Athul Energy, we stand for Quality, Reliability and Efficiency

No: AEC/GAC/29

18-12-2021

Audit Certificate

This is to certify that **M/s Pocker sahib Memorial Orphanage College Thirurangadi , Malapuram** have successfully completed the **Energy Audit** of their buildings and campus conducted on 10th November 2021 . They have submitted all necessary data and credentials for scrutiny.

We, **Athul Energy Consultants Pvt Ltd**, Thrissur congratulate the Management, Executive Director, Principal, staff members and students for the successful completion and participation in the audit report process.

Managing Director

Athul Energy Consultants Pvt Ltd

ATHUL ENERGY CONSULTANTS PVT. LTD. THRISSUR 680 020

Athul Energy Consultants Pvt Ltd
CIN: U74999KL2016PTC046898
info@athulenergy.com
www.athulenergy.com

Registered Office:
4/2, Capital Legend Building
Korapath lane, Round-North
Thrissur-680020, Kerala
+91 7356111990

Branch Office:
F-7, James Square
Asian paint Chowkady, GIDC
Ankleshwar-393002, Gujarat
+91 7356111991

ENERGY AUDIT - 2021

PSMO COLLEGE

TIRURANGADI, MALAPPURAM

EXECUTED BY

ATHUL ENERGY CONSULTANTS PVT LTD

4th FLOOR, CAPITAL LEGEND BUILDING,

KORAPPATH LANE, ROUND NORTH, THRISSUR-680020

Ph: +91 7356111990-6 Web: www.athulenergy.com E-Mail: info@athulenergy.com

November 2021

BRIEFCONTENTS

TABLEOFCONTENTS

LISTOFTABLES

defined.

LISTOFFIGURES

PREFACE

Every institution should be imparting knowledge about the campus environment and its surroundings through activities that follows the principles of sustainability. An energy audit is essential first step to reduce energy cost and greenhouse emissions. Audit is defined as a systematic and implement examination of data statements, records, operations and performance of an enterprise for a purpose. Energy audits is a systematic study or survey to identify how energy being used in its own facility. And identifying the energy savings opportunities in the building Behavioural Change through the student education can provide greatest benefit at least cost. Even small savings in each house holds make dramatic change in the society and for nation. The idea of energy conservation and sustainability will be percolated to society through students will have long standing effect and successful too

This report is compiled by the BEE certified energy auditor along with the project engineers who are experienced in the field of energy, environment and management. The student volunteers made a mammoth contribution with data collection and preparing an initial skeleton for the report.

ACKNOWLEDGEMENTS

We express our sincere gratitude to the PSMO College, Tirurangadi, Malappuram, for giving us an opportunity to carry out the project of Energy Audit. We are extremely thankful to all the staffs for their support to carry out the studies and for input data, and measurements related to the project of energy audit.

1 Dr. Azeez K Principal

2

Also congratulating our Energy audit team members for successfully completing the assignment in time and making their best efforts to add value.

GREEN AUDIT TEAM

1. **Mr. Santhosh A**
   Registered Energy Auditor of Bureau of Energy Efficiency (BEE – Govt. of India)
   Accredited Energy Auditor No – EA 7597

2. **Mr. Hari Krishnan K**
   Project Engineer

Yours faithfully Managing Director Athul Energy Consultants Pvt Ltd

EXECUTIVE SUMMARY

I. ENERGY SAVING PROPOSALS:

TABLE 1: EXECUTIVE SUMMARY –ENERGY

Sl. no	Energy conservation measures	Annual Energy Savings	Annual Financial Savings	Investment	Simple payback period
		kWh	**Rs**	**Rs**	**Months**
1	Replacement of T8-110n and T12- 12 No with LED Tube light of 20W	4500	2920	36600	15
2	Replacement of ceiling fan 100 No with BLDC of 35 W	6750	43875	350000	96
	Total	11,250	46,795	386600	

II. ENERGY AUDIT SUMMARY & RECOMMENDATIONS

The summary of the report with respect to each section is as follows.

1. Equipment and Utility

Light loads: Majority of the lighting fixtures are fluorescent type (T12 and T8). By replacing these loads with LED light fittings will reduce the overall power consumption. **Ceiling fan**

loads: Ceiling fans are installed in majority of the areas by replacing it with Brushless DC fans which consumes in the range of 25 to 30W at full speed, instead of 70W in normal fans, will reduce the power consumption considerably. Also, while purchasing new fans priority should be given for BLDC

III. AUDIT SUMMARY – ACTIONS

The actionable summary of the audit report is given in the table below.

