

Possibility of using Prepaid Meters as a Proposed Solution to Electricity Load Management Problem in Libya Case Study Tobruk City

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Abstract - Development is the main goal that we always strive to achieve, especially in this important and vital sector of the State of Libya. The electricity sector faced many big problems in the last decade, so it was necessary to put forward some solutions to confront these problems, and prepaid meters were proposed as a solution to this problem. A questionnaire, personal interviews and statistical analysis were prepared with using software (SPSS) in the city of Tobruk for the purpose of inquiry about the possibility of installing prepaid meters instead of postpaid meters. Through this research, it was found that the majority agreed on the process of moving to this system because it achieves complete comfort in terms of the payment system, tracking and reducing consumption.

Key Words: Prepaid meters, postpaid, energy consumption, Tobruk, Libya

1.INTRODUCTION

Libya is considered as a very important country in the whole of Africa in terms of its location and natural resources[1]. In the last century, a rapid development in most sectors leads to a huge demand in electricity sector, especially since 2010, the rate of consumption increased about five times in comparison with the consumption in other countries. So the consumption of electricity per capita has been increased from 338KWh in 1970 to 4561KWh in 2010, which is the year that last report has been issued from the general electric company of Libya (GECOL). Therefore, after 2010 the demand for electricity sharply increased with the increase in random housing construction, which caused major problems for the electricity sector due to the increase in loads with the lack of generation, which led to the deterioration of the electrical network, as well as the blackout significantly, which affected the consumer[2, 3]. However, Generation is not the main problem, but load management was the main cause of the electricity problem in Libya, given the excessive use of electricity by consumers without paying any bills to cover this consumption. Also, there are many consumers who do not have any meters to measure electrical loads[4]. However, access to electric energy is considered an essential right for every citizen, as issued by the United Nations in 2015, but this right is very expensive considering the cost of generation,

transmission and distribution of electricity. So someone must pay these costs in a way by the government to ensure that all these costs are paid. So, two methods currently exist that are designed to recover all energy cost by both public and private sectors. These are the postpaid metering system and the prepaid metering system[5]. The two ways have both advantages and disadvantages for example, postpaid meters lead to payment delays, debt accumulation, billing manipulations, and lack of transparency, where as prepaid meters are more transparent and guarantee prepaid rights to the service provider. However, prepaid meters represents a problem for families with limited income in terms of paying bills in advance for obtaining electrical energy. On the other hand, prepaid meter systems have proven to be highly efficient compared to postpaid systems, as the prepaid meter allows monitoring of consumption as it is more efficient and more flexible between the consumer and the supplier. In addition, this idea has proven a great success in several countries such as Argentina, South Africa and the United Kingdom[5]. Recent studies have discussed the negative and positive effects of using prepaid meters on electrical power systems. For example, a comparison was made in the city of Unguja in Tanzania between prepaid and postpaid meters, and it was found that the great satisfaction of the consumer relative to the supplier in terms of reducing the percentage of debt accumulation, which was a major obstacle for both the provider and consumer[6]. In another study was conducted in India in the state of Maharashtra, Mahapatra and Gulhar found that the majority of the population were very satisfied with this experience and were ready to the change from the old systems represented in postpaid meters to prepaid systems[7]. Moreover, another study took place in Germany in the same year in the city of Wigan, many families preferred the option of prepaid meters to provide many advantages[8]. In another study on Nigerian families, Baptista 2015 conducted some experiments on the residents of the city of Maputo, where the prepaid meters system had an advantage over traditional meters[9]. Malma et al 2014, conducted a study in which explained the effect

of using prepaid meters by consumers by low, medium and high incomes residence in Zambia, and discovered that most of the consumers agreed that this system helped a lot in reducing energy bills and fewer problems about payment programs[10].

1.1 Libyan grid Overview

The General Electricity Company of Libya (GECOL) was established in 1984 and is a governmental institution affiliated with the Libyan state. The electrical network of this company has an estimated capacity of about 6,768 megawatts and transmission lines to six geographical areas west and centre of Tripoli, central Benghazi and southern and eastern of Benghazi as shown in figure 1, and Kufra in addition to transmission lines of 400 kV, 220 kV, 132 kV.

