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Energy Consumption and Load Profile for Bayero University Kano

Abdulkarim Mayere, Kazeem Lawal
[1] *Centre for Renewable Energy Research, Bayero University Kano, Kano, Nigeria*
[2]*Department of Electrical Engineering, Bayero University Kano, Kano, Nigeria*
Corresponding Author: Abdulkarim Mayere

---***ABSTRACT***---
At present, the energy saving in the university campuses becomes an issue throughout the world. Hence accurate analysis of energy consumption pattern is necessary in order to achieve energy efficiency and deployment of appropriate renewable energy technology. Therefore, this paper aims to construct a load profile through the energy consumption pattern in the Bayero University Kano, focusing on the academic area, staff quarters and hostel area. As the daily operation pattern can decide system performance, it is important to collect accurate hourly energy consumption of the campus. Accurate data were collected by installing advance power system meter (APS meter) to all the substations, and data logger (Netbiter device) was also installed to capture the hourly load curve and load pattern. Result showed the consumption patterns in weekdays and weekends are different. Based on this result, the total load curve for the entire campus was deduced where the peak daily load consumption is 1100kW while on the average daily load is 710kW.
KEYWORDS;- *energy saving, load curve, load pattern, data logger*

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I. INTRODUCTION

In Nigeria the available power generated is not enough to meet the demands of the users leading to constant load shedding and blackouts. Power outages are particularly critical at university where the environment and public safety are at risk. Outages in the network are due to ageing of equipment and defects, vandalisation and poor maintenance. Thus institutions usually have backup power sources in case of power outage.

In electrical power system a load profile is a graph of the variation in the electrical load versus time. The load changes with time in response to changes in consumption pattern. The curve that represents load as a function of time, called the "load duration curve," can often yield useful information. Therefore, modern electricity distribution utilities need accurate load data for pricing and tariff planning, distribution network planning and operation, power production planning, load management, customers service and billing and finally also for providing information to the customer and public authorities[1].

In this paper, the load duration curve for Bayero University Kano was measured between the month of March to September at different hour of the day, different days of the week and seasons of the year. This study concentrates on development of load profile through estimation of Bayero University – Old Site Campus, load consumption. A data logger (phase monitoring unit - PMU), is used to determine the primary load consumption from the grid and as well operation of a backup power generators when there is no power from the grid. The study formulates the minimum load, average and peak load of the university for the purpose of appropriate sizing of alternative reliable, affordable and sustainable power supply to the university so as to address the rising cost of the university's energy consumption. The detailed cost analysis of the university's energy consumption is provided in another paper.

II. LITERATURE RIVEIW

The energy saving in residential buildings becomes an issue through the world, Youn-Kyu Seo et. al (2014) created load profile using Yokogawa CW240 Clamp Meter which was installed in addition with a standby watt meter: HPM-100A was used to measure the home appliances power consumption. In terms of home appliances, the electric rice cooker accounted for the biggest portion of total power consumption, followed by the refrigerator, TV and computer. In particular, as the refrigerator's actual power consumption was two to three times higher than the officially noticed, appropriate correction is needed. Load profile and standard load model can help consumers to easily understand the utilization pattern and energy consumption. According to many research on energy saving effects, in general, 5-15% of energy was saved when consumer know energy consumption. The study can be used as basic data to develop the power consumption prediction program for apartment buildings [2]. The effect of load profile uncertainty on the optimum sizing of off-grid PV system for rural electrification was investigated by Stefano Mandelli et. al. (2016). To the best knowledge of the authors, the effect of users' energy consumptions uncertainty on the sizing of these systems has not been appropriately investigated. It used stochastic method to form load profiles known as LoadProGen (Load Profile Generator).It was also highlighted, the effect of load profiles uncertainty on the sizing of PV-battery systems with particular reference to off-grid applications for rural electrification. The results confirmed the hypothesis concerning the effect of load profiles uncertainty on the optimum sizing of off-grid PV systems. The case study also highlight that it is possible to recognize a robust solution among all the optimum ones. Some systems configurations turned out to be the optimum one more often being capable to optimally adapt to different load profiles. It resulted that the introduction of further stochastic effect on the input parameters does not significantly affect the robust solution, while it affects the dispersion of the optimum systems configurations. In conclusion, this work highlighted that attention is required when defining load profiles for off-grid PV-battery system sizing since, given the typical inputs for users' electric needs, several system configurations may be the optimum one. Besides, a further development of this analysis should consider not only the uncertainty on load profiles for given static users' electric needs, but also possible evolution in time (year by year for instance) according to change in the consumers' welfare and habits[3].

