

ENERGY AUDIT – 2022-23



SREE NARAYANA GURU COLLEGE

CHELANNUR, KOZHIKODE

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

April 2023

TABLE OF CONTENTS

PREFACE	5
ACKNOWLEDGEMENTS	6
EXECUTIVE SUMMARY	7
I. ENERGY SAVING PROPOSALS:	7
II. AUDIT SUMMARY – ACTIONS	7
III. PRESENT ANNUAL ENERGY CONSUMPTION	8
IV. ENERGY PERFORMANCE INDEX (EPI)	11
V. ANNUAL CARBON FOOTPRINT OF APPLIANCES	12
VI. CARBON FOOT PRINT (PRESENT) ATTAINED BY COLLEGE	13
INTRODUCTION	14
I. ENERGY AUDIT	14
II. SREE NARAYANA GURU COLLEGE, CHELANNUR	15
III. GENERAL DETAILS	17
IV. CONNECTED LOAD BALANCE- ELECTRICAL	18
ENERGY & UTILITY DESCRIPTION	20
I. SINGLE LINE DIAGRAM – ELECTRICAL	20
II. SINGLE LINE DIAGRAM – WATER	21
ENERGY ANALYSIS	22
I. ELECTRICITY CONSUMPTION ANALYSIS	22
I. DESCRIPTION OF ELECTRICITY BILL	22
II. TARIFF RATES ANALYSIS	23
III. SPECIFIC ELECTRICITY CONSUMPTION	26
IV. UNINTERRUPTIBLE POWER SUPPLY (UPS)	27
II. LPG CONSUMPTION ANALYSIS	28
III. WOOD CONSUMPTION ANALYSIS	28
MEASURED DATA	29
DIESEL GENERATOR	30
RENEWABLE ENERGY INTEGRATION	31
I. GENERAL REQUIREMENT FOR ROOF TOP SOLAR PV PLANT INSTALLATION	31
II. CALCULATION	32
ANNEXURE – 1	33
I. ENERGY SAVING PROPOSAL - 1	33
ANNEXURE 2	34
CONNECTED ELECTRICAL LOADS	34
ANNEXURE-3	36
I. ABBREVIATIONS	36



II. REFERENCES:	36
III. CERTIFICATES	37

LIST OF TABLES

TABLE 1: EXECUTIVE SUMMARY –ENERGY.....	7
TABLE 2: ENERGY AUDIT SUMMARY – ACTIONS.....	7
TABLE 3: PRESENT ANNUAL ENERGY CONSUMPTION-COLLEGE	8
TABLE 4: PRESENT ANNUAL ENERGY CONSUMPTION-LADIES HOSTEL.....	9
TABLE 5: PRESENT ANNUAL ENERGY CONSUMPTION-CANTEEN	10
TABLE 6: PRESENT ANNUAL ENERGY CONSUMPTION- SPORTS HOSTEL & PUMP HOUSE.....	10
TABLE 7: ENERGY PERFORMANCE INDEX.....	11
TABLE 8 CARBON FOOT PRINT.....	13
TABLE 9: GENERAL DETAILS	17
TABLE 10: KSEB BILL ANALYSIS	22
TABLE 11: SPECIFIC ELECTRICITY CONSUMPTION	26
TABLE 12: UPS DETAILS.....	27
TABLE 13: ANNUAL LPG CONSUMPTION.....	28
TABLE 14: ANNUAL WOOD CONSUMPTION.....	28
TABLE 15: MEASURED DATA.....	29
TABLE 16 DG DETAILS.....	30
TABLE 17: RENEWABLE ENERGY INTEGRATION	32
TABLE 18: EC PROPOSAL 1.....	33
TABLE 19: LIGHT AND FAN LOADS – COLLEGE.....	34
TABLE 20: COMPUTER AND OTHER EQUIPMENT – COLLEGE.....	34
TABLE 21: LOAD MATRIX-PUMP HOUSE.....	35
TABLE 22: LOAD MATRIX-LADIES HOSTEL.....	35
TABLE 23: LOAD MATRIX-CANTEEN	35
TABLE 24: LOAD MATRIX-SPORTS HOSTEL.....	35

LIST OF FIGURES

FIGURE 1: ANNUAL ENERGY CONSUMPTION – COLLEGE.....	8
FIGURE 2: ANNUAL ENERGY CONSUMPTION – HOSTEL	9
FIGURE 3: ANNUAL ENERGY CONSUMPTION – CANTEEN.....	10
FIGURE 4: ANNUAL CO₂ EMISSION	12
FIGURE 5: COLLEGE LAYOUT	16
FIGURE 6: CONNECTED LOAD BALANCE-COLLEGE	18
FIGURE 7: CONNECTED LOAD BALANCE-HOSTEL.....	18
FIGURE 8: CONNECTED LOAD BALANCE-CANTEEN	19
FIGURE 9: SINGLE LINE DIAGRAM – ELECTRICAL	20
FIGURE 10: SINGLE LINE DIAGRAM - WATER.....	21
FIGURE 11: TARIFF RATE ANALYSIS - COLLEGE.....	23
FIGURE 12: TARIFF RATE ANALYSIS - HOSTEL.....	23
FIGURE 13: TARIFF RATE ANALYSIS – PUMP HOUSE.....	24
FIGURE 14: TARIFF RATE ANALYSIS – CANTEEN.....	24
FIGURE 15: TARIFF RATE ANALYSIS – SPORTS HOSTEL (779).....	25
FIGURE 16: TARIFF RATE ANALYSIS – SPORTS HOSTEL 922).....	25
FIGURE 17: SPECIFIC ELECTRICITY CONSUMPTION (KWH/STUDENTS)	26
FIGURE 18: SPECIFIC ELECTRICITY CONSUMPTION (KWH/AREA).....	27
FIGURE 19 SOLAR POWER PLANT IN THE COLLEGE.....	32



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 Sree Narayana Guru College, Chelannur 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. Kumar S.P | Principal |
| 2 | P.M Raveendran | S.N Trust Executive member |

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

ENERGY AUDIT TEAM

- | | | |
|---|-----------------|---|
| 1 | Mr. Santhosh A | Accredited Energy Auditor No – AEA 0275 |
| 2 | Ms. Keerthana K | Project Engineer, B Tech – Electrical Engineering |