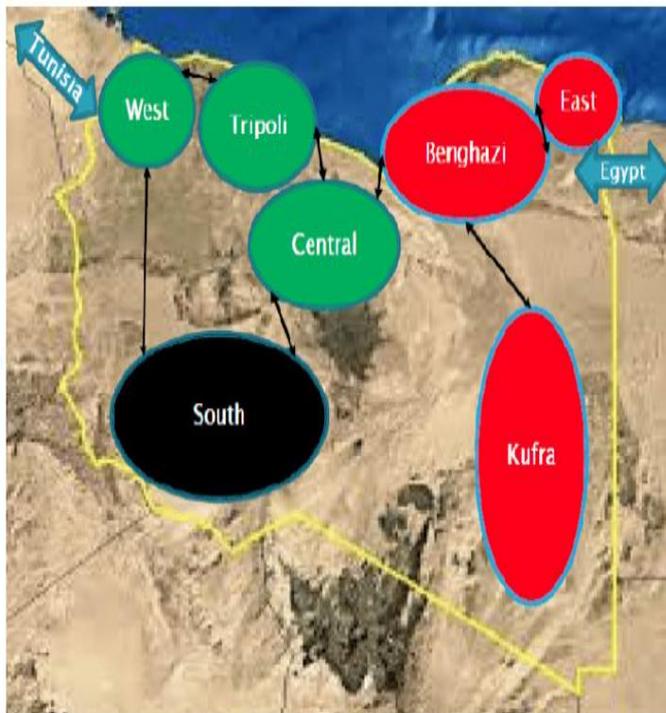


Fig -1: Geographical areas of electricity in Libya [11]

Also, the data from (GECOL) in 2012 illustrate that the transmission sub-networks of 66, 33 and 11 kV were connected, which can be seen in the following table.

Table -1: Libyan grid main details[11]

Peak power demand	5,981MW
Installed power capacity	6,768MW
Electricity generated	33,980MWh
Consumption per capita	4,850KWh
66 KV Transmission line length	14,311 Km
30KV Transmission line	11,142 Km

length	
220 KV Transmission line length	13,706 Km
400 KV Transmission line length	2,290 Km
Energy exchange import	61.020 GWh
Energy exchange export	14.419GWh

In addition, the value of the daily load in the winter and summer seasons in 2014 was 5600 MW of maximum load and the minimum load of 400 MW as shown in the figure below.

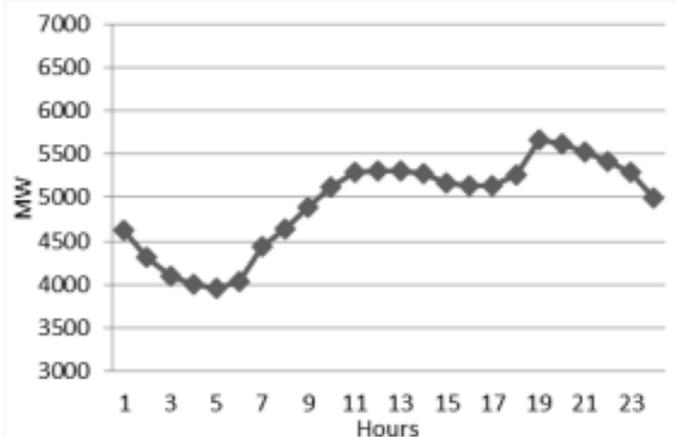


Fig -2: Average daily load profile of Jan-2014

Also, figure 3 shows that the load in summer higher than the in winter [11]

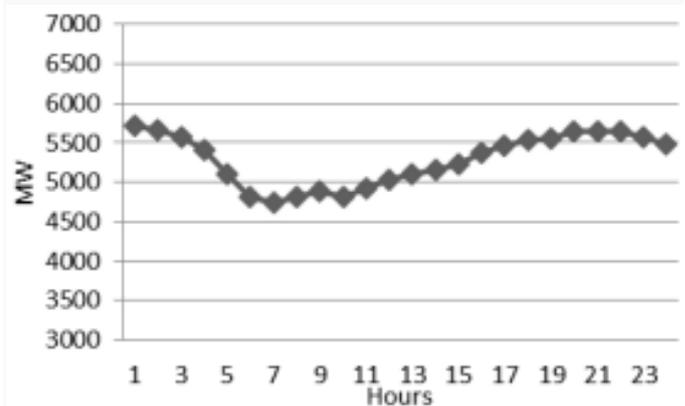


Fig -3: Average daily load profile of July-2014

1.2 Study area

This paper carried out in Tobruk city in Libya, which is a coastal city located in eastern Libya with the Egyptian border 32.0682° N, 23.9418° E, with a population of about 120,000 people in 2011 as the last population census as shown in figure 1 below. Now, in relation to

the immigration that took place after the 2011 revolution, it has caused an increase in the population to about half a million people. It consists of several tribes who have a same religion.