David Fisscer et. al (2015) investigate the factor responsible for approximate energy consumption of 27% by the domestic sector and 19% of energy demand by the electric devices in the European energy consumption. It used bottom-up model for generating electric load profile, the model is designed for investigating the effects of occupant behaviour, appliance stock and efficiency on the electric load profile of an individual household. A one year simulation of 100 households for different subgroups was under-taken to generate synthetic load profiles, which were compared to measured data from 430 households. The results show that synPRO reaches an accuracy of 91% for the mean yearly, monthly and daily energy consumption for each group investigated. He state that the strength of the model is the fact that stochasticity is covered, individuality of load profiles for different socio-economic groups can be integrated, and that the electric load profile of an household can be explained by the use of appliances. The synPRO model extends the existing stochastic model approaches and brings a valuable input to the discussion of bottom-up modelling for domestic electricity use, such as incorporating a correlation between duration and start time of an activity, a distinction of weekdays, high resolved measured data and changed behaviour based on seasons[4]. J.C Sousa et. al. (2016) focused on evaluating the relevance of load profiling information in electrical load forecasting, using neural networks as the forecasting methodology. Also mention the important of load profile using clustering algorithms, the adopted methodology was validated with two case studies and the use of sensitivity analysis applied to the artificial neural networks. The results support the significance of the synthesized load diagrams among the remaining inputs. Nevertheless, the authors recognize that the viability of the technique is strongly dependent on specific conditions, such as: adequate consumer segmentation, accuracy of the load profiles that represents each class, proper selection of the neural network input vector and updated commercial information about the individual contributions of a global load diagram. The authors recognize that the use of this concept for forecasting the electrical load outside Portugal needs a previous determination of adequate load profiles, eventually through clustering process [5]. F. Rodrigues et. al. (2016) presents a methodology to forecast the hourly and daily consumption in households assisted by cyber physical systems. The methodology was validated using a database of consumption of a set of 93 domestic consumers. Forecast tools used were based on Fast Fourier Series and Generalized Reduced Gradient. A load profile forecast tool for electrical appliances in households was developed. Optimization tools were analysed and tested. These tools are able to forecast hourly and daily average energy consumption, as well load profile. Generalized Reduced Gradient algorithm and Fourier series were used. When comparing the methods, it was observed that the best performance was obtained by the GRG method [6].

III. SCOPE AND METHODOLOGY

Load profile describes various energy load patterns on a graph. In general, it is presented with annual, monthly, daily and hourly load pattern curves; it is easy to understand the maximum load and isused for various analyses. The load profile can be divided into three types, no permanent load profile, permanent with a low base loading and permanent load profile with a high base loading. In this study, permanent load profile with a high base loading is used. It is because some equipment are continuously running and the usage of other devices is increasing by occupant's life pattern. In addition, the standby power for the university contributes to a high base loading. This study collected daily and hourly power consumption behaviour to analyse the power consumption pattern and draw out the load profile. For precision measurement, from March 2017 to October 2017 (considering peak time in the dry, hot and raining), the APS (PMU-RS485-C10-100) Power Meter was installed to measure power use every, and the a netbiter easy Connect EC250; which offers connectivity to the Netbiter server was installed and is being rotate across the substation on monthly or bi-monthly. In addition, manual weekly data reading were selected to collect from substations. The progress of the study is shown in Fig.1.

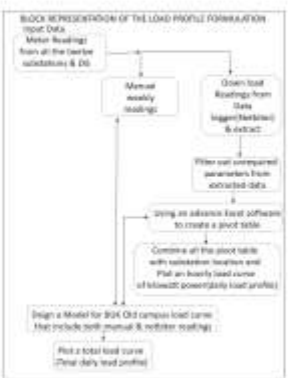


Fig.1: Block representation of load profile

Fig.2: APS (PMU-RS485-C10-100)