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 (49+25 nos) ceiling fan (60W) with BLDC (28W)	3830	29,002	2,59,000	107
	Total	3830	29,002	2,59,000	107
3	Installation of 05 kW Solar PV system		43,920	2,75,000	6 (years)

II. 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 , Hostel	Change the existing old ceiling fans with BLDC fans	Power Consumption will get reduced
2	Sanctioned Load enhancement		Sanctioned load needs to be enhanced to 30 kW for college and 2 kW for Canteen	Total connected load at college were observed as 26.97 kW for college and 1.45 kW for canteen

III. PRESENT ANNUAL ENERGY CONSUMPTION

The present annual energy consumption has been analysed in table below

➤ **COLLEGE**

TABLE 3: PRESENT ANNUAL ENERGY CONSUMPTION-COLLEGE

Particulars	Unit	Quantity	Gross calorific value (kCal)	Million kCal (Toe)	Percentage of distribution (%)
Electricity (KSEBL)	kWh	19139	860	1.65	96
LPG (approx.)	Kg	66	10500	0.07	4
Total				1.72	100

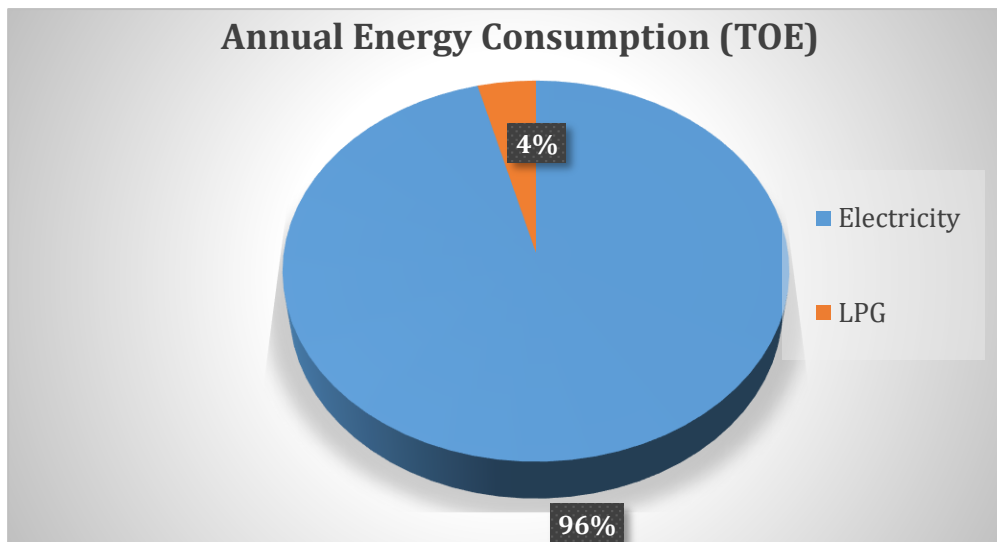


FIGURE 1: ANNUAL ENERGY CONSUMPTION - COLLEGE

➤ **LADIES HOSTEL**

TABLE 4: PRESENT ANNUAL ENERGY CONSUMPTION-LADIES HOSTEL

Particulars	Unit	Quantity	Gross calorific value (kCal)	Million kCal (Toe)	Percentage of distribution (%)
Electricity (KSEBL)	kWh	9902	860	0.85	42
LPG (approx.)	Kg	556.5	10500	0.58	29
Wood	Kg	1750	3500	0.61	30
Total				2.05	100

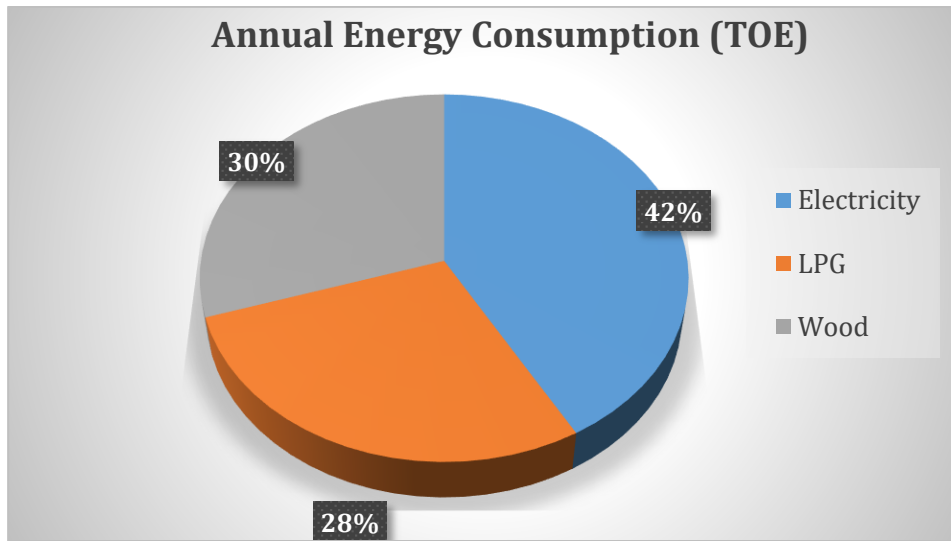


FIGURE 2: ANNUAL ENERGY CONSUMPTION - HOSTEL

➤ **CANTEEN**

TABLE 5: PRESENT ANNUAL ENERGY CONSUMPTION-CANTEEN

Particulars	Unit	Quantity	Gross calorific value (kCal)	Million kCal (Toe)	Percentage of distribution (%)
Electricity (KSEBL)	kWh	1249	860	0.11	19
LPG (approx.)	kg	445.2	10500	0.47	81
Total				0.57	100