Fig -4: Tobruk City, originally from [12]

2. Methodology

This paper involves the system of both quantitative and qualitative to clarify the data to the people in Tobruk city due to less dealing with this type of work. Also, the data were collected and analyzed with SPSS software in this city from January to May 2021 by means of a pre-designed questionnaire for 100 people males and females in residential, commercial, agricultural and industrial areas. In addition, some interviews with some citizens had been done to obtain better and more accurate results.

It is known that the State of Libya in general and the region of Tobruk in particular, so far uses traditional payment meters (postpaid) and is paid through a monthly bank subscription at a certain value or through a monthly bill according to consumption, and the two methods cause problems for the consumer due to the conditions of the Libyan state, as well as the problems of banks and wrong readings of the meters, and personal interaction with the Electricity Company. A questionnaire was designed that contains several questions to clarify the possibility of applying prepaid metering systems and whether they will actually help reduce consumption and also, most importantly, reduce the problems that the consumer suffers from. Among these questions that were directed to the consumer, educational level, age, average monthly income, do all consumers own payment meters. Also the research paper discussed payment method and have they ever dealt with prepaid meters in any other

country. In addition to the nature of the building, does the meter help reduce consumption. As for the qualitative information, 12 buildings were sorted out of all categories of proposed buildings in the research. More accurate and detailed information was taken for each building to obtain comprehensive information about the research.

3. Results

The results will be presented in the following tables and charts for the four types of buildings referred to previously, so that they are divided into three groups. The first group relates to consumer data in terms of age, place of work, gender, average income and type of building. The second group is related to the payment system, and the third group is energy consumption management.

3.1 Consumer data

Table-2: Number of males and females of the consumers

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	79	79.0	79.0	79.0
Female	21	21.0	21.0	100.0
Total	100	100.0	100.0	

The above table shows the number of consumers for males and female that involved in this research, as we can see that the number of males more than number of females.

Moreover, it can be seen from figure 5 below that the education level of the sample of the consumers showed the higher percentage was 59% of college graduate or above and the less percentage was 3% who entered high school but have not graduated.

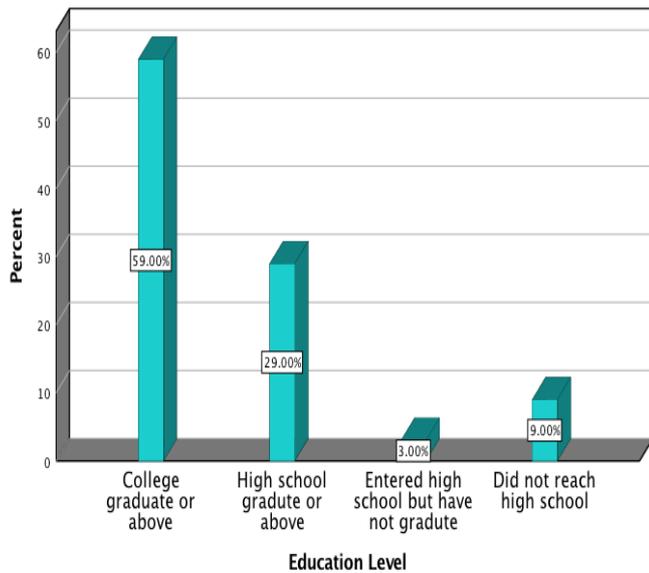


Fig -5: Education levels of the consumers

In comparison with the income rate of the consumers, table 3 below shows that the income rate of 10% of the consumers below 500 Libyan Dinar while 35% earning from 500 to 1000 Libyan Dinar, and the others who earning above 1000 LD represent the higher percentage 55%.

Table-3: The income rate of the consumers

	Frequency	Percent	Valid Percent	Cumulative Percent
0-500	10	10.0	10.0	10.0
500-1000	35	35.0	35.0	45.0
Over 1000	55	55.0	55.0	100.0
Total	100	100.0	100.0	

According to the type of building figure 6 illustrate that the higher percentage 77% of the buildings is residential building in comparison with commercial 11%, industrial 10% and agricultural 2%.

