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Energy Audit Report for the Michael Okpara University of Agriculture Umudike, Nigeria in 2017

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Abstract: The objective of this report is to study the energy consumption of the Michael Okpara University of Agriculture, Umudike with a view to identifying energy conservation measures within the campus. Between January 2017 and November 2017, the electrical consumption totaled 782650 kWh at a cost of N**45, 851, 543.49**. This is equivalent to 2670512655.8 BTU of energy. For the same period, the total fuel and engine oil for the entire campus totaled N**6, 629, 336.31**. Energy savings up to 807.218kWh on a daily basis was identified in this report. It is recommended that machines and appliances should not be kept in standby mode. These devices should be switched off from the socket outlet when not in use. There should be penalties enacted for unnecessary power consumption by negligence of the user or system administrator for not switching off appliances while leaving the office. Other recommendations were made in the following categories: 1. Capital improvements. 2. Operations and maintenance. 3. Energy conservation measures

Keywords: Energy, Audit, Michael Okpara University, Report, Umudike.

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I. INTRODUCTION

According to the definition in the ISO 50002 standard, an energy audit is a systematic analysis of energy use and energy consumption within a defined energy audit scope, in order to identify, quantify and report on the opportunities for improved energy performance (Krarti, 2000).Therefore, an energy audit is an energy assessment. This evaluation analyses energy flows in a building, process or system to reduce the amount of energy input into the system whilst maintaining or improving human comfort, health and safety (Krarti, 2000). The level of detail of this evaluation determines the type of audit.

The Michael Okpara University of Agriculture Umudike is a federal University in Umudike, Abia State established as a specialized University by a Federal Government of Nigeria Decree No 48 of November 1992. It began formal activities in May 1993 with eight colleges and two schools. Over the years, there has been significant progress in the University in both academic and research activities, and parallel improvements in facilities and infrastructures. The University now currently has eleven Colleges and two schools. Such expansions imply an increase in the consumption of electrical energy.

In the Michael Okpara University of Agriculture, electrical energy constitutes one of the top operating expenses of the University. An energy audit will help the University to understand more about the ways energy is used within the campus, and help to identify areas where waste can occur. This audit therefore seeks to identify means of improving the energy situation in the Michael Okpara University of Agriculture, Umudike. The scope of this assessment includes energy bill analysis, assessment of existing conditions and recommendations for energy conservation measures. The facility description includes energy usage, occupancy profiles and current building systems. The process of the audit included facility visits of the entire University campus from October 1, 2017 to October 31, 2017. Office occupancy profiles and equivalent full time students were used as indicators of activities within the campus. The specific objectives are:

1. Study the entire buildings, structures and equipments in MOUAU.
2. Study the utility bills of the university
3. Determine ways to reduce energy consumption.
4. Provide a benchmark, or reference point, for managing and assessing energy use across the University
5. Provide basis for ensuring more effective use of energy.

This audit was carried out in three phases.
Phase I - Inspection phase – Inspection of facilities and buildings.
Phase II - Monitoring phase – Monitoring the electrical equipment usuage.
Phase III - Analysis & reporting phase

II. UNIVERSITY CAMPUS DESCRIPTION

The entire campus comprises of more than 100 buildings scattered across the different colleges and schools. This also includes student hostels, administrative buildings, auditoriums, central library, hospital, shopping complex, bookshop and security offices. The University is fed with a 11kV incomer and then directly Tee-ed off to various distribution sub stations within the campus.

1. College of Engineering and Engineering Technology (CEET)

CEET has 14 laboratories, 2 class rooms, a college library, 54 offices and 4 conveniences.

Table 1: Estimated loads in CEET

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs (CFL)	197	30	5910	10	59100
2.	Laptop (staff)	85	77.5	6587.5	10	65875
3.	Photocopiers	10	800	8000	6	48000
4.	Refrigerator	6	100	600	10	6000
5.	Air conditioner	12	1hp(746W)	8952	10	89520
		18	1.5hp(1119W)		10	
				20142		201420
6.	Printer/Scanner	15	50	750	4	3000
7.	Ceiling fan	100	50	5000	10	50000
8.	Desktop	8	280	2240	10	22400
9.	Mobile phone	160	0.8	128	10	1280
10.	Standing fan	11	120	1320	10	13200
11.	Television	4	50	200	10	2000
12.	Projectors	4	65	260	4	1040
13	Laboratory equipments	50				
			Total	**60,089.5**		**562,835**

2. College of Education (CoEd)

CoEd has 8 offices, a departmental library, a single convenience, 2 lecture halls and a storage room.

