IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE)
e-ISSN: 2278-1676, p-ISSN: 2320-3331, Volume 18, Issue 3 Ser. I (May. – June. 2023), PP 56-60
www.iosrjournals.org

Energy Consumption Performance Analysis Based On A Typical Engineering College In Kerala In Self Financing Sector

Binz Abdul Aziz,
M. Tech Scholar, Electrical and Electronics Engg, Lourdes Matha College of Science and Technology, Kuttichal, India
Ajay P,
B.Tech Scholar, Mechanical Engg, Lourdes Matha College of Science and Technology, Kuttichal
Johnson Y,
Associate Professor, Electrical and Electronics Engg, Lourdes Matha College of Science and Technology, Kuttichal, Kerala, India

Date of Submission: 08-06-2023 Date of Acceptance: 18-06-2023

I. INTRODUCTION

Since the generation of energy is very expensive, the conservation of energy is very important. It is possible to reduce the losses through the energy auditing which helps to find the performance of the whole electrical system. If there are any leakages they will be observed and fixed. The objective of this paper is to study the energy consumption of an educational building and the ways to reduce the consumption. The institutional building is taken considering the uncontrolled and unpredictable usage of light, fans and air conditioning facilities in number of classrooms, practical rooms, auditoriums and rooms with computer facilities. An Energy Analysis is an examination of energy consuming equipments/systems to ensure that energy is being used efficiently. In many ways, this is like financial accounting.

II. OBJECT OF STUDY

The audit was conducted at Lourdes Matha College of Science and Technology (LMCST), Thiruvananthapuram, an engineering college affiliated to APJ Abdul Kalam Technological University. It has a spacious campus of 25 acres at Kuttichal, a rustic village in the outskirts of Thiruvananthapuram city, hardly 24 km away from it. The audit was conducted in the whole campus which covers Main Block, Electrical Block, CS Block, Civil Block, Mechanical Block, Workshop Block, Ladies and Men's Hostel.

Fig.2: Line Diagram of LMCST Campus

II METHODOLOGY FOR DATA COLLECTION AND ANALYSIS

The methodology adopted for this analysis was Targeted energy audit. It starts with the finding of the walk-through energy audit. This type of audit provides a detailed analysis of a specific project. In the preliminary data collection phase, exhaustive data collection was made using different methods such as observation, interviewing key persons, and measurements. Following steps were taken for data collection:

- Visited each department, blocks, laboratories, library, canteen, solar panel and other entities of the institution.
- Information about the general electrical appliances was collected by observation, searching and interviewing.
- The power consumption of appliances was measured in rated power.
- The details of usage of the appliances were collected by interviewing key persons e.g., Electrician, caretaker (in case of departments) etc.
- Approximations and generalizations were done at places with lack of information

Detailed analysis of data collected was done. Energy consumption per month in kWh is calculated based on each department and block-wise. The analysis of data is done in following way:

- Evaluation of collected data department wise analysis or block wise
- Reasons for the difference between connected load and actual consumption was evaluated.
- The database prepared was further studied and the results have been graphically represented.

ENERGY SOURCE PROFILE

Electricity is the major energy sources of the college, supplied by KSEB, Kerala using a transformer 11 kV/ 433 V of capacity 400 KVA. Diesel oil is being used in the DG sets for in-house generation of electricity during power cut. A part of it is produced using On Grid Solar Power System.