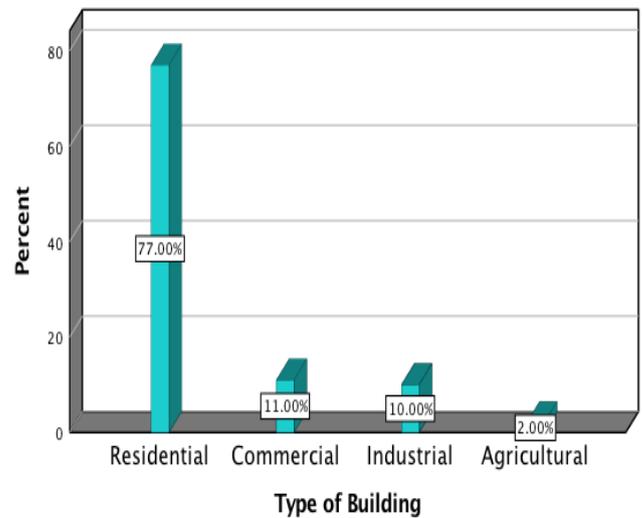


Fig -6: Building type

As we can see from the table below that 32% from the total number of consumers they don't have a postpaid meter to measure the consumption, because the live in a random areas, so when the interview has been done with them, it turns out that General Electric Company Of Libya (GECOL) did not install meters to these buildings, due to some of the existing deficit of the company in terms of providing its own equipment in the current conditions of the country. So, it was an estimated bill for consumption, not an actual and correct number that shows the citizen's consumption of electricity.

Table-4: Availability of electricity meter

	Frequency	Percent	Valid Percent	Cumulative Percent
No	32	32.0	32.0	32.0
Yes	68	68.0	68.0	100.0
Total	100	100.0	100.0	

3.2 Payment system

Figure 7 below shows that 49% of the consumers buying their electricity bills by monthly bank subscription. On the other hand, 25% pay their electric bills by way of a monthly bill according to consumption, while 26% of consumers do not pay their bills for electricity consumption, which causes problems in the electricity sector or the presence of their homes in random areas as mentioned previously, or finally due to the lack of trust between the consumer and the General Electricity Company in terms of miscalculation of consumption.

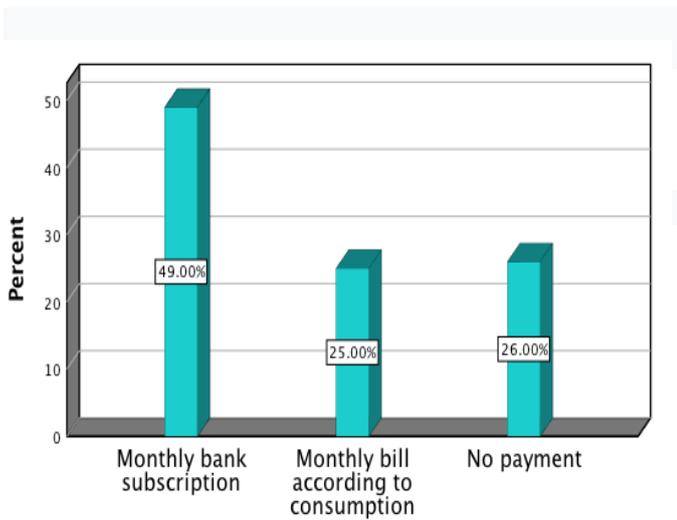


Fig -7: Payment method

3.3 Energy consumption management

This group of questionnaire discussed the issue of turning off unnecessary devices in the building to reduce consumption, and it was noted from the results that 87% of consumers turn off unnecessary devices to reduce their bills, including those who do not have a meter to measure electricity, While the other 13% do not do the same thing.

Table-4: reducing consumption of electricity by turning off unnecessary devices

	Frequency	Percent	Valid Percent	Cumulative Percent
No	13	13.0	13.0	13.0
Yes	87	87.0	87.0	100.0
Total	100	100.0	100.0	

Consumers has been given the choice in the questioner between prepaid meter and postpaid meter which is the regular one in the city of Tobruk, so figure 8 illustrated that 83% of them were convinced of the prepaid meter system because it would make them more control over consumption, while 16% of consumers were not satisfied with the idea because they have limited income.

