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# Behavior of Subscribers to the Introduction of Prepayment Meters in Relation to the Consumption of Electrical Energy (Lubumbashi, DR Congo)

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## Abstract

The objective of this research is to study the behavior of subscribers to the introduction of prepayment meters in relation to the consumption of electrical energy. Field surveys were conducted in two neighborhoods (Baudouin and Gécamines). On the one hand, the load profiles were taken from 5 SNEL booths and other consumers (customers) were questioned about the adoption of the prepayment meters. In terms of adoption, prepayment meters are adopted at 32% in the neighborhoods surveyed. The number of subscribers per post-pay system is greater than those using prepayment meters. About 15% of respondents believe that the prepayment meter is a very good system, 27% think the system is good, 35% think the system is bad, while 23% think the system is very bad. The majority (34%) of the surveyed customers report the inefficiency of prepaid meters compared to only 12% who think that the system is effective. In addition, 29% of subscribers think that the system is unfair, so 25% think that the prepayment meter system is simply too expensive compared to flat rate billing. The study also showed that the introduction of prepayment meters is an effective tool to optimize the consumption of electrical energy. Indeed, in the cabins whose subscribers use all the prepayment meters, consumption is generally low than in mixed cabins and those whose subscribers do not use prepayment meters. Among the appliances listed, the most energy-consuming are: stove, washing machine, water heater, plasma TV, refrigerator, oven and incandescent bulb.



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## 1. Introduction

Since the beginning of the electricity grid, meters have been required to measure consumption to establish bills [1]. These are meters as we have one at home, which measures the intensity of the electric current consumes and records the number of kWh consumed [2]. Very quickly network managers found that there were periods of high consumption and times when consumption was low. A significant price difference between day and night consumption has helped to rebalance demand and lead to a benefit for both grid operators and consumers [3]. In most cases, the meters being electromechanical, an agent must periodically pick up the indexes, usually once a month, in order to establish the bill, the electromechanical meters help to transmit the indexes directly to the supplier. Reducing the costs associated with meter reading. One of the first reasons to add "intelligence" to counters was therefore economical.

The efficiency of the network can be greatly improved by a better knowledge of the production and consumption profiles. Balancing is a major concern for network managers. Studies show that in some cases, consumers who are well informed about their habits can significantly reduce their electricity consumption and smart meters can provide this information. For a long time, there are different rates for both social reasons and for reasons of network balancing costs. The new meters offer unlimited possibilities for introducing more flexible mechanisms.

In Lubumbashi, SNEL has tried to improve billing through the implementation of an individualized package. This package is mainly based on the evaluation of receivers identified with the customer. This form of billing is only rarely put into practice. Generally, the bill is not based on any criteria and households are either favored or prejudiced (through excessive billing). The SNEL recognizes, today, glaring weaknesses in the application of the existing procedure (not even respecting the terms of the contract), including the absence of meters and the insufficiency of the staff engaged in indexing tasks and the distribution of invoices [4], [5] [6], [7].

Very recently, [7] showed that billing seems to be one of the main causes of conflicts between subscribers and SNEL. Those dissatisfied with the service provided by SNEL (following unscheduled and frequent power cuts) feel that they are victims of injustice in the billing method put in place by SNEL. The dissatisfaction of the customers makes that the complaints multiply, the consumers by fixed price seem to be favored that the consumers to the meter. Metered customers treat SNEL as partial. The objective of this research is to study the behavior of subscribers to the introduction of prepayment meters in relation to the consumption of electrical energy

### 2.1. Study area

Our study is conducted on the behavior of users of electricity consumers in the face of the introduction of pre-payment meters in Lubumbashi in the city GECAMINES MAMPALA district and in the district BAUDOIN in the town of LUBUMBASHI.

### 2.2. Methods

Field surveys were organized in Baudoin neighborhoods and cited GECAMINES. The load profiles were taken in the cabins with non-meter subscribers on the one hand and those resembling only prepaid subscribers on the other hand. Other cabins qualified mixed (including subscribers without and with counters) were also concerned. A total of 5 cabins were involved. Subscribers were also surveyed using a pre-established questionnaire. The questions focused mainly on their appreciation of prepayment meters and their consumption of electrical energy.

The data from the respondents were encoded in Excel and the averages were obtained for the different variables.

## 3. Results

In terms of adoption, prepayment meters are adopted at 32% in the neighborhoods surveyed. The number of subscribers per post-pay system is greater than those using the meters (figure 1).