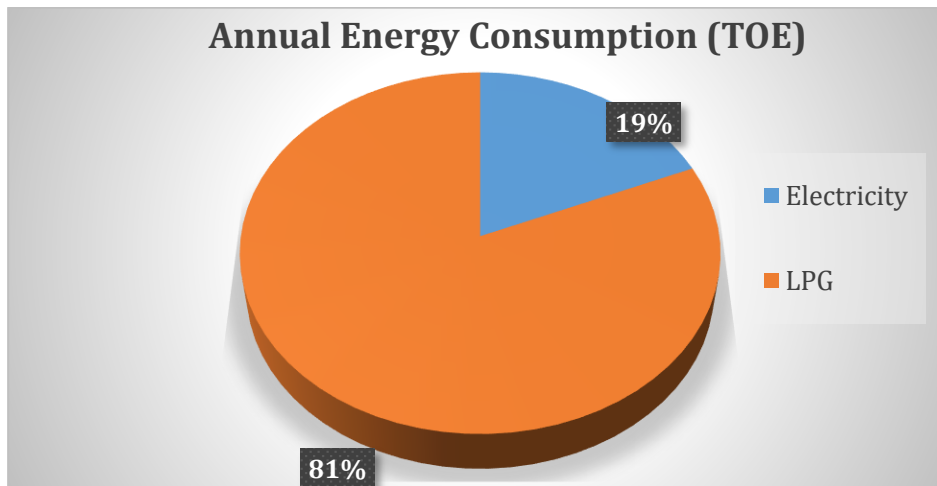


FIGURE 3: ANNUAL ENERGY CONSUMPTION - CANTEEN

➤ **SPORTS HOSTEL & PUMP HOUSE**

TABLE 6: PRESENT ANNUAL ENERGY CONSUMPTION- SPORTS HOSTEL & PUMP HOUSE

Electricity (KSEBL)	Unit	Quantity	Gross calorific value (kCal)	Million kCal (Toe)	Percentage of distribution (%)
Pump House	kWh	543	860	0.05	18
Sports Hostel (922)	kWh	1886	860	0.16	61
Sports Hostel (779)	kWh	638	860	0.05	21
Total				0.26	100



IV. ENERGY PERFORMANCE INDEX (EPI)

EPI was based on the energy consumption in Mar 2022 - Feb 2023. The projected energy consumption after the implementation of energy saving proposals in the college is given in the table below.

TABLE 7: ENERGY PERFORMANCE INDEX

Energy Performance	Unit	Present Consumption	Projection
Annual Electricity Consumption	kWh	19139	17069
Annual LPG Consumption	kg	66	66
Energy Performance Index	TOE/m ²	0.00025	0.00022
Specific Energy Consumption	TOE/Head	0.00132	0.00118
Annual Energy Cost	Rs/Year	132,087	130,505
Carbon Footprint - Electricity	Ton CO ₂	15.12	13.48
Carbon Footprint - LPG	Ton CO ₂	0.20	0.20
Annual Carbon Footprint	Ton CO ₂	15.32	13.68
Specific Carbon Footprint - Annual	Ton CO ₂ /Head	0.0118	0.0105
% of reduction in energy consumption in cost and carbon foot print by projected	%		11

Note: Unit conversions:

TOE	=	10 million kCal (BEE energy audit manual)
MWh of electricity	=	0.79 Ton of CO ₂ (www.cea.gov.in)
Ton of LPG	=	2.99 Ton of CO ₂ (www.cea.gov.in)
Kg of LPG	=	10500 kCal (BEE energy audit manual)
kWh of electricity	=	860 kCal (BEE energy audit manual)

V. ANNUAL CARBON FOOTPRINT OF APPLIANCES

The present carbon dioxide generation by old ceiling fan in the college and the hostel and the projected value after the implementation of the energy conservation measures ie; the implementation of the BLDC fans is given in the figure below

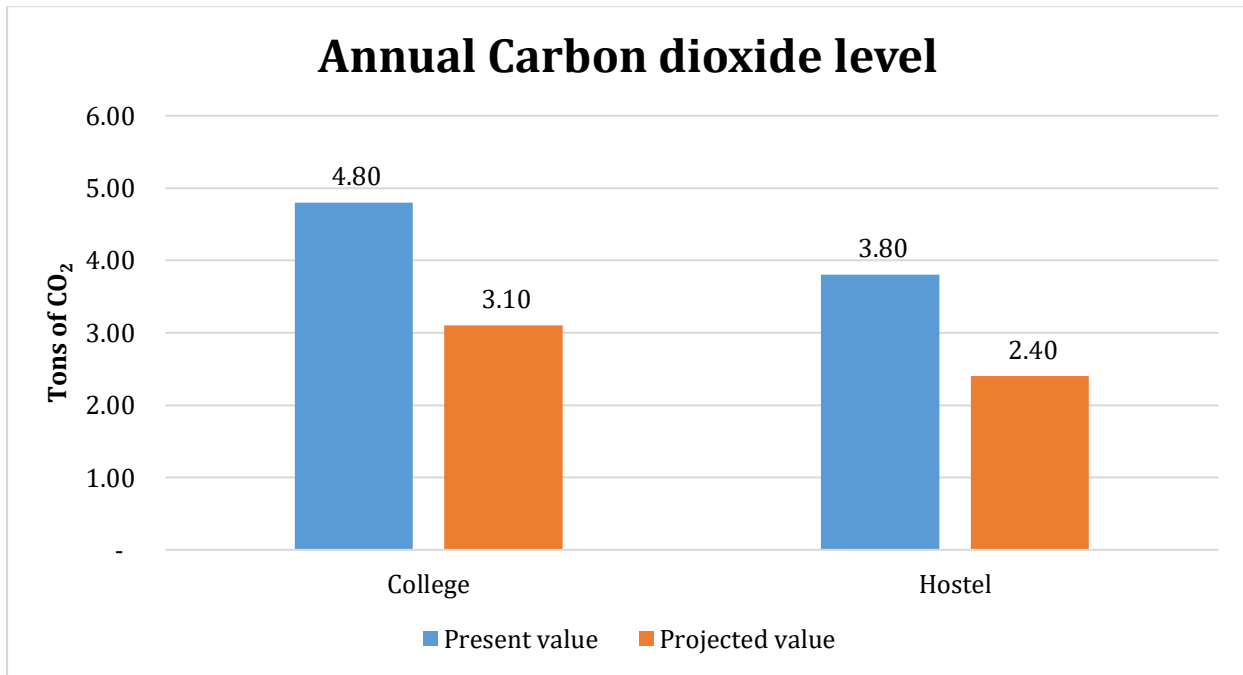


FIGURE 4: ANNUAL CO₂ EMISSION

VI. CARBON FOOT PRINT (PRESENT) ATTAINED BY COLLEGE

Carbon foot print is often used as short hand for the amount of carbon emission (usually in Tones) being emitted by an activity or by organization this is an important component in ecological foot print or the depicting the biological space reduction in the earth. Various environment protection and energy conservation connected with carbon footprint. The college took its accountability to protect nature and taken few steps for the carbon neutral campus

1. Protecting and conserving trees inside and outside the campus through various students' activities
2. Replacement of old CFLs and tubes with energy efficient LED lights
3. Sustainable construction of buildings for natural ventilation and light in the classrooms and laboratories.