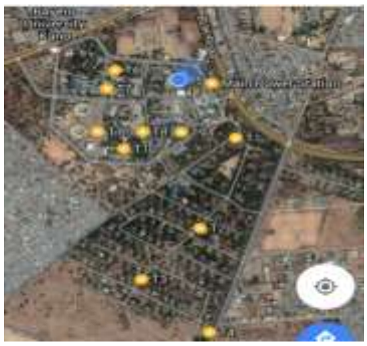
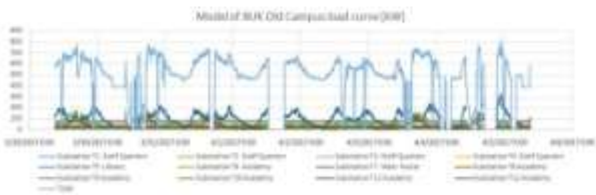


Fig. 3: Location of substations

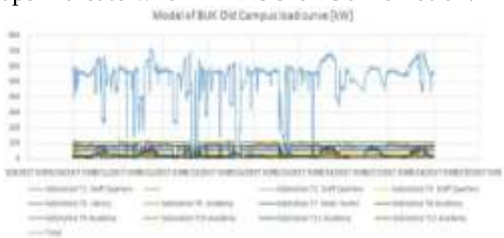
The device use for the collection of data for the development of load profile and formulating of the load pattern are: the advance power system meter (APS Meter) which is also kwon as phase monitoring unit (PMU) as shown in Figure 2., the netbiter device, and the power supply converter.

IV. RESULT AND DISCUSSION

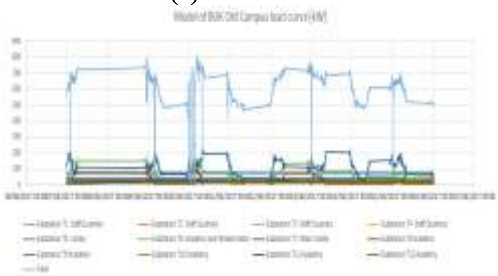
The total hourly load measurements for the entire substation in the campus as shown in figure below indicate that, load demand is less during the weekend and demand go to peak within the week days, because power demand at the academy area at weekend is less compared to the week days. The average daily load is 710 kW. Loads are about 150kW higher on average. The sharp drops indicate when KEDCO or Gen is not on.



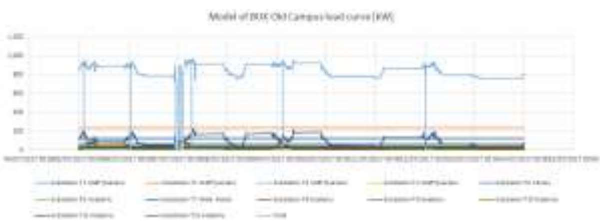
(a) March



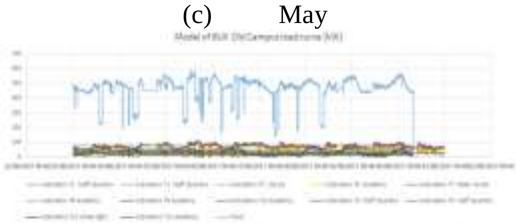
(b) April



(c) May



(d) June



(e) July

(f) August

Fig.4: Total load curve for the months of March to August

V. CONCLUSION

The load analysis as discussed in this paper within the month under review (March to August) which include three season namely; dry, hot and raining. The peak daily load consumption is 1100kW while on the average daily load is 710kW.

The developed load profile can be used to propose an optimum design of PV system at Bayero University, Kano. With proper way of energy saving, accurate analysis of the load profile and prediction for energy consumption pattern should be preceded. This will further remove the challenge of poorly design solar system which leads to system been underutilized.

REFERENCE

[1]. Julkaisida, Load research and load estimation in electricity distribution:VTT Publications 289(1996)

[2]. Youn-Kyu Seo, Won-Hwa Hong, Constructing electricity load profile and formulating load pattern for urban apartment in Korea. 78 (2014) 222-230.

[3]. Stefano Mandelli, Claudio Brivio, Emanuela Colombo, Marco Merlo, Effect of load profile uncertainty on the optimum sizing of off-grid PV system for rural electrification. 18 (2016) 3447

[4]. David Fisscer, Andreas Hartl, BerhardWille-Haussmann, Model for electric load profiles with high time resolution for German households. 92(2015) 170-179.

[5]. J.C Sousa, L.P Neves, H.M. Jorge, Assessing the relevance of load profiling information in electrical load forecasting based on neutral network models. 40(2012) 85-93.

[6]. F. Rodrigues, C. Cardeira, J.M.F. Calado, R. Melício, Load Profile Analysis Tool for Electrical Appliances in Households Assisted by CPS 106 (2016) 215-224

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