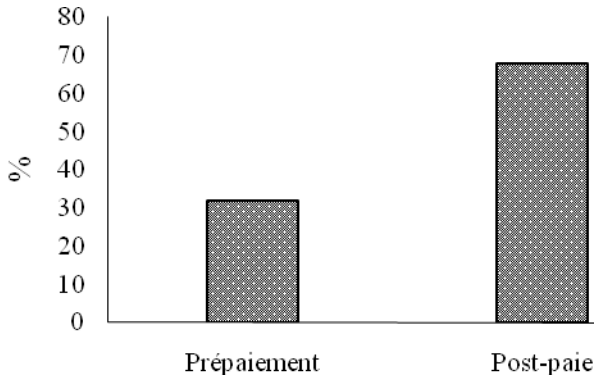


Figure 1. Percentage of pre-paid and post-pay subscribers among SNEL customers surveyed in Baudoin and GECAMINES neighborhoods.

The opinions of subscribers are varied vis-à-vis the system of prepayment meters. About 15% of respondents believe that the prepayment meter is a very good system, 27% think the system is good, 35% think the system is bad, while 23% think the system is very bad.

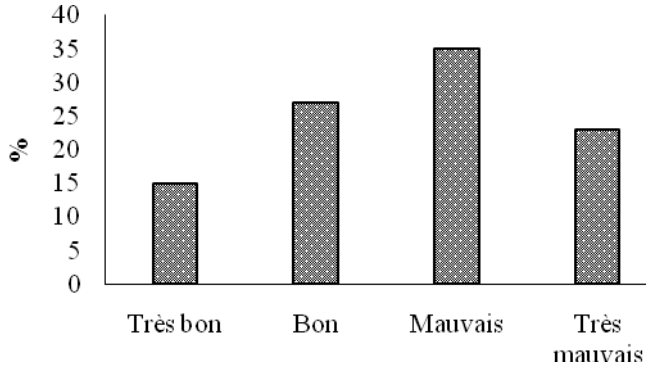


Figure 2. Rating of the billing system by prepayment subscribers in the neighborhoods surveyed.

The causes of appreciation or non-assessment of prepayment meters are given in 3. The majority, or 34% of customers surveyed, report the inefficiency of prepayment meters compared to only 12% who think that the system is effective. In addition, 29% of subscribers think that the system is unfair, so 25% think that the prepayment meter system is simply too expensive compared to flat rate billing.

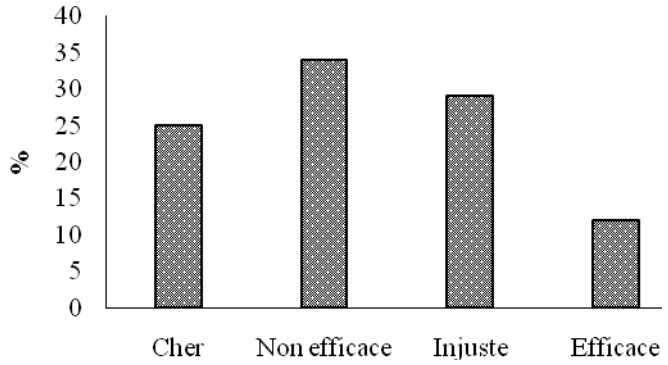


Figure 13. Criteria for assessing the prepayment system.

### 3.2. Influence of prepayment meters on load profiles

#### 3.2.1. Cite gecamines

In the CITE GECAMINES (figures 4, 5 and 6), the load profiles vary according to whether it is a cabin whose subscribers use the prepaid meters or not. The cabins whose subscribers use the prepayment meters, the consumption varies between 232 and 356A. The daily variation is observed in each cabin, the hours of low consumption are between 12H and 17H.