Table 2: Estimated loads in CoEd

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs (CFL)	68	30	2040	24	48960
2.	Laptop (Staff)	55	77.5	4262.5	10	42625
3.	Photocopiers	8	800	6400	6	38400
4.	Refrigerator	3	100	300	10	3000
5.	Air conditioner	3	1.5hp(1119W)	3357	24	80568
6.	Printer/Scanner	4	50	200	4	800
7.	Ceiling fan	33	50	1650	24	39600
8.	Desktop	8	280	2240	10	22400
9.	Mobile phone	110	0.8	88	10	880
10.	Standing fan	5	120	600	10	6000
11.	Television	2	50	100	10	1000
12.	Projectors	1	65	65	4	260
			Total	**21,302.5**		**284,493**

3. College of Agricultural Economics, Rural Sociology & Extension (CAERSE)

CAERSE has 16 offices, 3 laboratories, a departmental library, 3 lecture rooms and 3 conveniences.

Table 3: Estimated loads in CAERSE

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs (CFL)	92	30	2760	24	66240
2.	Laptop (Staff)	51	77.5	3952.5	10	39525
3.	Photocopiers	7	800	5600	6	33600
4.	Refrigerator	2	100	200	10	2000
5.	Air conditioner	13	1.5hp(1119W)	14547	24	349128
6.	Printer/Scanner	5	50	250	4	1000
7.	Ceiling fan	50	50	2500	24	60000
8.	Desktop	7	280	1960	10	19600
9.	Mobile phone	98	0.8	78.4	10	784
10.	Standing fan	5	120	600	10	6000
11.	Television	2	50	100	10	1000
12.	Projectors	2	65	130	4	520
			Total	**32,677.9**		**579,937**

4. College of Physical and Applied Sciences (COLPAS)

COLPAS has 10 offices, 3 laboratories, a departmental library, 4 lecture rooms and 3 conveniences.

Table 4: Estimated loads in COLPAS

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs (CFL)	72	30	2160	24	51840
2.	Laptop (Staff)	62	77.5	4805	10	48050
3.	Photocopiers	3	800	2400	6	14400
4.	Refrigerator	3	100	300	10	3000
5.	Air conditioner	5	1.5hp(1119W)	5595	24	134280
6.	Printer/Scanner	5	50	250	4	1000
7.	Ceiling fan	41	50	2050	24	49200
8.	Desktop	8	280	2240	10	22400
9.	Mobile phone	98	0.8	78.4	10	784
10.	Standing fan	4	120	480	10	4800
11.	Television	2	50	100	10	1000
12.	Projectors	2	65	130	4	520
13.	Lab. equipments	35				
			Total	**20,588.4**		**311,274**

5. College of Natural Science (COLNAS)

COLNAS has 25 offices, 6 laboratories, a departmental library, 8 lecture halls and 4 conveniences.

Table 5: Estimated loads in COLNAS

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs (CFL)	121	30	3630	10	36300
2.	Laptop (Staff)	75	77.5	5812.5	10	58125
3.	Photocopiers	10	800	800	6	4800
4.	Refrigerator	2	100	200	10	2000
5.	Air conditioner	5	1.5hp(1119W)	1678.5	10	16785
		3	2.5hp(1865W)	5595	10	55950
6.	Printer/Scanner	6	50	300	4	1200
7.	Ceiling fan	85	50	4250	10	42500
8.	Desktop	7	280	1960	10	19600
9.	Mobile phone	98	0.8	78.4	10	784
10.	Standing fan	14	120	1680	10	16800
11.	Television	3	50	150	10	1500
12.	Projectors	1	65	65	4	260
13.	Laboratory equipments	42				
			Total	**26,199.4**		**256,604**

6. College of Management Science (COLMAS)

COLMAS has 4 lecture halls, 11 offices, a conference room, 2 conveniences.

Table 6: Estimated loads in COLMAS

S/N	Load type	Qty	Load rating in Watts	Demand In Watts	Time in hours	Demand in Wh
1.	Electric bulbs (CFL)	98	30	2940	10	29400
2.	Laptop (Staff)	45	77.5	3487.5	10	34875
3.	Photocopiers	3	800	2400	6	14400
4.	Refrigerator	1	100	100	10	1000
5.	Air conditioner	2	1.5hp(1119W)	2238	10	22380
6.	Printer/Scanner	4	50	200	6	1200
7.	Ceiling fan	45	50	2250	10	22500
8.	Desktop	8	280	2240	10	22400
9.	Mobile phone	78	0.8	62.4	10	624
10.	Standing fan	5	120	600	10	6000
11.	Television	2	50	100	10	1000
12.	Projectors	3	65	195	4	780
			Total	**16812.9**		**156,559**

7. College of Crop and Soil Science (CCSS)

CCSS has 6 lecture halls, 39 offices, 3 laboratories, a departmental library and 4 conveniences.