TABLE 8 CARBON FOOT PRINT

Particulars	Energy consumption reduction (kWh)	Carbon Emission reduction(Tons)	% of total
Replacement of 152 numbers of T12 Tube (40 W) with LED tube light	2675	2.11	32
Replacement of 63 number of CFL (18 W) with 9 W LED	499	0.39	6
Installation of solar power plant of 3KWp in the college	3600	2.83	42
Natural ventilation in the college building reduced the usage of ceiling fan in the class room.	1200	0.95	14
Natural lighting in the classs rooms reduces the usage of lighting in the class rooms	500	0.39	6
Total	8474	6.67	

Note: Carbon sequestration of trees in the college campus is not calculated.

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. 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.

II. SREE NARAYANA GURU COLLEGE, CHELANNUR

Sree Narayana Guru College, Chelannur, is situated at the foot of the towering Kalari Hills, in a quiet village about 14 kilometres in the north-east direction from Kozhikode. The college has a serene and extensive campus of about 67 acres, by the side of Kozhikode-Balusser Road, noted for its scenic beauty and blessed with the natural spring water fountain in the south-east location.

The foundation stone of the college building was laid in February 1968 by Dr. T. Balakrishnan. The formal inauguration of the commencement of classes took place in June 1968 with Sri. R. Sankar, the Founder Secretary of the S.N. Trusts engaging the first-Pre-Degree class. In 1975, with the beginning of under graduate courses in Botany and Commerce, the college was elevated to the status of a degree college. It became a venue for Post Graduate Studies with the commencement of M. Com degree course in 1995 and MA (English) Degree course in 1999. Recently in 2021 the 4th PG course Msc Biology course with specialization Genetics, Biomechanics, Biomedicine, Genomics, and Green Biology was started. In March 2007, the college was accredited by the NAAC at the level of B+ grade and re- accredited by the NAAC at the level of B++ grade in October 2016.

At present the college is one of the prestigious institutions of higher learning run by S.N. Trusts, Kollam. It is managed by the executive committee of the S.N. Trusts with Sri.Vellappally Natesan as the manager. The Regional Development Committee, Calicut, assists the Trusts in the management and developmental activities of the college. The Principal is the Ex-officio member of the Regional Development Committee.

Motto

- Enlightenment Through Education

Mission

- To promote tolerance, secularism, communal harmony and democratic spirit among the youth.
- To create morally responsible citizens.
- To expel the darkness of ignorance by lighting the lamp of wisdom.
- To promote higher education among the economically weak and socially backward sections of society, irrespective of caste and creed.

Vision

To create a democratic society, ensuring all round development of students through education, irrespective of their caste, class or creed, following the preaching of Sree Narayana Guru- Enlightenment through Education.



FIGURE 5: COLLEGE LAYOUT

III. GENERAL DETAILS

The general details of the College are given below.

TABLE 9: GENERAL DETAILS

Sl.No:	Particulars	Details
1	Name of the College	Sree Narayana Guru College, Chelannur
2	Address	Sree Narayana Guru College, Kozhikode Balussery Rd, Chelannur, Kozhikode, Kerala 673616
3	Contact Person	Dr. Anusmitha, Ph: 9961777677
4	E-mail ID	sngcollege2007@yahoo.com
5	Website Details	www.sngcollegechelannur.edu.in
6	No: of Shifts	01
7	No: of students	1235
8	No: of teaching staffs	33+17
9	No: of non-teaching staffs	18
10	Total campus area	67 acres
11	Total built up area(m ²)	6927

IV. CONNECTED LOAD BALANCE- ELECTRICAL

Load balance among the connected loads in the college is given in the figure below. The detailed connected load details are given in Annexure 2