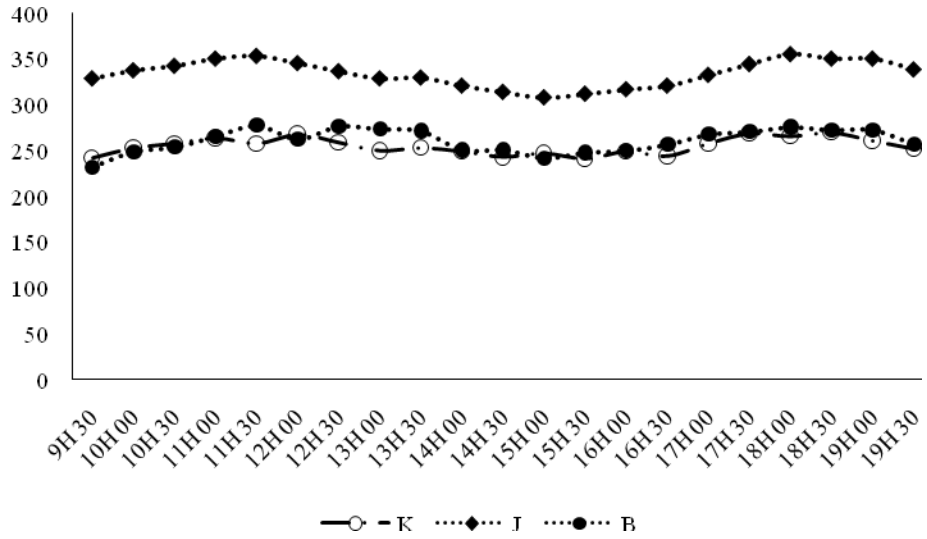


Figure 4. Load profiles in a mixed cabin.

In cabins where customers do not use prepayment meters, consumption varies between 270 and 396 A.

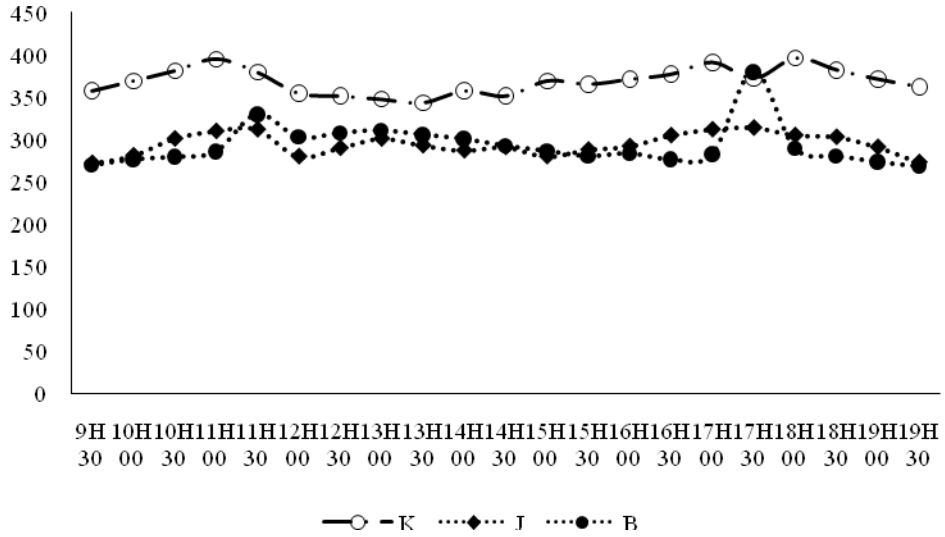


Figure 5. Load profiles in a cab whose subscribers do not use prepaid meters.

In the cabins with prepayment meters, the highest consumption is 230 A while the lowest is 165 A. The consumption values in the meter cabs seem to be much lower compared to the values observed in the mixed cabins a share and post-payroll.

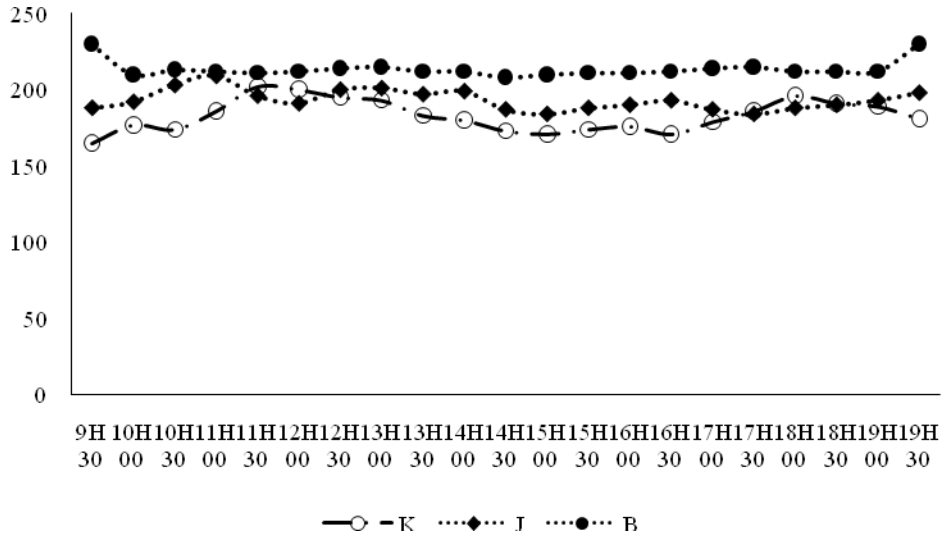


Figure 6. Load profiles in a cab with prepayment meters.