TABLE 2: ENERGY AUDIT SUMMARY – ACTIONS

Sl No:	Particulars	Location	Action to be taken	Remarks
1	Energy efficiency – Replacement of ceiling fans with BLDC fans	Office, staff rooms, Classrooms	Change the existing old ceiling fans with BLDC fans	Power Consumption will get reduced
2	Energy efficiency – Replacement of fluorescent lights with LED lights	Office, staff rooms, Classrooms	Change the existing lights with LED lights	Power Consumption will get lowered

IV. ENERGY PERFORMANCE INDEX

EPI is based on the energy consumption during November 2020 to October 2021. The futuristic energy consumption after the implementation of energy saving proposals is given in the tables below.

TABLE 3: ENERGY INDEX

Parameters	**Values**
Present Annual electricity consumption(kWh/year)	43028
Present annual specific electricity consumption (kWh/m2)	3.70
Present CO_2 emission (Tons/year)	21.514
After Energy Saving Implementation	
Expecting annual electricity consumption (kWh/year)	31778

Expecting annual specific electricity consumption (kWh/m2)	2.73
Electricity and CO2 emission reduction %	26.15

INTRODUCTION

I. ENERGY AUDIT

An energy audit is a key to assessing the energy performance of an energy consuming facility and for developing an energy management program. The typical steps of an energy audit are:

- Preparation and planning
- Data collection and review
- Plant surveys and system measurements
- Observation and review of operating practices
- Data documentation and analysis
- Reporting of the results and recommendations

1.1. Definition of energy auditing

In the Indian Energy Conservation Act of 2001 **(BEE 2008)**, an energy audit is defined as: **"The verification, monitoring and analysis of the use of energy and submission of technical report containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce energy consumption."**

1.2. Objectives of Energy Auditing

The objectives of an energy audit can vary from one plant to another. However, an energy audit is usually conducted to understand how energy issued within the plant and to find opportunities for improvement and energy saving. Sometimes, energy audits are conducted to evaluate the effectiveness of an energy efficiency project or program. In Mount Zion College as per the request from the institution, we have assessed the energy consumption and saving opportunities at present scenario.

Methodology for the study

The methodology adopted for energy audit starts from historical energy data analysis, power quality analysis, monitoring of operational practices, system evaluation, cost benefit analysis of the energy conservation opportunities, and prepare plan for implementation. The proposals given in the report includes economical energy efficiency measures to reduce facilities unnecessary energy consumption and cost. The energy conservation options, recommendations and cost benefit ratio, indicating payback period are included in this report.

Scope of Work

The Scope of Work includes:

1. Historical energy data analysis.
2. Electrical, Mechanical and Thermal energy analysis.
3. Power Quality Analysis.
4. Identification of Energy saving opportunities.

II. PSMO COLLEGE- TIRURANGADI

Pocker Sahib Memorial Orphanage College was established in July, 1968 as an aided junior college, affiliated to the University of Kerala under the management of the Tirurangadi Muslim orphanage committee (Regd.). Though the college was initially intended for the educational advancement of the orphans in the Muslim community, presently it fulfils the educational aspirations of students from all communities. The campus is located 13 km away from the University of Calicut, at an earshot distance from Kakkad, on the Calicut – Thrissur National Highway. It is just 8 km from Parappanangadi Railway station, 13 km from Calicut International Airport and 25 km from Malappuram District Head Quarters.

Vision

To achieve national and international recognition as a premier academic institution, through an extraordinary, student centered, value based, teaching learning practices and quality Research output.

Mission

• To align the academic endeavours of the college with the best nationally and globally

• To collaborate with institutions of eminence leading to elevated student experiences

• To establish student-centred instructional ecosystem with active learning practices •

To provide top-class exposure to research in terms of thought and material support

FIGURE 1: COLLEGE CAMPUS – SATELLITE VIEW (GOOGLE)

III. GENERAL DETAILS

The general details of PSMO College are given below in table.

TABLE 4: GENERAL DETAILS

Sl.No:	Particulars	Details
1	Name of the College	PSMO College
2	Address	PSMO College Tirurangadi Malappuram, Kerala 676 306, India
3	Contact Person	
4	E-mail ID	mail@psmocollege.ac.in
5	Website Details	www.psmocollege.ac.in
6	Type of college	Affiliated to Calicut University
7	Annual Working Days	210
8	No: of Shifts	1
9	No : of students	1876
10	No: of teaching staff	78
11	No: of non-teaching staff	30
12	Total campus area(acres)	20.92
13	Total built up area(M^2)	11634

IV. LOAD BALANCE- ELECTRICAL

Load balance among the connected loads is given in the figure below. The office equipment and the light – fan loads share 67% of the total connected load in the building.

