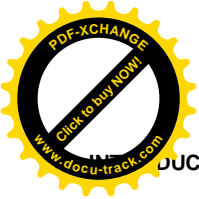


Prepaid Metering in Tanzania

By

William D.S. Magambo



Prepaid metering in Tanzania is considered to be metering of the future in all utilities provided that its introduction is carefully planned and implemented. Apart from TANESCO, two telecommunication companies are already offering prepaid services for mobile phones.

The prepayment metering system provides an effective and efficient revenue management. This benefits the supply company through guaranteed payment for electricity delivered, with reduced revenue collection costs and advanced cash collection, while at the same time enabling consumers to budget for their electricity consumption.

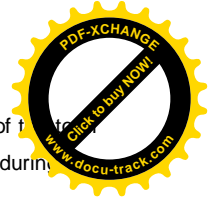
This paper on prepaid metering in Tanzania covers TANESCO's prepayment metering experiences. The following areas are covered: - background to TANESCO's prepayment metering project, basic concepts and operations of prepayment metering, advantages of the prepayment meters, stepped tariff and problems experienced in the prepayment metering systems.

TANESCO undertook a prepayment metering project between 1993 and 1997. The World Bank funded the project. The prepayment metering (LUKU meters) project consisted of the design, manufacture, work testing, packing and delivery to site of prepayment metering and vending equipment including training and associated public relations campaign; installation and commissioning of the meters in selected areas in Dar es Salaam where consumption was medium and high. All customers in one of the four regions in Dar es Salaam had their meters changed to prepaid meters. Vending equipment were also installed at TANESCO offices and other areas to enable customers to purchase electricity from vending sites close to their premises.

The technology did not cater for demand meters. The installation of these meters was therefore restricted to domestic, light industrial and light commercial customers.

2. BACKGROUND TO TANESCO'S PREPAYMENT METERING PROJECT

The procurement and installation of these meters was aimed at improving TANESCO's revenue collection. The tendering took almost one year from June 1994. Installation of the meters commenced in October 1995 and was completed in February 1997. At the end of the project 40,622 meters had been installed. The number of customers has grown to around 50,000. At the end of last year (1999)



The total number of meters was 49,266. During the year 189.8 GWh, representing 10.1% of the total electricity generated, were sold to prepayment metered customers. The amount of money collected during the same period was TShs. 11.3 billions.

3. PREPAYMENT METERING CONCEPT

Prepaid meters are meters that automatically disconnect a customer's supply if pre-purchased electricity credits are exhausted. TANESCO has installed two types of prepayment meters, namely magnetic token meters and numeric token meters. The magnetic token meters uses magnetic cards which are normally coded by the vending equipment depending on the amount of money paid for purchasing electricity, while the numeric token meters or key pad meters use twenty digit numbers generated by the vending equipment depending on the data regarding the customer and the amount of money paid to purchase electricity.

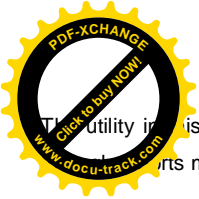
4. PREPAYMENT METERING OPERATIONS

The prepaid meter must first be registered in the central computer or System Master Station and its data distributed to all sales points before the customer can be able to purchase electricity in those vending stations. There is a choice between three phase and single phase meters and using either disposable magnetic or numeric tokens to transfer the credit. The prepayment meter dispenses electricity and decrements the credit according to the units (kilowatt-hours) used. If further credit is not entered into the prepaid meter before the stored value is used up, the prepaid meter will disconnect the supply to the customer's appliances. Reconnection is only possible when more credit has been purchased and entered into the prepaid meter.

5. INTERACTIONS BETWEEN THE UTILITY AND CUSTOMER

There are two ways of communication between the customer (through the meter) and the company, which provides the service. These ways enables the utility to transfer any changes made in the system to the meter. The keypad meters use a one way token method that is information flows to the meter, kilowatt-hours are loaded onto the tokens at the point of sale.

If the utility wish to use a two-way token method, that is, feedback information is sent to the utility from the meter after tokens are loaded by the use of prepayment meter smart card. The system, which is discussed in this paper, uses the one way token method in communication between the utility and the customer.



The utility in this case gets the meters data by interrogating it by using the engineering tokens. The data is used to generate reports made on customers' purchase details.

6. PREPAID METERS AND TARIFF STRUCTURE

The prepayment metering is a part of the Revenue Management System (RMS). The RMS is an integrated electricity measurement and audit control system, consisting of:

- q an Electricity Dispenser (ED or prepayment meter)
- q a Credit Dispensing Unit (CDU, Validator or point of sale), and
- q a System Master Station (SMS or central computer).

The CDU codes tokens for customers to load units into their prepayment meters. Disposable magnetic cards or numeric tokens conform to the Standard Token Specifications (STS). Each group of prepayment meters use a Supply Group Code (SGC), to distinguish one set of the prepayment meters from another, and to prevent cross boundary purchases by customers. The SMS maintains a check and audit trail on all transactions issued by the CDU's, and manages energy balances, reporting, cash reconciliation and the database. The RMS supports both straight line and step tariffs. The tariffs are based in the point of sale device known as Credit Dispensing Unit (CDU). These tariff tables are easily managed and updated by the System Master Station (SMS). The SMS communicates with multiple point of sale sites so as to maintain customer records and to manage the system.

A tariff structure is linked to each customer (prepayment meter) during the registration on the System Master Station. The tariff indexes form part of the prepayment meter coding and security features and ensure that the customer purchases credit tokens in the correct sales area as they are bound to the Supply Group Code. A monthly service charge is also levied as part of the tariff. It is collected with the first purchase in a month. Service charges are accumulated if a customer does not purchase credit tokens in any particular month.