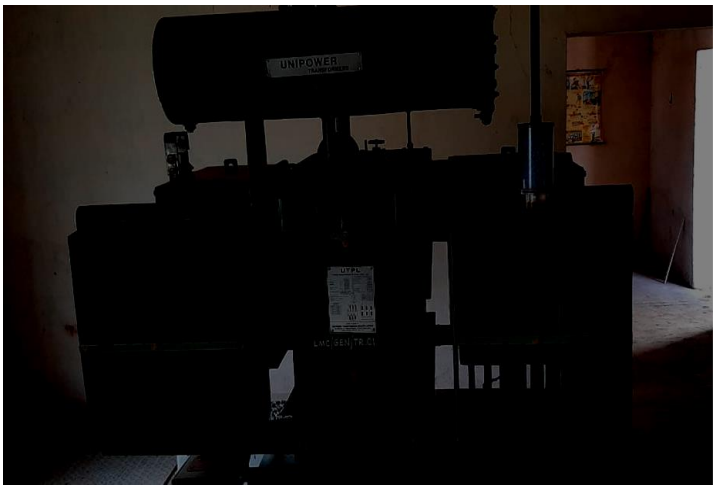

Fig.3: 400 KVA, 11kV/433V distribution transformer

HT–II (B) Tariff is applicable here. This tariff is based on three different zones. They are Normal period, Peak period and Off peak period. KSEB charges 6.2 Rupees for Normal period (6.00 AM - 6.00 PM), 9.3 Rs for Peak period (6.00 PM-10.00 PM), 4.65 Rs for off peak period (10.00 PM-6.00 AM) and 200 Rs for increase in maximum demand. If power factor is beyond 0.9, Penalty is imposed on electricity bill by KSEB and if it exceeds 0.9 bonus will be given. Trivector meter is used for energy calculation.

DISTRIBUTION NETWORK

There is a main electrical panel installed near the DG Set. All the distribution cables are going from the main panel to all the buildings, submersible pump, street light etc. Sub panels are installed in the buildings. There is a taping on each floor from the raising mains. During the study, it was observed that the conductor size is good according to ampere load. No any conductor was found over heated or its insulation burnt. Adequate size of conductor is going to feed the utility area. So, distribution losses are within the limit.

There is a DG set available in the college of capacity 250 KVA for in house generation of electricity. As the power supply is very good in the area so the running hour of DG set is very less. It is advisable to put an energy meter on each DG set then it would be easy to conduct the efficiency of DG set. This way, the operator could also note down the unit generation and oil consumed. It may be noted that the efficiency of the DG set depends largely on the operating load factor. The maximum efficiency of the DG set is available at about 80-85% load factor.

ELECTRICITY BILL ANALYSIS

The analysis of Electricity Bills from 2021 December to 2022 November is given below.

Table-1: Electricity Bills Summary

Sl No	Month	Energy Consumed, kWh	MD, kVA	Power Factor
1	02-Dec-2021	11120	45.75	0.77
2	03-Jan-2022	13474	56.49	0.80
3	02-Feb-2022	12304	62.04	0.82
4	03-Mar-2022	13148	68.85	0.84
5	02-Apr-2022	15784	73.53	0.86
6	04-May-2022	14330	79.27	0.87
7	02-June-2022	15552	81.38	0.89
8	09-Jul-2022	4066	72.38	0.89
9	04-Aug-2022	4408	68.26	0.88
10	03-Sep-2022	3232	62.76	0.87
11	06-Oct-2022	4664	64.38	0.86
12	03-Nov-2022	5549	60.84	0.86

It's clear that, the energy consumption from 09-july-2022 have decreased dramatically. The reason for the decrement is the implementation of on grid solar power plant which has a capacity of 100 kWp. Also the small decrease in pf causes some additional charge in some months.

ENERGY CONSUMPTION – SAMPLE CASE

A sample table of audit conducted in Main block is given in Table-2. In similar way, the audit was conducted in all the blocks in the campus. Based on the overall audit, a summarized data of consumption profile equipment-wise is given in Table-7, Annexure-1.

Table-2. Office Block

Sl. No	Load	Ratings (Watts)	Number	Total connected Load (W)	Running hrs /Day	Consumption per day (Whr)
1	TubeLight	40	95	3800	7	26600
2	CeilingFan	60	89	5340	7	37380
3	Computer	150	26	3900	7	27300
4	Printer	30	12	360	7	2520
5	AC	750	1	750	7	5250
6	Cooler	500	1	500	7	3500
7	Coffeemaker	750	1	750	7	5250
8	Inductioncooker	1500	1	1500	1	1500
9	Waterpurifier	25	1	25	7	175
10	Amplifier	1500	1	1500	7	10500
11	TV	100	2	200	7	1400
12	EPBX	100	1	100	7	700
13	Xerox	1840	1	1840	7	12880

III AUDIT BASED EXPERIMENTAL PERFORMANCE EVALUATION AND ITS FINDINGS

Testing with Capacitors Inserted

Good healthy capacitors should deliver 1.3 times amperage in all the three phases compared to its rating in kVAr. Thus, a 10 kVAr capacitor should deliver about 13 amps in each of the three phases. Due to development of internal faults, the capacitors get derated/ damaged in the course of time. A capacitor derated to less than 75%

of its rating should be replaced. On the other hand, if there is considerable unbalance between the phases, that can be indication of possible damage of the capacitor and may be removed immediately.