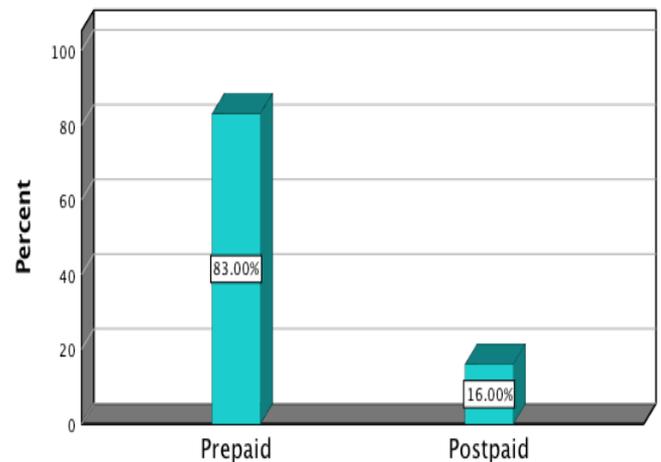


Fig -8: the choice between prepaid meter and postpaid meter

Another question in the questioner has been taken into account, which is Prepaid meters represent as solution from the traditional payment methods. Figure 9 answered this question, 83% of consumers agreed that prepaid meters will relieve them of the aforementioned traditional payment methods, such as a monthly banking subscription, which represents a big problem given the conditions the country is going through.

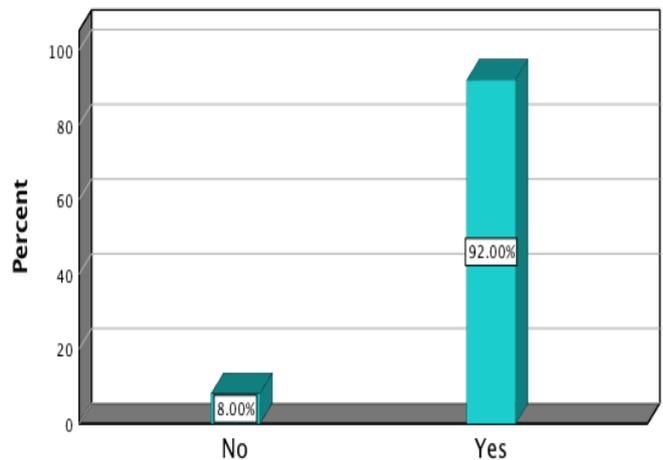


Fig -9: Prepaid meters may relieve the citizen of traditional payment method

Figure 10 showed that the a percentage of 95% agreed that the prepaid meters it may represent a great solution to the problem of electricity because the use of this type of meters forces the citizen to track consumption and reduce the use of unnecessary electricity.

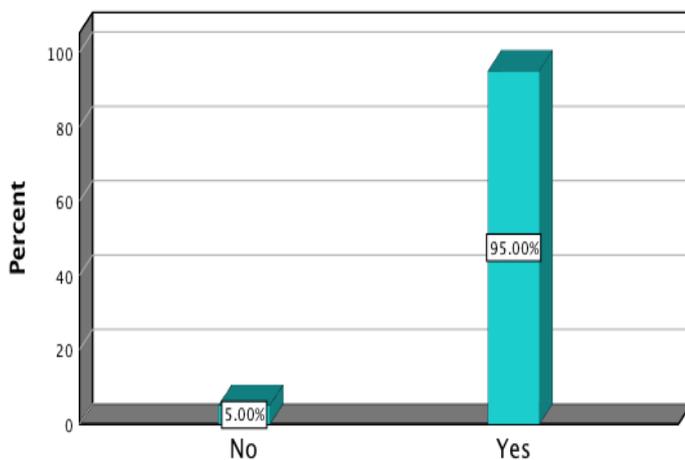


Fig -10: prepaid meters represent a solution in Libya for the crises of electricity

4. Discussion and conclusion

This research presents the possibility of transition from the old system of postpaid meters to prepaid meters in one of the cities of Libya as a case study. We have presented some percentages represented in three groups for clarification regarding the citizen in terms of accepting and switching to the prepaid meter system. We found that despite some criticisms of this system and its restrictions among some consumers in terms of its complete control over the consumption of electricity and forcing the citizen to use it limited. However, through this research, it was found that many consumers were satisfied and accepted to switch to the prepaid meter system, which they said that would help them a lot and make the consumption control more smooth and easy.

Also, through personal interviews and the above-mentioned analysis, it was found that prepaid meters represent a radical solution to the problem of debt accumulation represented by the use of the system of deferred payment meters, especially for people with limited income. In addition to the problem of exempting some entities from paying their bills, which causes major problems for the electricity sector, prepaid meters represent a solution to this problem, as the old saying is "no money, no connection"[6].

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