The tariff structure is the key element in the system, which affects the customers and the utility in revenue collection. The tariff structure which is used in the current prepayment meters we have system is a stepped tariff whereby the cost of a unit of electricity is defined in ranges of blocks (refer table 1 below). The higher the consumption of the electricity per month the higher the unit price of electricity. Customers buy electricity at the higher rate as the consumption of electricity increases.

This is not different from the normal billing system as long as the prepayment meter customers know exactly how much electricity they consume per month and buy only that amount of electricity within a month. There are several scenarios where customers want to purchase electricity for more than one



...n. It will be realized that the customers will have to buy electricity at a very high rate, which is unfair. To solve this ambiguity the averaging system was introduced.

Table 1. An illustration of the tariff structure

Step 1	Range in Kwh	Price per Kwh	Service Charge per Month
1	0 – 100	24.00	200.00
2	101 – 500	38.75	750.00
3	501 – 2500	88.50	2000.00
4	2501 and above	165.50	2000.00

7. IMPLEMENTATION OF THE AVERAGING SYSTEM IN THE PREPAID METERS.

The prepaid meters averaging system allows the customer to purchase electricity for future months and still take advantage of the lower steps in the RMS tariff. The system charges the customer the same tariff for all electricity purchased for future months as if the customer was buying the average monthly consumption each month and a service charge is automatically added to the bill for each complete average monthly consumption.

The averaging system was based on assumption that, when a customer make a purchase that is greater than the average monthly consumption, the system automatically assumes that the customer is buying electricity for future months. But this is not always true as sometimes the increase in monthly consumption depends on the weather and other factors that may distort the customer's consumption pattern.

Therefore, another algorithm was added to make sure that the changes in consumption patterns adjust the monthly averages. It should be noted that, it was important to include this portion of tariff structure and averaging system because those are key features in showing the usage of customers' amount tendered until he/she gets a token credited with units.



ADVANTAGES OF PREPAID METERS.

The advantages of the prepayment meters are grouped into two groups. The prepayment meters advantages for the utility and the prepayment meters advantages for the customer.

Advantages of prepaid meters to the utility

The prepaid meters enable tracking of individual and group sales, detect fraudulent activity and provide comprehensive management reporting for the utility. There are other specific advantages for the utility from the introduction of prepayment system, namely:

- q Payment is made up front
- q There is no meter reading
- q There are no accounts to be posted
- q Bad debts are eliminated
- q Disconnection and reconnection fees are eliminated, and
- q There is an improved level of customer service

Advantages of prepaid meters advantages to the customer

There are also advantages for the customer having a prepayment meter installed, namely:

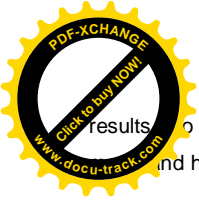
- q There is effective budget management
- q Electricity usage is controlled
- q Convenience of purchase through distributed points of sale
- q There is no cost for disconnection and reconnection

9. PROBLEMS EXPERIENCED WITH THE PREPAID METERS

There is no system in the world, which is problem free. Some of the problems are caused by level of education among the users of the prepaid meters. Others are caused by inadequate after sale support arrangements. These problems include:

- **Insertion of credit by using disposable magnetic token.**

Some of the new customers feel ashamed to show that they cannot insert the disposable magnetic token into the prepaid meter even if there are utility staff to demonstrate to them. This



- results in damaging the disposable magnetic tokens by bending them on trying to insert them into the meters and hence fail to get the electricity.

- For the customers who use key pad type of prepaid meters, not all of them can read and hence always require some assistance from neighbors to enter the twenty digits into their prepayment meters before they can enjoy using electricity.

- **Tariff structure**

It is very difficult to read the minds of the customers to know whether the electricity purchased is for future consumption (if the electricity purchased is beyond one month) or just for that particular time (for a special occasion such as a birthday party etc.).

- **Failure of the Revenue Management System Equipment**

Most of the time defective prepaid meters do not give electricity to customers. Therefore, it depends on the readiness of the emergence staff to replace the defective meter. Although this protects the company from losing the revenue, it affects customers.

Although there are always some alternatives of getting electricity from other points of sale, failure of vending equipment at one sales point inconveniences the customers.

- **Vending Hardware**

Although the vending hardware supplier appointed a local company to repair and maintain the hardware, the local company does not appear to be equipped with the appropriate resources to deal with breakdowns of the hardware. Some of the hardware items like the PWRs and touch screens are proprietary.

- **Vending Software**

The supplier of the software handles the maintenance of the vending software. The company has had serious communication breakdowns with the supplier. Not only has the system taken several years to stabilize but also it can easily be manipulated. The company has lost a lot of money through fraud involving collusion between staff working on the system (SMS and CDU Operators) with the customer.



Third Party Agent:

Party agents were appointed to sell electricity on behalf of the company at a fee of 3% of total collection. Staff appointed by most of these agents were not qualified to perform the job. This led to substantial loss of revenue to the company.

10. CONCLUSIONS:

- a) Single phase and three phase prepaid meters can be used in the Revenue Management System from low to high-end usage users, as medium cost solution. However, more cost-effective technology solutions are possible for low usage customers where loads can be limited.
- b) The prepayment metering system has enabled large scale electrification in many parts of the city that would otherwise not be possible (due to poor infrastructure caused by some buildings being constructed in uneasily reachable areas.
- c) Although one of the advantages to the company was to do away with Meter Readers, in the absence of a sound control system to monitor electricity supplied from each feeder to the customer, meter inspection is likely to replace the meter reading function in the near future. With losses as high as 25%, extensive meter inspection is mandatory to reduce/ minimize non-technical losses.
- d) The Standard Transfer System is anti-competitive. It restricts companies already using this system to purchase additional meters from suppliers whose meters conform to the system.