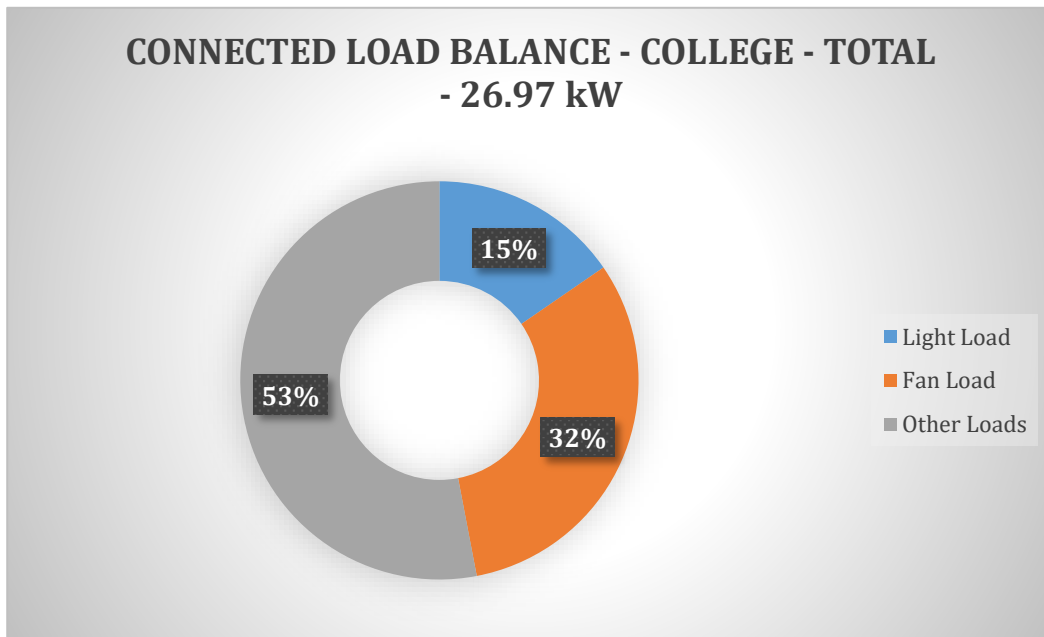


FIGURE 6: CONNECTED LOAD BALANCE-COLLEGE

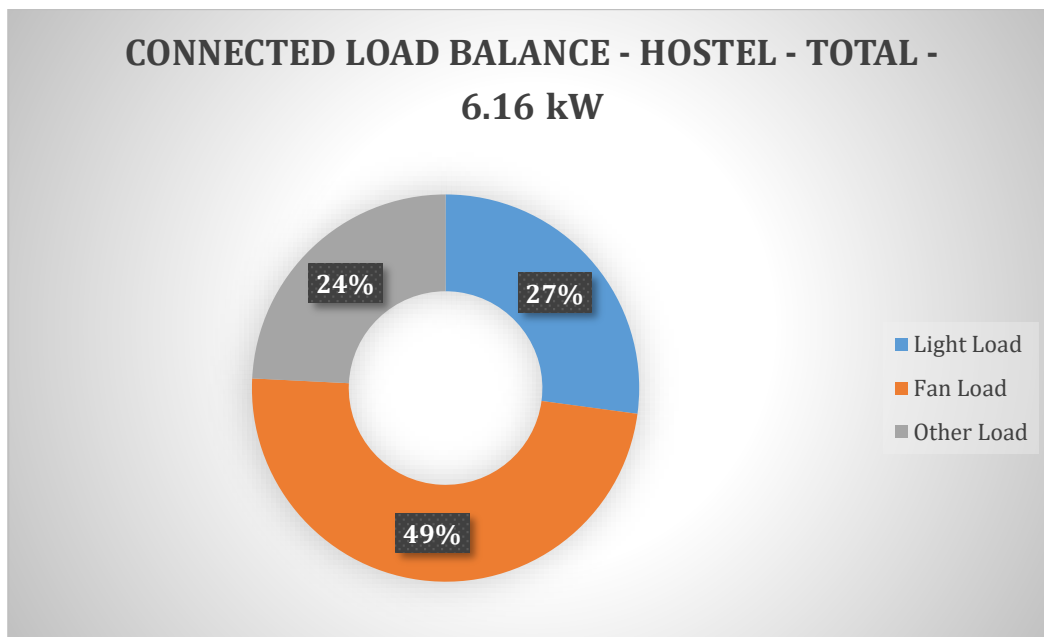


FIGURE 7: CONNECTED LOAD BALANCE-HOSTEL

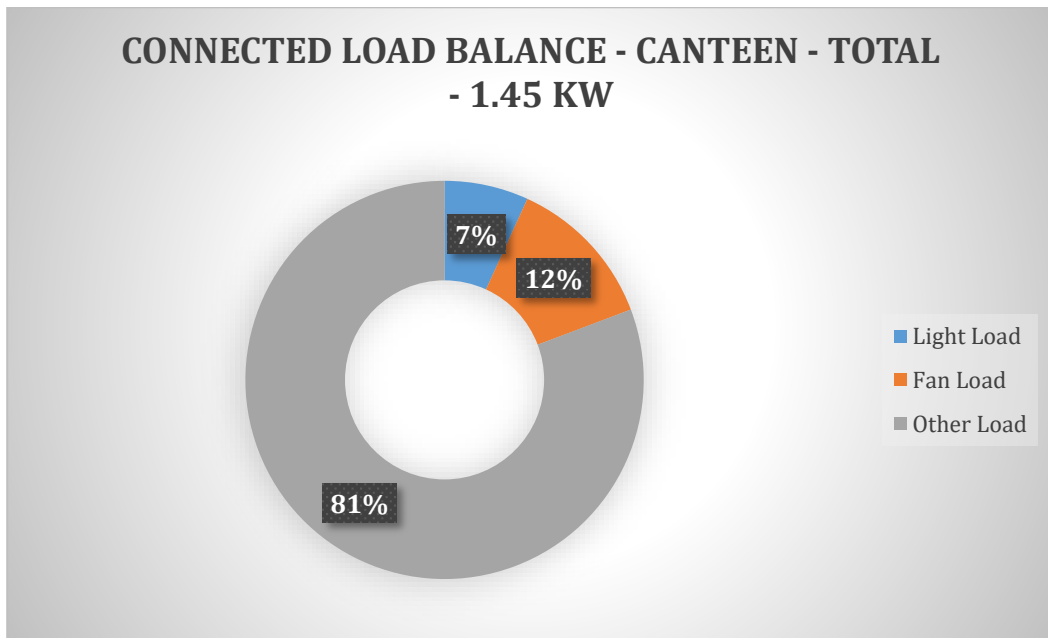


FIGURE 8: CONNECTED LOAD BALANCE-CANTEEN

ENERGY & UTILITY DESCRIPTION

In this section the single line diagrams of electricity and water are given which provides an overview of the energy and water flow in the college