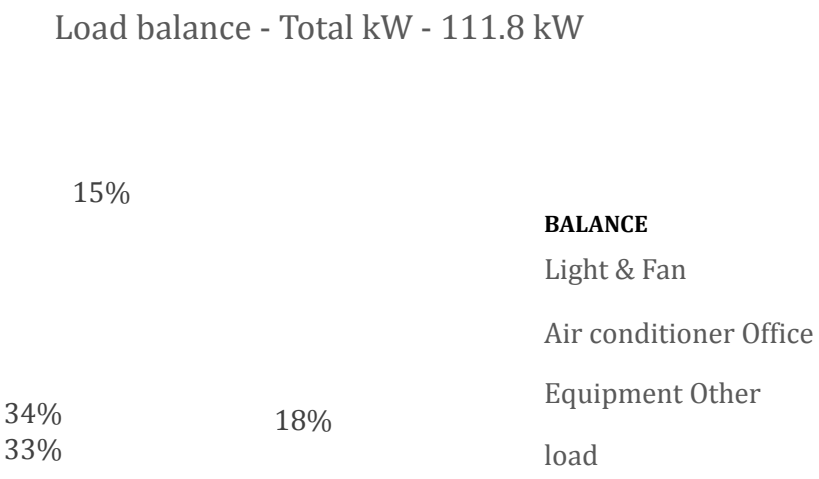
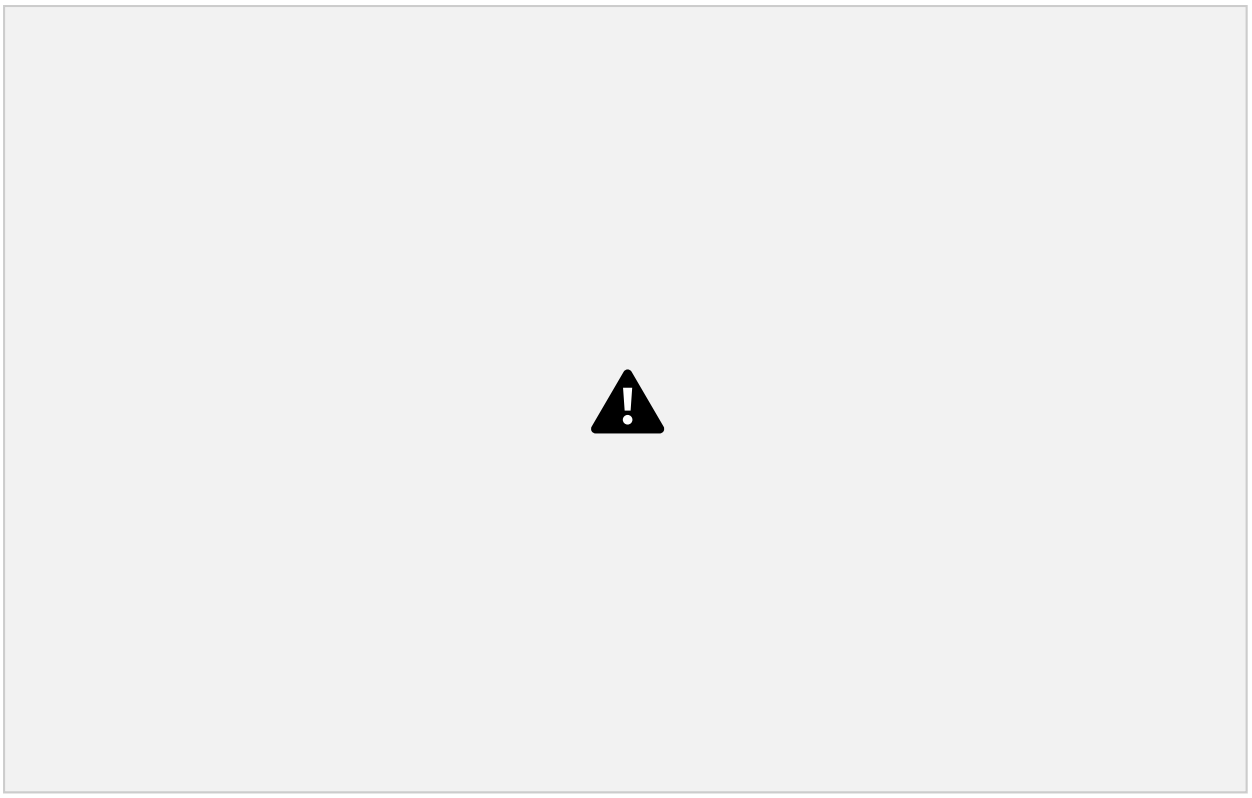


FIGURE 2: LOAD

SINGLE LINE DIAGRAM

The electrical single line diagram of the college is given below:



ENERGY ANALYSIS

The different type's energy usage is given in this section. The major source of energy to the college is electricity. Other forms come in the form of LPG, petrol and diesel.