Table 7: Estimated loads in CCSS

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs	91(CFL) 14(Halogen)	30 100	2730 1400	10 10	27300 14000
2.	Laptop (Staff)	91	77.5	7052.5	10	70525
3.	Photocopiers	10	800	8000	6	48000
4.	Refrigerator	3	100	300	10	3000
5.	Air conditioner	18	1.5hp(1119W)	20142	10	201420
6.	Printer/Scanner	6	50	300	6	1800
7.	Ceiling fan	94	50	4700	10	47000
8.	Desktop	9	280	2520	10	25200
9.	Mobile phone	131	0.8	104.8	10	1048
10	Standing fan	15	120	1800	10	18000
11.	Television	3	50	150	10	1500
12.	Projectors	4	65	260	4	1040
13.	Laboratory equipments	49				
			Total	**49,459.3**		**459,833**

8. College of Natural Resources & Environmental Management (CNREM)

CNREM has 3 lecture rooms, 3 laboratories, 44 offices, a departmental library and 2 conveniences.

Table 8: Estimated loads in CNREM

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs	100(CFL) 1(Halogen)	30 100	3000 100	10 10	30000 1000
2.	Laptop (Staff)	78	77.5	6045	10	60450
3.	Photocopiers	3	800	2400	6	14400
4.	Refrigerator	2	100	200	10	2000
5.	Air conditioner	12	1.5hp(1119W)	13428	10	134280
6.	Printer/Scanner	6	50	300	6	1800
7.	Ceiling fan	92	50	4600	10	46000
8.	Desktop	6	280	1680	10	16800
9.	Mobile phone	131	0.8	104.8	10	1048
10.	Standing fan	11	120	1320	10	13200
11.	Television	1	50	50	10	500
12.	Projectors	2	65	130	4	520
13.	Laboratory equipments	39				
			Total	**33357.8**		**321,998**

9. College of Animal Science & Animal Production (CASAP)

CASAP has 5 lecture rooms, 4 laboratories, 38 offices, a departmental library and 4 conveniences.

Table 9: Estimated loads in CASAP

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs(CFL)	113	30	3390	10	33900
2.	Laptop (Staff)	91	77.5	7052.5	10	70525
3.	Photocopiers	8	800	6400	6	38400
4.	Refrigerator	1	100	100	10	1000
5.	Air conditioner	13	1.5hp(1119W)	14547	10	145470
6.	Printer/Scanner	7	50	350	6	2100
7.	Ceiling fan	102	50	5100	10	51000
8.	Desktop	9	280	2520	10	25200
9.	Mobile phone	111	0.8	88.8	10	888
10.	Standing fan	4	120	480	10	4800
11.	Television	2	50	100	10	1000
12.	Projectors	3	65	195	4	780
13.	Laboratory equipments	51				
			Total	**40,323.3**		**375,063**

10. College of Applied Food Science & Tourism (CAFST)

CAFST has 4 lecture halls, 41 offices, 5 laboratories, 3 conveniences and a departmental library.

Table 10: Estimated loads in CAFST

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs	76 (CFL)	30	2280	24	54720
		15 (Haloen)	100	1500	24	36000
2.	Laptop (Staff)	87	77.5	6742.5	10	67425
3.	Photocopiers	4	800	3200	6	19200
4.	Refrigerator	2	100	200	10	2000
5.	Air conditioner	8	1hp(746W)	5968	24	143232
6.	Printer/Scanner	4	50	200	6	1200
7.	Ceiling fan	82	50	4100	10	41000
8.	Desktop	9	280	2520	10	25200
9.	Mobile phone	98	0.8	78.4	10	784
10.	Standing fan	3	120	360	10	3600
11.	Television	2	50	100	10	1000
12.	Projectors	2	65	130	4	520
13.	Lab. equipments	48				
			Total	**27,378.9**		**395,881**

11. College of Vertinary Medicine (CVM)

CVM has 51 offices, 8 laboratories, a departmental library, 8 lecture halls and 4 conveniences.

Table 11: Estimated loads in CVM

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs (CFL)	121	30	3630	10	36300
2.	Laptop (Staff)	64	77.5	4960	10	49600
3.	Photocopiers	3	800	2400	6	14400
4.	Refrigerator	3	100	300	10	3000
5.	Air conditioner	3	1.5hp(1119W)	3357	10	33570
		5	1hp(746W)	3730	10	37300
6.	Printer/Scanner	6	50	300	6	1800
7.	Ceiling fan	87	50	4350	10	43500
8.	Desktop	8	280	2240	10	22400
9.	Mobile phone	91	0.8	72.8	10	728
10.	Standing fan	4	120	480	10	4800
11.	Television	2	50	100	10	1000
12.	Projectors	3	65	195	4	780
13.	Laboratory equipments	58				
			Total	**26,114.8**		**249,178**

12. School of General Studies & Administration (SGSC)

SGSC has 39 offices and 4 conveniences.