The college has installed one Automatic Power Factor controller (APFC) with capacity 125 kVAr capacitor bank i.e., 25 kVAr x 3, 5kVAr x 2, 20kVAr x 1, 10kVAr x 2. All the capacitors were tried to examine during the study. Details of test report are given below.

Table-3 Capacitor Bank

Sl No		Capacity (kVAr)	R	Y	B	Remarks
1	Capacitor 1	25	34.3	34.5	34.3	OK
2	Capacitor 2	25	34.6	34.8	34.6	OK
3	Capacitor 3	25	34.3	34.8	34.6	OK
4	Capacitor 4	20	0	0	26.8	Recheck
5	Capacitor 5	10	13.2	13.8	13.6	OK
6	Capacitor 6	10	13.5	13.8	13.2	OK
7	Capacitor 7	5	7.4	7.1	6.8	OK
8	Capacitor 8	5	7.1	6.7	7.2	OK

It is clear from the above table that all the capacitors are all right except one capacitor. It is advisable to recheck the capacitor, its contactor and connected wire. For fine tuning of the power factor of the system to maintain unity power factor, the usage of small capacity capacitors like 25 kVAr x 3, 5kVAr x 2, 20kVAr x 1, 10kVAr x 2 in the panel is better. If the unit even maintains unity or 0.99 power factor, it will yield saving in the bill by around Rs. 39397/ year (see Table-4)

Table-4: Payback Period

Particulars	Value	Unit
Annual (Approximate) saving in Fixed cost for maintaining unity/ 0.99 PF	39397/-	Rs.
Cost for maintain 0.99 PF	8000/-	Rs.
Payback Period	3	Months

Testing on Fans and Lights

The readings obtained from the experiments are given below (see Table-5).

Table-5

Sl. NO	**Tested Devices**	**Consumed Energy while Testing (W)**	**Rated energy consumption on the devices**	**Remarks**
1	Ceiling fan	118	90	Lesser performance
2	Blinking Lamps	42	40	Very poor performance

C) Testing on Air Conditioners without Cooling Film on Windows

In the walkthrough audit, it is observed that the air-conditioned room's windows don't have any cooling film. Due to this, the heat is directly entered to the room and the work of air conditioners thus increased further.

An experiment is conducted in a split AC which situated in the Conference Hall. An energy meter is connected to the circuit and the energy consumption in two conditions is measured

1. Sunlight directly entering condition
2. Sunlight entering blocked by reflective medium.

The energy consumed for 1 hour is noted (see Table-6).

Table-6

Particulars	Value	Unit	Remarks
AC rated energy consumption	1.45 - 1.54	kWhr	
Energy consumption without film	1.56	kWhr	Energy consumption is maximum
Energy consumption with film	0.9	Kwhr	Heat entering has been blocked

It is clear from the above observation that the energy consumption is high if sunlight is entered into the room. The AC consumes less energy if the heat entered is the minimum. For energy saving, apply cooling film on every window of the air-conditioned room for reducing the energy consumption.

Annexure-1

Table-7: Summary-Equipment wise

LOAD	QUANTITY	CONSUMPTION PER DAY
LIGHT	1274	917892
FAN	486	109452
COMPUTER	297	149700
LAB EQUIPMENTS	1557	338833.5
AC	19	545611.6
CAMERA	14	2880
SPEAKER	20	4430
PROJECTOR	5	24600
OTHER EQUIPMENTS	55	159515
COOLER	3	5900
MOTOR	13	69740
XEROX MACHINE	2	14736
PRINTER	30	61970
HEATER	8	31000