ELECTRICITY CONSUMPTION ANALYSIS

The major source of electricity to the college is the electrical connection from the KSEB. A diesel generator is provided in the college, but it is only used during power failures.

I. DESCRIPTION OF ELECTRICITY BILL

Base line data given below is based on the Electricity bill provided by the supplier of electricity to the College. Details obtained from the KSEB bill for the month of April 2020 to March 2021 is as follows in the Table.

TABLE 5: KSEB BILL ANALYSIS

Consumer No 1165782000874
Connected Load(kW) 73.36

Tariff LT-6A/Three
Average monthly consumption (kWh) 2822
Average Fixed charges (Rs) 4810
Average Energy charge (Rs) 23307

II. TARIFF RATE ANALYSIS

The monthly energy and demand charges for the period November 2020 to October 2021 is represented in Fig.

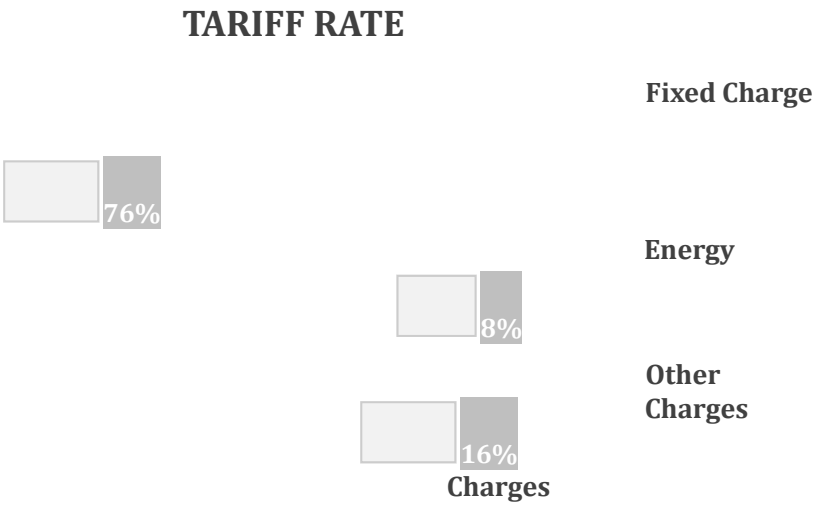


FIGURE 3: TARIFF RATE ANALYSIS

Inference i. Average fixed charges for the past one year were Rs 4,810/ per month and energy charges was Rs 23,307/ per month.

ii. The energy charges come about 76% of the total bill.

III. SPECIFIC ELECTRICITY CONSUMPTION (KWH/M2)

The electricity consumption from the March 2020 to Aug 2021 has been taken for the benchmarking. Here the comparison is done with electricity consumption and the building area which is the average of each month. The below table shows the specific electricity consumption of PSMO College **TABLE 6: SPECIFIC ELECTRICITY CONSUMPTION**

Month	Electricity Consumption	Building Area	SEC
	kWh	**Sq. Metre**	**kWh/Sq. Metre**
Nov-20	2796	11634	0.24
Dec-20	2412	11634	0.21
Jan-21	4902	11634	0.42
Feb-21	5034	11634	0.43
Mar-21	5814	11634	0.50
Apr-21	5250	11634	0.45
May-21	1922	11634	0.17
Jun-21	2082	11634	0.18
Jul-21	2544	11634	0.22
Aug-21	2724	11634	0.23
Sep-21	3902	11634	0.34
Oct-21	3646	11634	0.31
Avg			

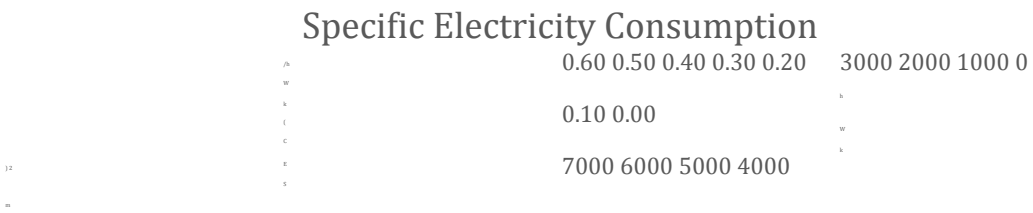


FIGURE 4: SPECIFIC ELECTRICITY CONSUMPTION

RENEWABLE ENERGY

The Sun is an inexhaustible, reliable and non-polluting source of power. Since the inception of life on earth, the only energy that was available came from the sun. The time is now approaching when mankind will again depend upon the sun as dominant energy source. We are aware that fossil fuels are not going to last forever. A growing worldwide concern for conservation of energy has reignited our interest in ecologically sustainable materials, processes and

sources of energy. The advantages of solar power are:

- The solar energy is more evenly distributed in the world than wind or bio-mass.
- It is well proven and demonstrated technology
- It promises to be most cost effective renewable power at high volumes.
- The solar energy potential in India is immense due to its convenient location near the Equator. India receives nearly 3000 hours of sunshine every year, which is equivalent to 5000 trillion kWh of energy.