Table 12: Estimated loads in SGSC

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs(CFL)	75	30	2250	10	22500
2.	Laptop (Staff)	45	77.5	3487.5	10	34875
3.	Photocopiers	13	800	10400	6	62400
4.	Refrigerator	1	100	100	10	1000
5.	Air conditioner	9	1hp(746W)	6714	10	67140
6.	Printer/Scanner	6	50	300	6	1800
7.	Ceiling fan	69	50	3450	10	34500
8.	Desktop	12	280	3360	10	33600
9.	Mobile phone	87	0.8	69.6	10	696
10.	Standing fan	7	120	840	10	8400
11.	Television	1	50	50	10	500
			Total	**31,021.1**		**267,411**

13. School of Post Graduate Studies (SPGS)

SPGS has 45 offices and 3 conveniences.

Table 13: Estimated loads in SPGS

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs (CFL)	87	30	2610	10	26100
2.	Laptop (Staff)	55	77.5	4262.5	10	42625
3.	Photocopiers	8	800	6400	6	38400
4.	Refrigerator	1	100	100	10	1000
5.	Air conditioner	13	1.5hp(1119W)	14547	10	145470
6.	Printer/Scanner	5	50	250	6	1500
7.	Ceiling fan	91	50	4550	10	45500
8.	Desktop	5	280	1400	10	14000
9.	Mobile phone	77	0.8	61.6	10	616
10.	Standing fan	6	120	720	10	7200
11.	Television	1	50	50	10	500
			Total	**34,951.1**		**322,911**

14. Admin Block

This admin block has a total of 64 offices and 5 conveniences.

Table 14: Estimated loads in Admin Block

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs (CFL)	189	30	5670	10	56700
2.	Laptop (Staff)	101	77.5	7827.5	10	78275
3.	Photocopiers	12	800	9600	6	57600
4.	Refrigerator	3	100	300	10	3000
5.	Air conditioner	21	1.5hp(1119W)	23499	10	234990
6.	Printer/Scanner	5	50	250	6	1500
7.	Ceiling fan	111	50	5550	10	55500
8.	Desktop	8	280	2240	10	22400
9.	Mobile phone	117	0.8	93.6	10	936
10.	Standing fan	7	120	840	10	8400
11.	Television	3	50	150	10	1500
			Total	**56,020.1**		**520,801**

15. Hospital and Security Offices

Table 15: Estimated loads in the hospital and security offices

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs	66(CFL)	30	1980	24	47520
		12(Halogen)	100	1200	24	28800
2.	Laptop (Staff)	27	77.5	2092.5	10	20925
3.	Photocopiers	1	800	800	6	4800
5.	Air conditioner	4	1hp(746W)	2984	10	29840
6.	Printer/Scanner	2	50	100	6	600
7.	Ceiling fan	82	50	4100	24	98400
8.	Desktop	9	280	2520	10	25200
9.	Mobile phone	81	0.8	64.8	10	648
10.	Standing fan	10	120	1200	10	12000
11.	Television	5	50	250	10	2500
			Total	**17,291.3**		**271,233**

16. Central Library and Book Shop

The central library houses 24 offices and 2 conveniences.

Table 16: Estimated loads in the library and bookshop

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs (CFL)	165	30	4950	24	118800
2.	Laptop (Staff)	65	77.5	5037.5	10	50375
3.	Photocopiers	6	800	4800	6	28800
4.	Refrigerator	1	100	100	10	1000
5.	Air conditioner	6	Central AC(3500W)	21000	10	210000
6.	Printer/Scanner	5	50	250	6	1500
7.	Ceiling fan	125	50	6250	10	62500
8.	Desktop	4	280	1120	10	11200
9.	Mobile phone	117	0.8	93.6	10	936
10.	Standing fan	3	120	360	10	3600
11.	Television	1	50	50	10	500
			Total	**44,011.1**		**489,211**

17. Engineering Workshop

The workshop has 3 conveniences and 25 offices.