**3.2.2. Baudoin neighborhood**

In the Baudoin district, a particular situation is observed in figure 7 for the cabins whose subscribers do not use the prepayment meters. Peak hours are in the morning and evening. Between 10:00 and 18:30, the consumption is the lowest. Consumption varies between 608 and 855 A.

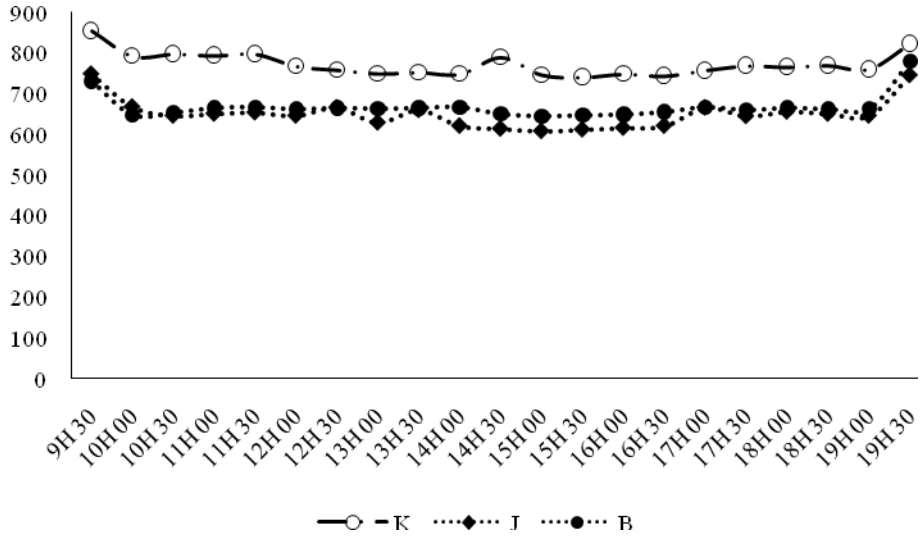


Figure 7. Load profiles in a cab whose subscribers do not use prepayment meters.

The curves of the load profiles are very dynamic in the mixed cabins. Significant variations are observed during the hours observed. The low consumption represents 201A while the high represents 371A.

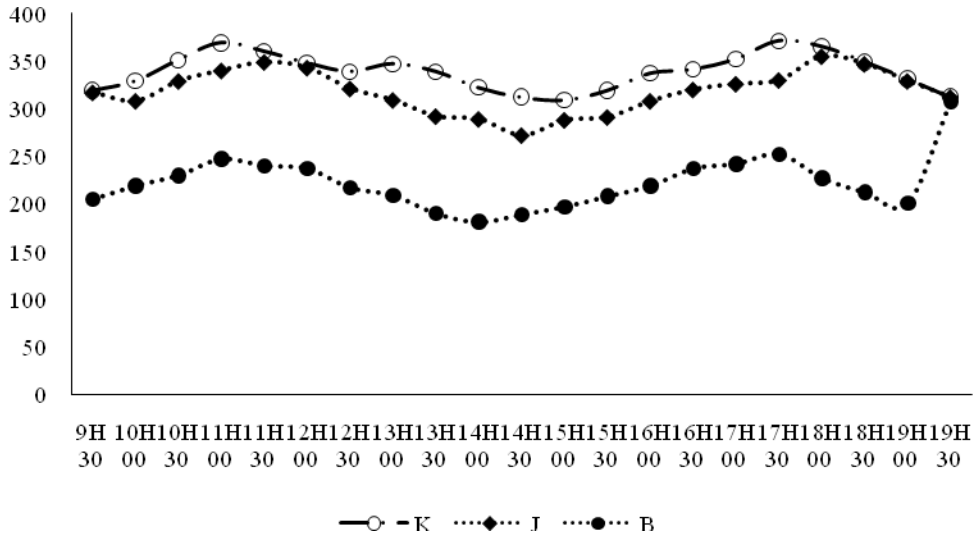


Figure 8. Load profiles in a mixed cab.