PSMO College has installed 15kw ongrid solar system. Polycab inverter of rating 15 kva and xx number of solar panels are being used by the system. Approximately xx kwh is generated per day by the solar system. During the low electricity consumption period the surplus solar energy generated is back fed to KSEB, which in turn result in monetary benefits

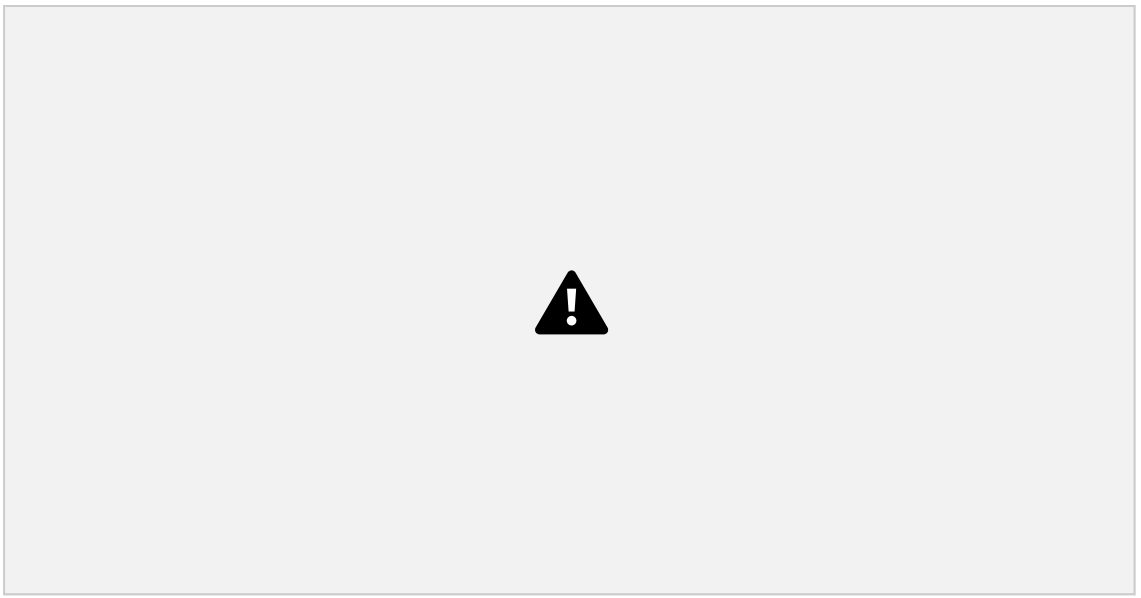


Figure 5 SOLAR PANLES ABOVE MAIN BLOCK

ANNEXURE 1

I. CONNECTED ELECTRICAL LOADS

I. LIGHT AND FAN LOADS

TABLE 7: LIGHT AND FAN LOADS

Location	T12	T8	T5	CFL	CFL	Incandescent Bulb	LED bulb	LED TUBE LIGHT	LED	LED	LED	LED	
Power (W)	**40**	**36**	**28**	**23**	**12**	**60**	**9**	**20**	**100**	**9**	**5**	**11**	
Main Building													
Room No.77										2			
Room No.76										2			
Room No.75										2			
Research library		2			1								
PG dept Library		4											
History		2											
Room No.71								1					
Room No.70								1					
Room No.69								1					
Room No.68								2					

Room No.67								1				
Room No.66		2						1				
Room No.65		1								1		
Room No.64		3										
Room No.63								2				

Location	**T12**	**T8**	**T5**	**CFL**	**CFL**	**Incandescent Bulb**	**LED bulb**	**LED TUBE LIGHT**	**LED**	**LED**	**LED**	**LED**	
Power (W)	**40**	**36**	**28**	**23**	**12**	**60**	**9**	**20**	**100**	**9**	**5**	**11**	
Room No.62													
Room No.61													
Room No.60	2	6						1					
Room No.58													
Room No.57		2	2			1							
Room No.56		2											
Room No.55						1							
Room No.53	1	6					1						
Room No.52		1											
Office	1	5		1				1					
Room No.48		2									10	1	
Room No.47		2				1							
Room No.45		4						3					
Room No.44		5											
Room No.41		1						1					
Room No.40		2											
Room No.39		1					1						
Room No.38								8					
Room No.37								8					
Room No.36					2								
Room No.35					1								
Principal											4		
Visitors room		1											
Room No.34					1								