I. SINGLE LINE DIAGRAM – ELECTRICAL

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

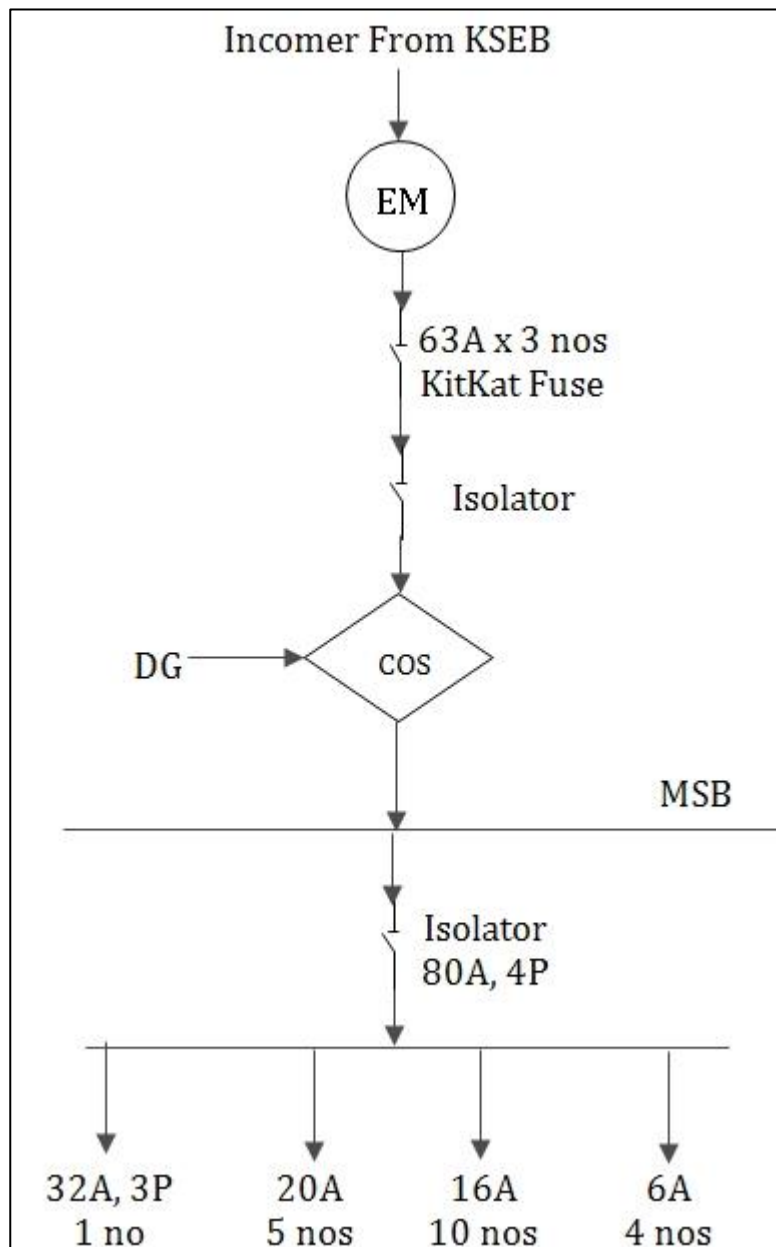


FIGURE 9: SINGLE LINE DIAGRAM – ELECTRICAL



II. SINGLE LINE DIAGRAM – WATER

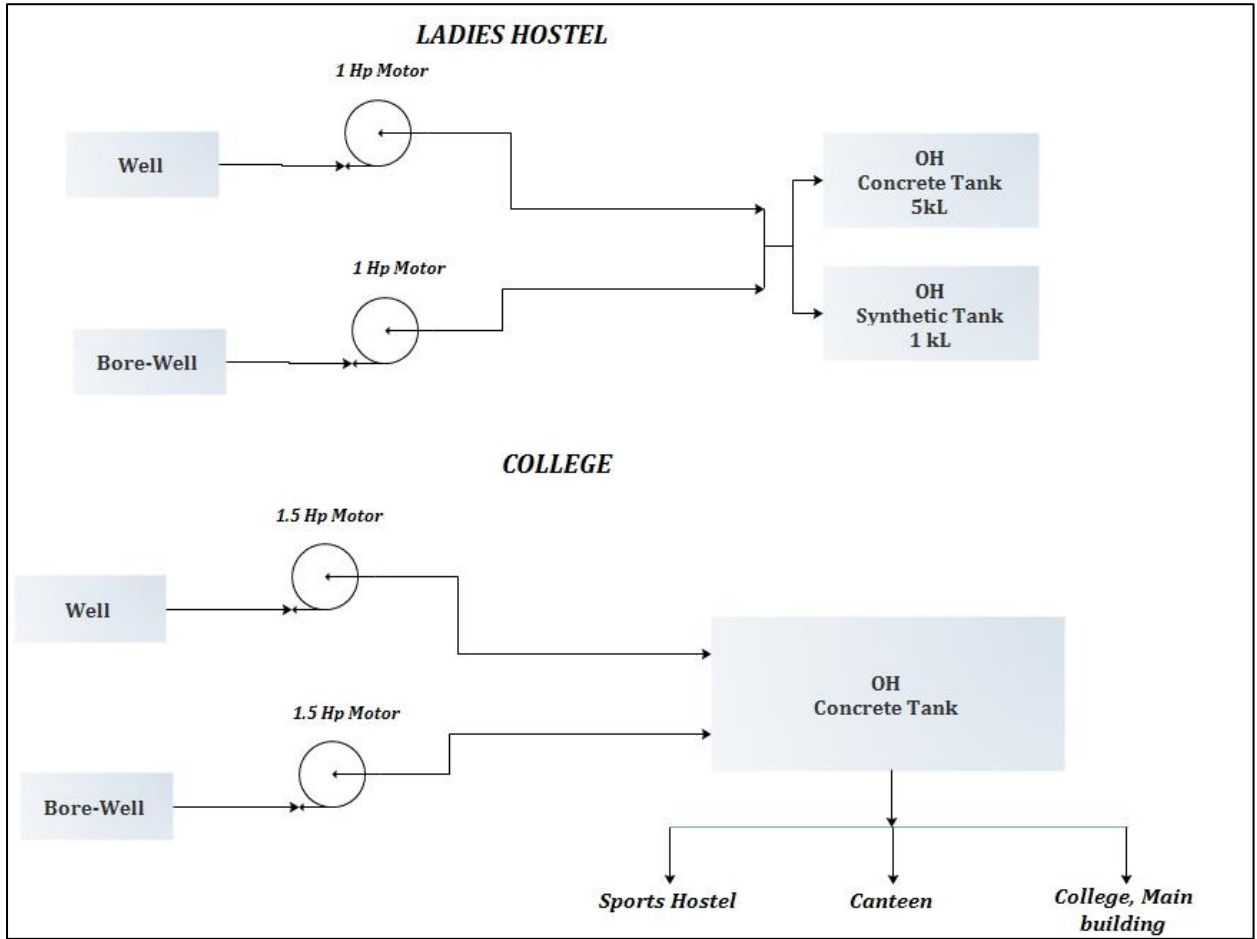


FIGURE 10: SINGLE LINE DIAGRAM - WATER

ENERGY ANALYSIS

The different type's energy usage is given in this section. The major source of energy to the college is electricity. The other energy sources are LPG, and wood for which the pattern of consumption described below.