Table 17: Estimated loads in the Engineering workshop

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs (CFL)	89	30	2670	10	26700
2.	Laptops (Staff)	12	77.5	930	10	9300
3.	photocopiers	1	100	100	6	600
5.	refrigerator	1	100	100	10	1000
6.	Air conditioner	1	1hp(746W)	746	10	7460
7.	Printer/Scanner	4	50	200	6	1200
8.	Ceiling fan	45	50	2250	10	22500
9.	Electric motor	3	1300	3900	10	39000
10.	Planning machine	1	2500	2500	10	25000
11.	Electric hand drill	1	2010	2010	10	20100
12.	Lathe machine	1	2080	2080	10	20800
13.	Mobile phone	79	0.8	63.2	10	632
14.	Welding machine	1	1200	1200	10	12000
15.	Table fan	5	100	500	10	5000
16.	Standing fan	6	120	720	10	7200
17.	Electric boilers	3	600	1800	10	18000
18.	Radio set	4	30	120	10	1200
19.	Laminating machine	1	200	200	10	2000
			Total	**22,089.2**		**219,692**

18. Afri Hub/ICT Centre

There are 68 ofices and 3 conveniences.

Table 18: Estimated loads in Afri Hub/ICT centre

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs (CFL)	70	30	2100	10	21000
2.	Laptops (Staff)	91	77.5	7052.5	10	70525
3.	photocopiers	10	800	8000	6	48000
5.	refrigerator	3	100	300	10	3000
6.	Air conditioner	8	1.5hp(1119W)	8952	10	89520
		9	Central ac(3500W)	31500	10	315000
7.	Printer/Scanner	5	50	250	10	2500
8.	Ceiling fan	51	50	2550	10	25500
9.	Mobile phone	119	0.8	95.2	10	952
10.	Standing fan	6	120	720	10	7200
11.	Television	2	50	100	10	1000
12.	Laminating machine	1	200	200	10	2000
			Total	**23,319.7**		**544,197**

19. Computer Village

Table 19: Estimated load in the computer village

S/N	Load type	Qty	Load rating in Watts	Demand in Watts	Time in hours	Demand in Wh
1.	Electric bulbs	53 (CFL)	30	1590	24	38160
		45 (Halogen)	100	4500	24	108000
2.	Laptops (Staff)	59	77.5	4572.5	10	45725
3.	photocopiers	32	800	25600	10	256000
5.	refrigerator	13	150	1950	10	19500
6.	Air conditioner	3	1hp(746W)	2238	10	22380
7.	Printer/Scanner	36	50	1800	10	18000
8.	Ceiling fan	16	50	800	10	8000
9.	Mobile phone	109	0.8	87.2	10	872
10.	Standing fan	19	100	1900	10	19000
11.	Television	2	50	100	10	1000
12.	Laminating machine	10	200	2000	10	20000
13.	Electric boiler	6	600	3600	10	36000
14.	Electric stove	6	1400	8400	10	84000
15.	Electric iron	4	1500	6000	10	60000
			Total	**65,137.7**		**736,637**

20. Student Hostels

There are 3 main student hostels:

a. NDDC Hostel

This hostel has three blocks: A, B and C. Each block has 50 rooms.

Table 20a: Estimated loads in the NDDC hostel

S/N	Load Type	Qty.	Load (Watts)	Demand (Watts)	Time (hours)	Demand in Wh
1.	Electric bulbs (CFL)	300	30	9000	24	216000
2.	Electric boiler	6	800	4800	6	28800
3.	Electric stove	1	1400	1400	6	8400
4.	Radio set	4	40	160	10	1600
5.	Mobile phone	500	0.8	400	24	9600
6.	Water pump	1	1000	1000	10	10000
7.	Laptop	350	77.5	271125	10	2711250
8.	Ceiling fan	300	50	15000	24	360000
			Total	**287,885**		**2,985,650**

b. Good Luck Jonathan Hostel

This hostel has blocks A, B, C, D, E, F, G, H, I. Each block has 150 rooms.

Table 20b: Estimated loads in the Good Luck Jonathan hostel

S/N	Load Type	Qty.	Load (Watts)	Demand in Watts	Time (hours)	Demand in Wh
1.	Electric bulbs (CFL)	1400	30	42000	24	1008000
2.	Electric boiler	2	800	2400	6	14400
3.	Electric stove	3	1400	4200	6	25200
4.	Radio set	15	40	600	6	3600
5.	Mobile phone	1000	0.8	800	24	19200
6.	Water pump	1	1000	1000	10	10000
7.	Laptop	1000	77.5	77500	10	775000
8.	Ceiling fans	1350	50	67500	24	1620000
			Total	**128,500**		**3,475,400**

c. Old Hostel

Table 20c: Estimated loads in the old hostel

S/N	Load Type	Qty.	Load (Watts)	Demand (Watts)	Time (hours)	Demand in Wh
1.	Electric bulbs (CFL)	398	30	11940	24	286560
2.	Electric boiler	16	800	12800	6	768000
3.	Radio set	2	40	80	6	480
4.	Mobile phone	400	0.8	320	24	7680
5.	Water pump	1	1000	1000	10	10000
6.	Laptop	400	77.5	31000	10	3100000
7.	Ceiling fan	398	50	19900	24	477600
			Total	**57,140**		**4,172,720**

2.2 Office and Hostel Occupancy Profile

This section provides the occupancy profile (in percentage) for department of Electrical/Electronic Engineering in CEET. This can also be used for the other colleges. Also, the occupancy profile of the administrative building and student's hostel is also presented.