Room No.33	2			1	8		2					
Room No.32												

Location	**T12**	**T8**	**T5**	**CFL**	**CFL**	**Incandescent Bulb**	**LED bulb**	**LED TUBE LIGHT**	**LED**	**LED**	**LED**	**LED**
Power (W)	**40**	**36**	**28**	**23**	**12**	**60**	**9**	**20**	**100**	**9**	**5**	**11**
Room No.31		2	1					1				
Room No.30		1						1				
Room No.29		1										
Room No.27		1		2						3		
Research lab chemistry								6				
Dept of chemistry		1					1	3				
Class room								2				
Class room		1						1				
Class room								4				
Dept of Maths		1						1				
Class room								2				
Dept of Botany		2										
Bsc lab	4	5				1						
Botany classroom		1						1				
Cooperative store								7				
Physical Education												
PE		2			2							
Canteen												
Canteen						1	1	3				
Staff Club												
Staff Club								4				
Library Block												
Hall								8				
Childline room								1				

Location	T12	T8	T5	CFL	CFL	Incandescent Bulb	LED bulb	LED TUBE LIGHT	LED	LED	LED	LED
Power (W)	**40**	**36**	**28**	**23**	**12**	**60**	**9**	**20**	**100**	**9**	**5**	**11**
Research								4				
Msc Botany								8				
Library		23	13									
Library		10	6				12	3				
NCC Bhavan												
		3					2					
Auditorium												
Auditorium	1	8		11			1	5	1			
Hostel		2	8									
Women's Hostel												
		56	2					16				
IGNOU Block												
	1	27					1					
Ladies corner												
							7					
Science Block												
Room No.80		2										
Bsc. Che lab 2		5					1					
Room No.85										24		
Room No.84		1						1				
Room No.83		1						1				
Room No.82		4										
Room No.90		2										
Room No.89		2										
Room No.88		2										
Room No.87		2										

Location	T12	T8	T5	CFL	CFL	Incandescent Bulb	LED bulb	LED TUBE LIGHT	LED	LED	LED	LED

Power (W)	**40**	**36**	**28**	**23**	**12**	**60**	**9**	**20**	**100**	**9**	**5**	**11**	
Room No.86		2											
Arabic Dept		3											
Room													
	12	227	32	15	15	5	30	114	1	34	14	1	
	0.48	**8.172**	**0.896**	**0.345**	**0.18**	**0.3**	**0.27**	**2.28**	**0.1**	**0.306**	**0.07**	**0.011**	**0.**
Total (kW)	**36.699**												

II. COMPUTER AND OTHER POWER LOADS

TABLE 8: COMPUTER AND OTHER POWER LOADS

Location	**PC**	**Projector**	**Laser Printer**	**Scanner**	**Xerox Machine**	**3 in 1 Printer**	**Refrigerator**	**Induction Cooker**	**TV**	**TV**	**Amplifier**	**Oven**	**Muffle furnace**
Power(W)	**200**	**150**	**400**	**80**	**450**	**450**	**250**	**1500**	**80**	**120**	**350**	**1800**	**3000**
Main building													
Room No.75		**1**											
Research library	**4**					**1**			**1**				
Room No.65		**1**											

Location	**PC**	**Projector**	**Laser Printer**	**Scanner**	**Xerox Machine**	**3 in 1 Printer**	**Refrigerator**	**Induction Cooker**	**TV**	**TV**	**Amplifier**	**Oven**	**Muffle furnace**
Power(W)	**200**	**150**	**400**	**80**	**450**	**450**	**250**	**1500**	**80**	**120**	**350**	**1800**	**3000**
Room No.64						**1**							
Room No.60	**1**						**2**					**2**	**1**
Room No.58		**1**											
Room	**5**		**1**			**1**		**1**					

No.57													
Office	**9**		**6**		**1**								
Room No.48	**1**		**2**										
Room No.45	**30**		**1**	**1**	**1**								
Room No.43		**1**											
Room No.44	**48**	**1**											
Room No.38		**1**										**1**	
Principal						**1**				**1**			

Location	**PC**	**Projector**	**Laser Printer**	**Scanner**	**Xerox Machine**	**3 in 1 Printer**	**Refrigerator**	**Induction Cooker**	**TV**	**TV**	**Amplifier**	**Oven**	**Muffle furnace**
Power(W)	**200**	**150**	**400**	**80**	**450**	**450**	**250**	**1500**	**80**	**120**	**350**	**1800**	**3000**
Room No.32		**1**											
Room No.31	**1**		**1**										
Room No.27							**1**					**1**	
Class room		**1**											
Dept of Maths	**1**		**1**										
Bsc lab							**2**						
Botany classroom		**1**											
Coperative store													

