural areas are not at all underprivileged as it is assumed. This also reveals how vibrant business activities exist in these communities.

7 Conclusion

Electricity and telecommunication devices (mobile phones) have become unavoidable agents of convenient living. An effective method of metering, billing and payment system stimulates judicious electricity or mobile phone usage and compels consumers to pay their bills on time. The method of billing and payment system used by telecom companies is tamper-free (fully secured) to customers. Installed energy meters by electricity companies do not have effective security or tamper-evident integrations and consequently breed free usage and illegal connections. This study is expected to aid electricity companies in their policies, and also trigger future studies into the technicalities of electricity billing and payment systems. We recommend temper-impossible energy meters for ECG.

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Figure 1: Figure 1 :

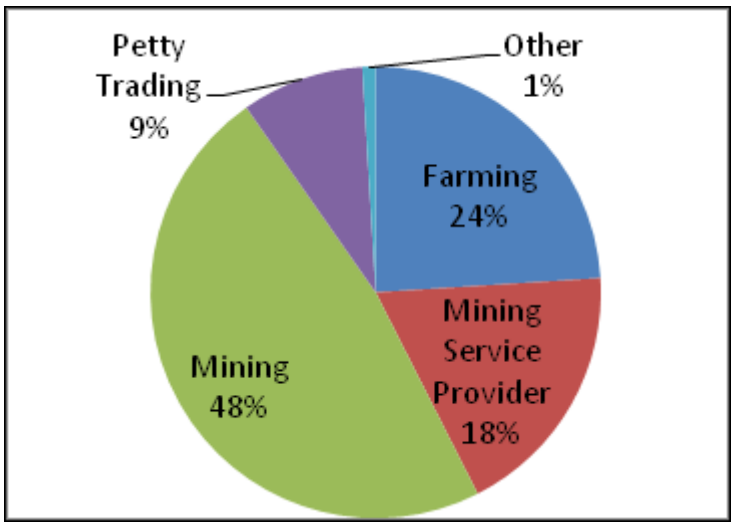

Figure 2: Global

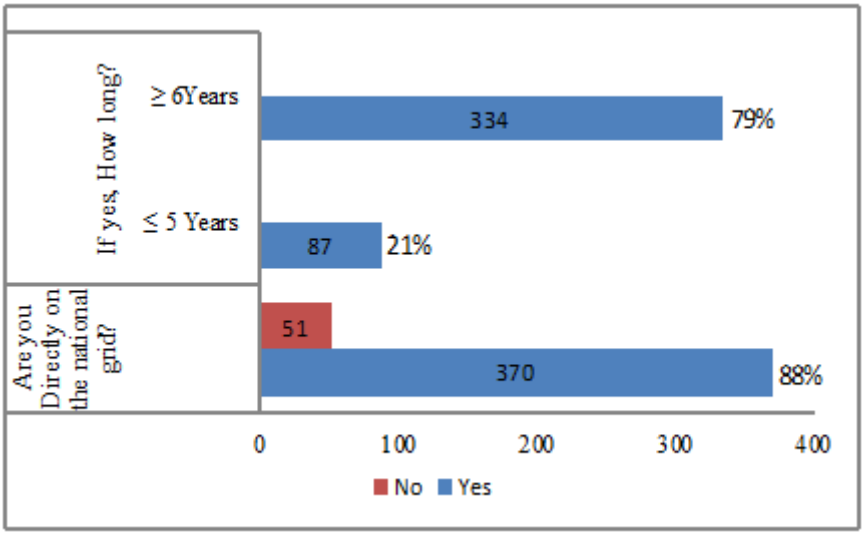

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Figure 3: Figure 2 :