Table21: Electrical Engineering office occupancy profile**

	Mon	Tue	Wed	Thur	Fri	Sat	Sun
8am-9am	76.6	77.8	75.4	51.4	52.6	3.3	3.3
9am-12pm	91.3	89.9	92.3	55.3	56.1	3.3	3.3
12pm-2pm	87.1	88.3	90.1	57.1	56.3	10	6.6
2pm-4pm	79.3	81.0	84.3	49.7	39.7	10	6.6
4pm-6pm	74.1	79.2	70.8	39.3	28.1	6.6	3.3
6pm-8pm	16.1	16.3	13.1	15.8	13.2	3.3	3.3

Table22: Administrative building office occupancy profile

	Mon	Tue	Wed	Thur	Fri	Sat	Sun
8am-9am	87.1	89.8	91.4	81.4	92.6	0	0
9am-12pm	99.1	97.9	98.3	90	86.1	0	0
12pm-2pm	100	100	100	100	86.3	0	0
2pm-4pm	92.2	97.0	84.3	95	81.4	0	0
4pm-6pm	31.1	49.2	30.8	39.3	28.1	0	0
6pm-8pm	0	1.3	0	0	0	0	0

Table23: Student hostel occupancy profile

	Mon	Tue	Wed	Thur	Fri	Sat	Sun
8am-11am	61.3	67.8	65.4	61.4	52.6	83.3	93.3
12pm-3pm	91.3	89.9	92.3	85.3	86.1	83.3	93.3
4pm-7pm	97.1	88.3	90.1	67.1	86.3	92	96.6
8pm-12am	99.3	81.0	84.3	89.7	99.7	90	96.6
12am-6am	100	79.2	80.8	89.3	98.1	100	100
6am-7am	86.1	88.3	83.1	85.8	83.2	84.3	87.3

III. ENERGY CONSUMPTION OF THE UNIVERSITY

The utility bills of the University campus from January, 2017 to October 2017 were reviewed. The university is served by one electric meter and buys electricity from the Enugu Electricity Distribution Company (EEDC), Umuahia branch at an average rate of N424.1 per kWh (over a 11 months period). For the most recent 11months, the total consumption totaled 782650 kWh at a cost of **45,851,543.49**

Table 24: Electric bill

Electricity Bill	
Month	**Cost(N)**
January	3017472
February	4763375
March	3150874
April	5155959
May	3324304
June	3720026
July	5119007
August	3803896
September	5394892
October	5260820
November	3140920
Total	**45851543.49**

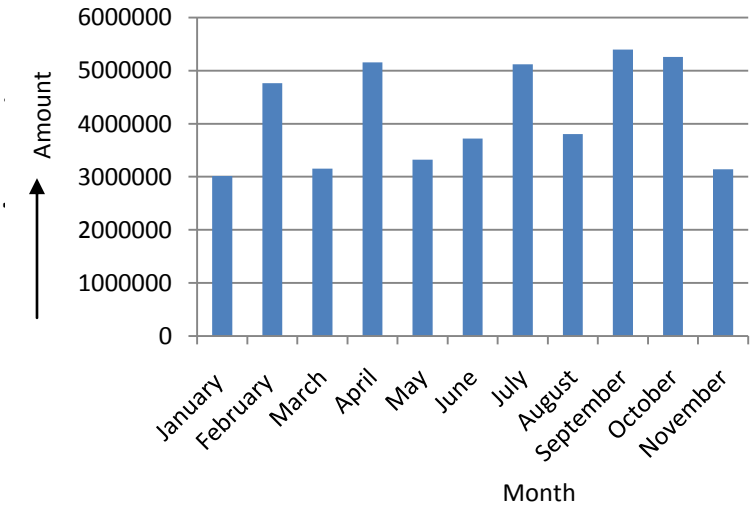

Figure 1: Electricity bill

The university utilizes 8 diesel generators as backup power supply for the entire campus. For the 11 months under review, the total cost of running these generators is shown below.