I. ELECTRICITY CONSUMPTION ANALYSIS

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

I. DESCRIPTION OF ELECTRICITY BILL

Base line data given below is based on the Electricity bill provided by the electricity supplier to the College.

TABLE 10: KSEB BILL ANALYSIS

Particulars	College	Ladies Hostel	Pump House	Canteen	Sports Hostel	
Consumer No	1167444008534	1167444014532	1167446000199	1167444009777	1167440009779	1167445009922
Electrical section	Chelannur	Chelannur	Chelannur	Chelannur	Chelannur	Chelannur
Approved connected Load	26.98	10.56	5.85	1.00	0.60	1.04
Measured connected load	26.97	6.16	2.24	1.45	0.42	
Tariff	LT-6A/Three	LT-6B/Three	LT-6A/Three	LT-7A/Single	LT-6A/Single	LT-6A/Single
Average monthly consumption (kWh)	1595	825	91	104	53	157
Average monthly electricity charges (Rs)	13525	7417	715	873	420	1298

II. TARIFF RATES ANALYSIS

The average monthly energy and demand charges for the period Mar 2022 - Feb 2023 is represented in Fig.

➤ College

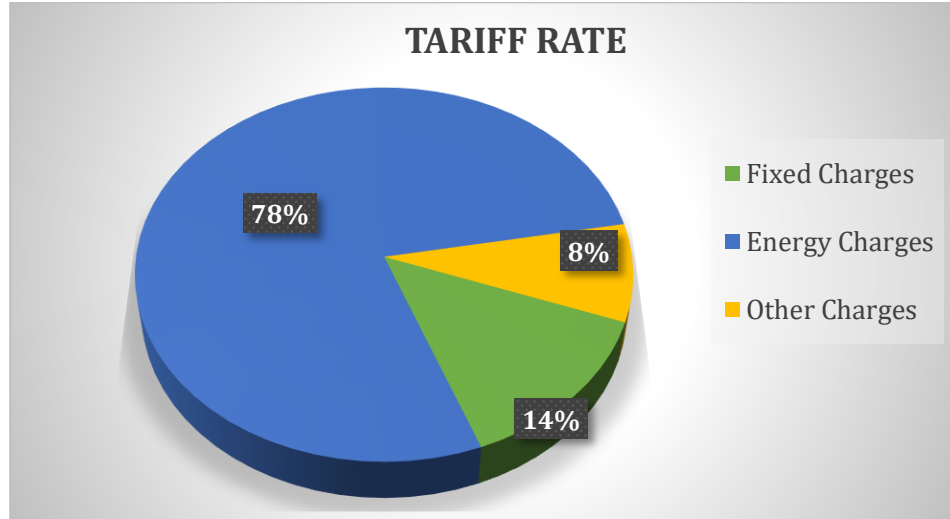


FIGURE 11: TARIFF RATE ANALYSIS - COLLEGE

Inference

- i. Revised average fixed charges from June 2022 was Rs 1,890/ per month
- ii. The total energy charges during the past one year were Rs 1,26,443 /-

➤ Hostel

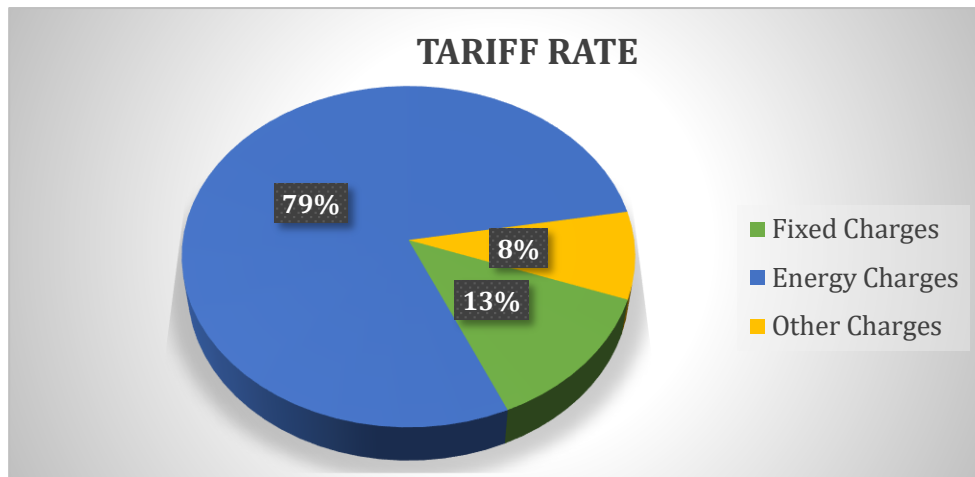


FIGURE 12: TARIFF RATE ANALYSIS - HOSTEL

Inference

- i. Revised average fixed charges from June 2022 was Rs. 990/-monthly
- ii. The total energy charges during past one year were Rs. 70,168/-

➤ **Pump House**

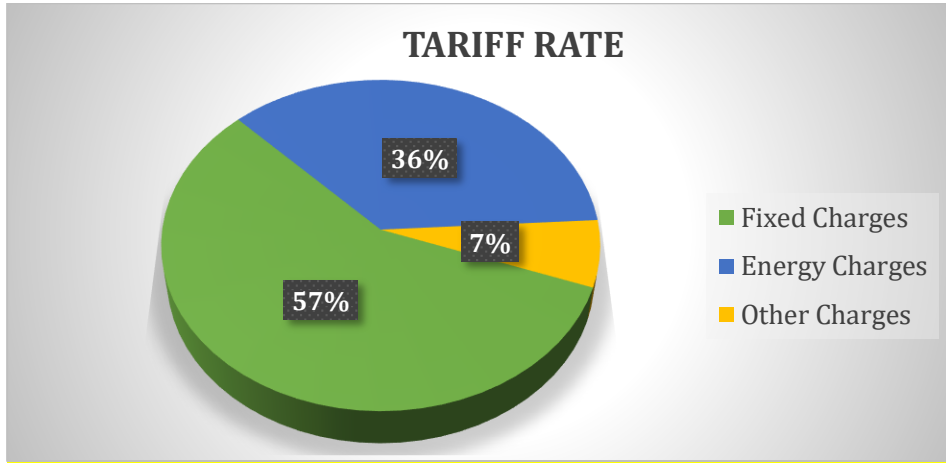


FIGURE 13: TARIFF RATE ANALYSIS – PUMP HOUSE

Inference

- i. Revised average fixed charges from June 2022 was Rs. 840/- bi-monthly.
- ii. The total energy charges during past one year were Rs. 3116/- bi-monthly
- iii. Fixed charge is greater than the energy charge about 21%.