**Discussion**

In terms of adoption, prepayment meters are adopted at 32% in the neighborhoods surveyed. The numbers of subscribers per post-pay system are more numerous than those using the meters. This field observation could indicate the mistrust of the population in this system, the low level of popularization of the system and the financial and technical weakness of SNEL in their efforts to adopt prepayment meters.

In addition, the opinions of subscribers are varied compared to the system of prepayment meters. About 15% of respondents believe that the prepayment meter is a very good system, 27% think the system is good, 35% think the system is bad, while 23% think the system is very bad. Favorable notices for prepaid meters would be justified by the fact that these subscribers are confronted with transparency, the bill paid is precisely the energy consumed. On the other hand, the majority (34%) of the clients questioned show the inefficiency of

prepayment meters compared to only 12% who think that the system is effective. In addition, 29% of subscribers think that the system is unfair, so 25% think that the prepayment meter system is simply too expensive compared to flat rate billing. Opinions that are not favorable to prepaid meters would be justified by several factors, including the feeling of unfairness and load shedding. Indeed, the feeling of unfairness arises from the fact that several households living in the same plot can receive a single bill (flat rate billing) that does not even include the consumption of all households while a contribution is made in each household to pay the bill. A household in a parcel like this would pay ten times less than a single household with the same consumption but billed using a prepayment meter. In addition, the variation in the price per kWh aggravates the discontent of subscribers by prepayment meters. Indeed, the price of kWh which returned to 20 FC at the time of the introduction of the counters returns now to 200FC. However, some households living in a multi-household plot prefer meters because they avoid being taxed by the lessor SNEL [7] who charge the bill to tenants more than four times its fair value.

In ISCED GECAMINES, mixed cabins (similar to prepayment and post-pay subscribers), consumption varies between 232 and 356 A. The daily variation is observed in each cabin, hours of low consumption are between 12h and 17h. In cabins whose customers do not use prepayment meters, consumption varies between 270 A (in the evening) and 396 A (in the morning). In the cabs whose subscribers use the prepayment meters, the consumption varies between 165 and 230A. The consumption values in the cabs without meters are much higher compared to the values observed in the cabins with the prepayment subscribers. However, SNEL benefits more from the consumption of the subscribers to the meter than that of subscribers billed at a flat rate. In fact, every kWh consumed is controlled and billed, so cases of electricity theft are very recurrent to the absence of meters [4], [5]. The high consumption in cabins whose subscribers do not use meters would be attributed to illegal connections [4].

In the Baudoin district, peak hours are in the morning and evening. Between 10:00 and 18:30, the consumption is the lowest. However is a significant difference is observed between the highest consumption (855 A) and the lowest (668 A). Significant variations are observed during sampling times. The low consumption represents 201 A while the highest consumes 371 A. Among the devices listed, the most energy-consuming are: the stove, washing machine, water heater, plasma TV, refrigerator, oven and incandescent bulb. This observation corroborates the results of Banza [7].

The objective of this research was to study the behavior of subscribers to the introduction of prepaid meters. Respondents at SNEL (Société Nationale d'Electricité) and subscribers made it possible to understand the problems around prepaid meters in the BAUDOIN and CITE GECAMINES neighborhoods.

**Conclusion**

This study showed that in terms of adoption, prepayment meters are adopted at 32% in the neighborhoods surveyed. The numbers of subscribers per post-pay system are more numerous than those using the meters. In addition, the opinions of subscribers are varied compared to the system of prepayment meters. Favorable notices for prepaid meters would be justified by the fact that these subscribers are confronted with transparency, the bill paid is precisely the energy consumed. Opinions not favorable to prepayment meters would be justified by several factors including the feeling of unfairness and load shedding. In the CITE GECAMINES, the cabins whose subscribers use prepaid meters, consumption varies between 165 and 230 A.

The study also showed that the introduction of prepayment meters is an effective tool to optimize the consumption of electrical energy. Indeed, in booths whose subscribers use all prepayment meters, the consumption is generally low than in mixed cabins and those whose

subscribers do not use meters. Among the appliances listed, the most energy-consuming are: stove, washing machine, water heater, plasma TV, refrigerator, oven and incandescent bulb.
In terms of perspectives, this study needs to be conducted in other areas of the city in order to have more or less complete information on Lubumbashi.

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