Table 25: Generator bill

Cost of running generators	
Month	**Cost(N)**
January	672689.19
February	469511.7
March	583900.22
April	505543.9
May	756136.6
June	705122.5
July	537085.2
August	647193
September	502588.1
October	459243.6
November	590322.3
Total	**6629336.31**

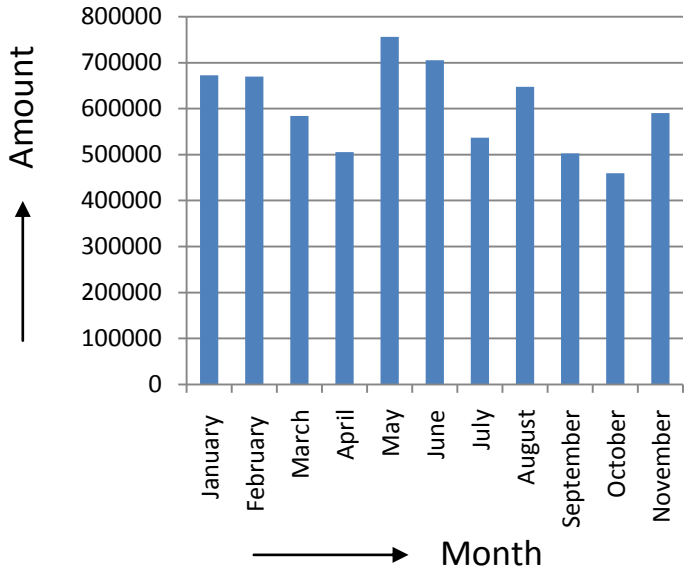

Figure 2: Cost of running generators

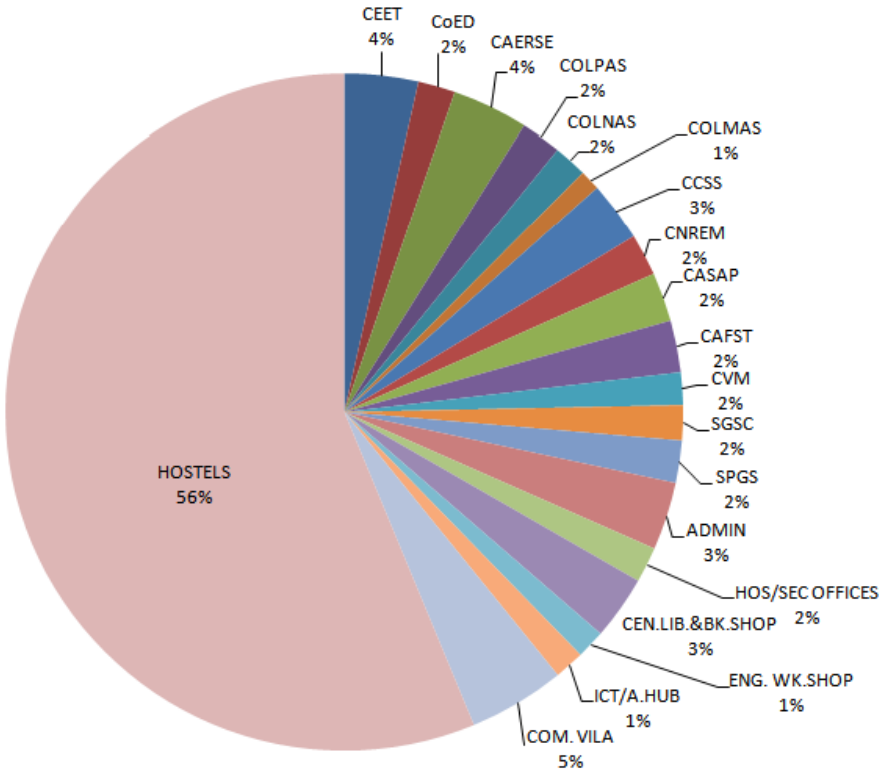

Figure 3: Showing energy consumption within the different colleges and establishments

The chart shows that hostels consume more than half of the total energy. Therefore, proper means should be sought to reduce the energy consumed in the hostels.

IV. LIST OF MAJOR UTILITIES OF THE UNIVERSITY

1. Air conditioners – 3 no. 2.5hp; 42 no. 1hp; 131 no. 1.5hp and 15 central ac
2. Refrigerators – 51
3. Television sets - 40
4. Electric bulbs – 4128 (1890 CFL office bulbs, 87 halogen office bulbs, 2098 CFL hostel bulbs and 53 CFL business bulbs)
5. Fans – 3599 (Office: 126 standing fans, 1385 ceiling fans and 5 table fans
   Hostel: 2048 ceiling fans
   Business: 19 standing fans and 16 ceiling fans)
6. Desktop and laptop computers – Over 1,000
7. Cell phone chargers – Over 1,000
8. Photocopiers – 152 (151 no. 800W and 1 no. 100W)
9. Printer/scanners – 136
10. Personal computers (Laptops - 1239 nos. Desktops- 125 nos.)