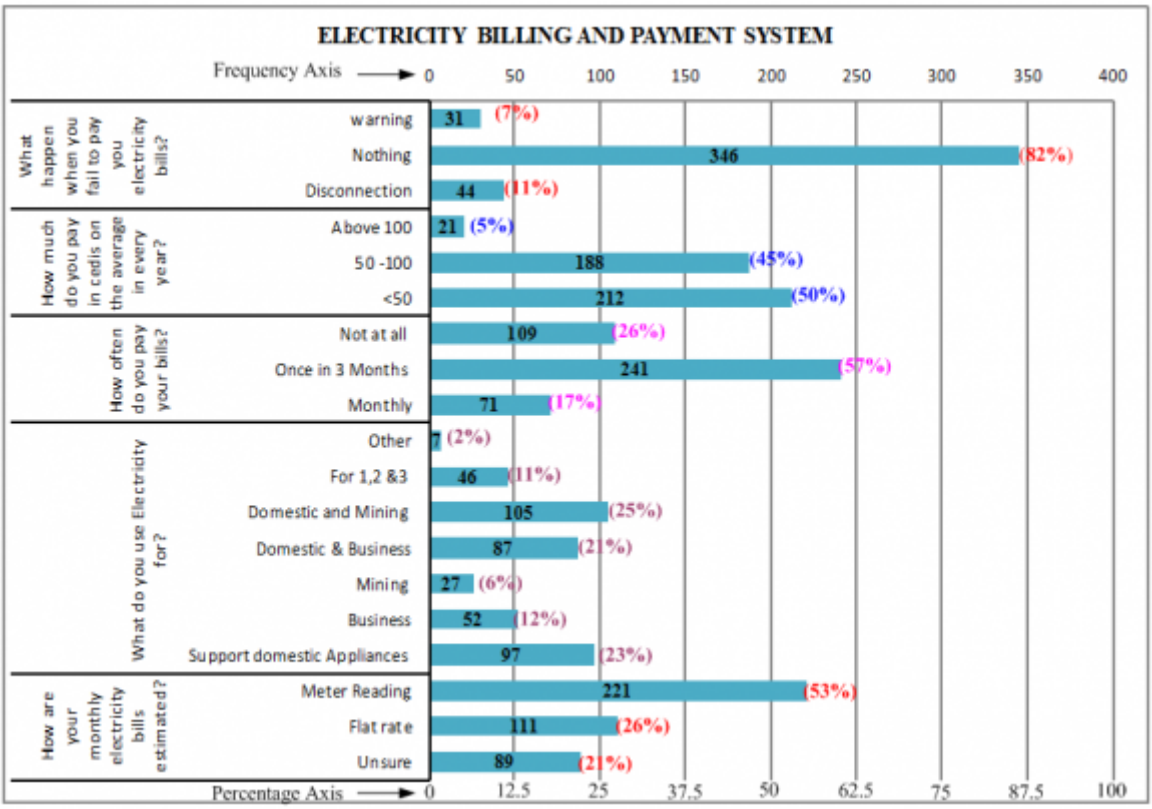

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Figure 4: Figure 3 :

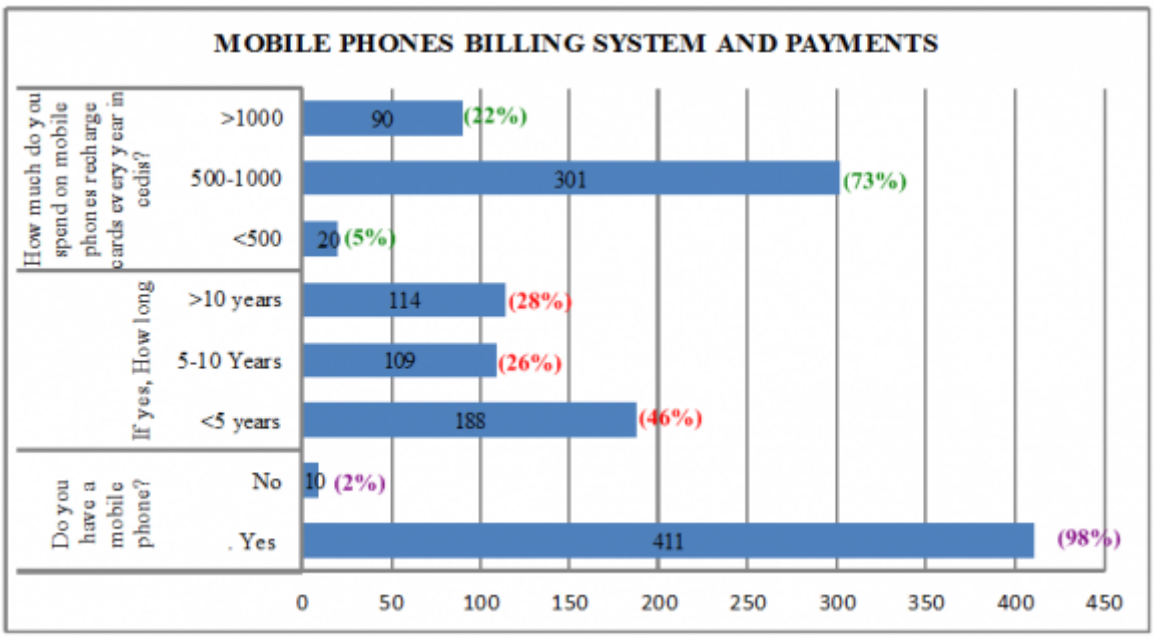

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Figure 5: GlobalFigure 4 :

Figure 6:

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