Canteen

							1						
Staff club													
									1				
Library block													

Location	**PC**	**Projector**	**Laser Printer**	**Scanner**	**Xerox Machine**	**3 in 1 Printer**	**Refrigerator**	**Induction Cooker**	**TV**	**TV**	**Amplifier**	**Oven**	**Muffle furnace**
Power(W)	**200**	**150**	**400**	**80**	**450**	**450**	**250**	**1500**	**80**	**120**	**350**	**1800**	**3000**
Childline room	**1**		**1**										
	2												
	41									**1**			
IGNOU Block													
	1						**1**						
Science Block													
Bsc. Che lab 2													
Room No.85		**1**									**1**		
Room No.82			**1**										
Room		**1**											
	141	**9**	**14**	**1**	**2**	**3**	**7**	**1**	**1**	**2**	**1**	**4**	**1**
	28.2	**1.35**	**5.6**	**0.08**	**0.9**	**1.35**	**1.75**	**1.5**	**0.08**	**0.24**	**0.35**	**7.2**	**3**
Total (KW)	**55.30**												

III. AIR CONDITIONER LOADS

TABLE 9: AIR CONDITIONER LOADS

Location	Make	Type	Capacity (Tr)	EER	Star rating	Rated power (W)
Principal		Split	1		3	1000
IQAC	Mitsubishi	Split	1		3	1000
Room No.45	Carrier	Split	1.5		3	1500
Room No.45	Carrier	Split	1.5		3	1500
Room No.44	Voltas	Split	1.5		No star	1500
Room No.44	Voltas	Split	1.5		No star	1500
Library	Voltas	Split	2		3	2200
Library	Voltas	Split	2		3	2200
Library		Split	1		3	1000
Room No.85	Mitsubishi	Split	2	3.33	5	2160
Room No.85	Mitsubishi	Split	2	3.33	5	2160
Room No.85	Mitsubishi	Split	2	3.33	5	2160
Total	19.88kW					

IV. UPS

TABLE 10: UPS DETAILS

Location	Make	KVA	Battery Make/Type/No	Volt/AH
Room No.60		**2**	**Tubular/2**	**12/130**
Room No.57	**Hykon**	**1**	**Exide/Tubular/4**	
Room No.57	**Hykon**	**2**	**Exide/Tubular/4**	
Room No.53	**Supra**	**3**	**Exide/Tubular/4**	**12/100**
Office	**Supra**	**3**	**Exide/Tubular/4**	**12/100**
Room No.45	**Hykon**	**7.5**	**Exide/Tubular/12**	**12/150**
Room No.44	**Supra**	**7.5**	**Exide/Tubular/16**	
Dept. of chemistry	**Supra**	**3**	**Tubular/2**	**12/100**
Bsc. Lab	**Hykon**	**1**	**Tubular/2**	
Library	**Zenster**	**3**	**Tubular/6**	**12/150**
Library	**Supra**	**2**	**Tubular/4**	**12/100**

Digital Library	**Hykon**	**7.5**	**Tubular/15**	**12/100**
Digital Library	**Hykon**	**7.5**		
Arabic dept.	**Zenster**	**1.5**		

ANNEXURE - 2

ENERGY SAVING PROPOSALS - 1

REPLACEMENT OF CEILING FANS WITH ENERGY EFFICIENT BLDC FANS

Background

A BLDC fan takes in AC voltage and internally converts it into DC using SMPS. The main difference between BLDC and ordinary DC fans is the commutation method. A commutation is basically the technique of changing the direction of current in the motor for the rotational movement. In a BLDC motor, as there are no brushes, so the commutation is done by the driving algorithm in the Electronics. The main advantage is that over a period, due to mechanical contact in a brushed motor the commutators can undergo wear and tear, this thing is eliminated in BLDC Motor making the motor more rugged for long-term use. To explain, BLDC technology in simpler terms, BLDC uses a combination of Permanent Magnets and Electronics to achieve the kind of efficiency and performance, it delivers. A BLDC fan composes of 3 main components: - 1. Stator 2. Rotor 3. Electronics

Proposal

Replace the ceiling fans with BLDC in the as per preference of operating hours as office areas., staff rooms and in security cabin and in hostels the calculation for the savings is given in the table. **TABLE 11: EC PROPOSAL 1**

Existing Ceiling Fans	Watts	60
Proposed BLDC Fans	Watts	30
Difference in Wattage	Watts	30
Avg No: of working hours/day	Hrs.	9
No: of working days per year (Average)	Days	250
No: of working hours per annum	Hrs.	2250
Number of Fans operating	Nos	100
Energy Saving per Annum	kWh	6750
Cost per kWh	Rs	6.50
Annual Financial Savings	Rs	43875.00
Cost of BLDC Fans	Rs	3500
Investment for Fans	Rs	350000
Simple Payback period	Months	96

Actual savings and comparison chart with normal, star rated and BLDC fans. Actual savings and simple payback period will be less for BLDC fans.