V. ENERGY SAVING CALCULATIONS

1. Energy savings from switching off electric bulbs when due

Rating of CFL electric bulb = **30W**
Rating of halogen electric bulb = **100W**
For offices, electric power = (30x1890) + (87x100) = 65400W = 65.4kW
For hostels, electric power = 30x2098 = 62940W = 62.94kW
For business offices, electric power = (53x30) + (49x100) = 6.49kW
Total power = 135.28kW
Normal office working hours is 8am to 4pm. However, most staff comes as early as 7am and close as late as 6pm. Therefore, let's assume normal office work hours to be 7am to 6pm. If all office bulbs were switched on between 7am – 9am and 4pm -6pm only.
Energy used daily would be 4 x (65.4 + 6.49) kW = **287.56kWh**
For the students, the electric bulbs are assumed needed between 4pm to 7am every day. If the bulbs were switched on only during these times,
Energy saved daily would be 9x62.94kW = **566.46kWh**

2. Energy savings from switching off ceiling fans appropriately

Rating of ceiling fan = **50W**
Colleges such as CoED (10), CAERSE (25) and COLPAS (18) leave their ceiling fans switched on even after close of work.
If these fans were used only for the assumed office 10 hours, energy saved = 14 x (10 + 25 + 18) x 50W = **37.1kWh**

3. Energy savings from switching off air conditioners

Rating of 1.5hp ac = 1119W
In the same colleges mentioned above, a total of 13 no. 1.5hp air conditioners were left running for 24 hours. If these were switched on during working hours only,
Energy saved = 14 x 1119 x 13 = **203.658kWh**

VI. RECOMMENDATIONS

In this report, recommendations were made in the following categories:

1. Capital Investments

- **Wind Energy**

The university has very few aesthetic constrains making it suitable for wind energy technology. Electricity generated via this means can help curb the utility cost. Wind mills can be installed in strategic open areas within the campus.

- **Solar Energy**

Nigeria has a unique geographical location. The country receives abundant sunshine all year round ranging from 6.70kwh/m2/d to a low of 4.42kwh/m2/d during the month of August alone. This level of solar radiation can be optimally harnessed to minimize the money spent on running generators and electricity bill. Solar panels can be installed on roof tops and other open areas within the campus.

2. Operations and Maintenance

- Most offices have ceiling fans, standing fans and air conditioners as cooling systems. In such offices, only one should be switched on. Either use the air conditioners or ceiling fans or standing fans. Using all at the same time results in waste of electrical energy.
- Efficiency of electrical appliances like air conditioners, electric motors, e.t.c decreases with time. A decrease in efficiency implies a greater consumption of electrical energy. Such appliances can be serviced regularly or replaced if very old. Equipments due for replacements should be replaced with 5 star units for energy conservations.
- All air conditioned offices should be air tight to avoid entry of outside air.
- Fans running without a capacitor or under rated capacitor will draw more current. Therefore, use of a proper rated capacitor will reduce power consumption.
- All major appliances like air conditioners, electric motors, e.t.c should run with a good power factor. Incorporation of power factor recording and correction equipments should be made mandatory to cater for this.
- Programmable thermostats for air conditioners are a simple and cost- effective way to reduce operating costs and improve control during unoccupied periods. Programmable thermostats should be installed and the program settings should be reviewed to ensure appropriate schedules and set points are being maintained.
- Installation of movement sensor control for passage and corridor lights.
- There should be penalties enacted for unnecessary power consumption by negligence of the user or system administrator for not switching off appliances while leaving the office or hostels.
- Smart electrical meters like the **POWER XPERT METER 4000/6000/8000** should be installed in the University. This provides enhanced functions for monitoring power consumption and power quality. These meters can be used in various applications, including energy management, monitoring circuit loading, and identifying power quality problems.

3. Energy Conservation Measures

Electrical appliances not in use should not be left in the standby mode and should be switched off for the following reasons.

- A cell phone charger left plugged in without a phone consumes about 0.1W – 0.5W.
- In the standby mode, a laptop consumes up to 1W of power while a desktop consumes 5W.
- Heavy duty photocopiers (800W – 1500W) in standby mode consumes between 100W – 300W because the rollers are usually kept hot during this time. Office and home photocopiers/printers/scanners consume between 1W – 5W in standby mode.
- In the standby mode, modern television sets consume up to 1W of electric power.
- Desktop computer whose monitors use CRT should be replaced with an LCD monitor.
- All halogen bulbs should be replaced with CFL.
- When leaving the office or hostel, switch off all electrical equipments.

REFERENCE

[1]. Krarti, M. (2000). *Energy Audit of Building Systems: An Engineering Approach*. CRC Press.