Type	Power at Various Speeds					
	1	2	3	4	5	Max (M3/Min)
Regular Ceiling Fan	14	25	39	48	76	230
5 Star rated Fan	13	24	30	40	55	210-220
BLDC Fan	3.8	7.7	13.8	22.7	35.8	230
% Variation of BLDC fan with Ceiling fan in power	72.85	69.2	64.62	52.71	52.89	
% Variation of BLDC fan with 5 Star rated fan in power	70.77	67.92	54	43.25	34.91	
Saving in power for Ceiling fan and BLDC	10.2	17.3	25.2	25.3	40.2	
Saving in power for 5 Star rated Ceiling fan and BLDC	9.2	16.3	16.2	17.3	19.2	

ENERGY SAVING PROPOSALS – 2

REPLACEMENT OF FLUORESCENT TUBES WITH ENERGY EFFICIENT LED LIGHTS

At present LED lights are used in very few areas. Replacement of Fluorescent lights to be done in phased manner with LED lights.

TABLE 12: EC PROPOSAL 2

Particulars	Units	T8	T12
Existing Fluorescent lights	Watts	36	40
Proposed LED light	Watts	20	20
Difference in Wattage	Watts	16	20
Avg No: of working hours/day	Hrs	9	9
No: of working days per year (Average)	Nos	250	250
No: of working hours per annum	Hrs	2250	2250
Number of Lights operating for change	Nos	110	12

Energy Saving per Annum	kWh	3,960.00	540.00
Cost per kWh (Average)	Rs	6.50	6.50
Annual Financial Savings	Rs	25,740.00	3,510.00
Cost of LED light	Rs	300	300
Investment for LED lights	Rs	33,000	3,600
Simple Payback period	Months	15	12

SUMMARY

Particulars	Unit	Details
Total Annual energy savings	**kWh**	**4500**
Total Annual Financial savings	**Rs**	**29,250**
Total Investment	**Rs**	**36,600**
Simple payback period	**Months**	**15**

Reason for change in the lighting system

Lighting quality can have a dramatic influence on the attitude and performance of working persons, if they have an environment that with proper uniform lighting.

In addition to the lumens per watt which is a lighting quantity calculation lighting quality and life of lighting system is also to be considered.

Lighting quality can be divided into Uniformity, Glare, Colour rendering Index, coordinated colour temperature.

In case of consistency and in uniformity, the life time of LED is far better than CFL s and FTLs.

Deterioration of lumens or lux level in FTLs and CFL are more as compared with LED which is consistent during in its life time.

Considering VCP (Visual Comfort Probability) LED is better option than FTLs and CFL because the glare value is lesser.

The LED are whitish in colour than FTLs which is giving a better feeling of brightness to the persons occupied or working

CCT of LED is 5000k which is white as compared with lesser CCT for FTLS of 4500 k There is no mercury content in the LED as compared with CFL and FTL s hence it is environmentally supportive.

The life cycle data of tube lights with LED is given in the table below.

TABLE 13: LIFECYCLE DATA OF LIGHT TYPES

`	**Typical life in Hours**	**Cost per lamp**	**No: of lamps required during LED lifetime (led 60,000 Hours)**	**Replacement cost per lamp**	**Approximate maintenance expense for replacement**	**Total cost per lamp**

T12	5000	45	12	540	500	1040
T8	5000	45	12	540	500	1040
T5	5000	100	12	1200	500	1700
LED	60000	800	1	800	0	800

ANNEXURE-3

I. ABBREVIATIONS

AVG : Average
BEE : Bureau of energy efficiency
CO_2 : Carbon dioxide
KSEB : Kerala State Electricity Board.
DB : Distribution Board
EC : Energy Conservation
IEEE : The Institute of electrical and electronics engineers IS : Indian Standard
kL : kilo Liter
KVA : kilo Volt Ampere
kVAh : kilo volt Ampere Hour
kVAr : kilo volt ampere
kW : kilo Watts
kWh : kilo watt hour
LT : Low tension
MAX : Maximum
NSS : National Service Scheme
SLD : Single Line Diagram

II. REFERENCES:

• Handbook on energy audit and environment management by TERI. • Bureau of Energy Efficiency (BEE) books for certification of Energy Auditors & Managers.

I. BEE Accreditation Certificate