➤ **Canteen**

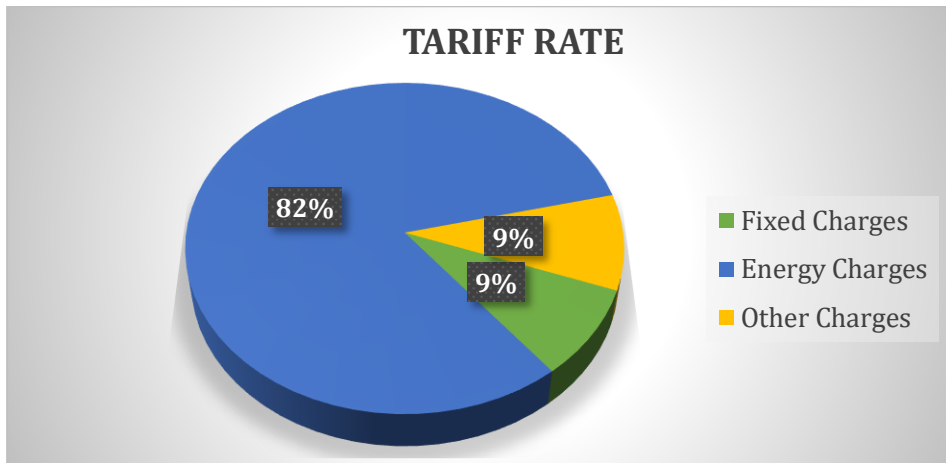


FIGURE 14: TARIFF RATE ANALYSIS – CANTEEN

Inference

- i. Revised average fixed charges from June 2022 was Rs. 160/- bi-monthly.
- ii. The total energy charges during past one year were Rs. 8,588/- bi-monthly

➤ **Sports Hostel (779)**

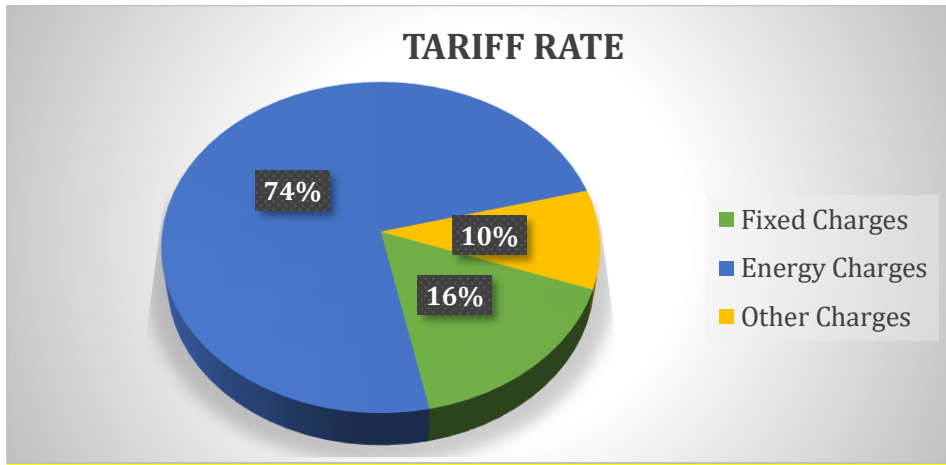


FIGURE 15: TARIFF RATE ANALYSIS – SPORTS HOSTEL (779)

Inference

- i. Revised average fixed charges from June 2022 was Rs. 140/- bi-monthly.
- ii. The total energy charges during past one year were Rs. 3,740/- bi-monthly

➤ **Sports Hostel (922)**

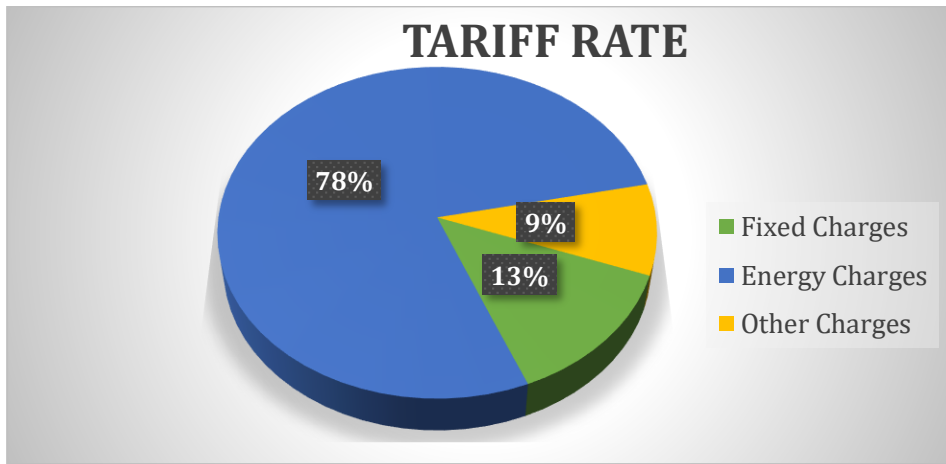


FIGURE 16: TARIFF RATE ANALYSIS – SPORTS HOSTEL 922)

Inference

- i. Revised average fixed charges from June 2022 was Rs. 360/- bi-monthly.
- ii. The total energy charges during past one year were Rs. 12136/- bi-monthly

III. SPECIFIC ELECTRICITY CONSUMPTION

The electricity consumption from Mar 2022 - Feb 2023 has been taken for the benchmarking. Here the comparison is done with electricity consumption and the number of students and building area. The below table shows the specific electricity consumption of the college.

TABLE 11: SPECIFIC ELECTRICITY CONSUMPTION

Month	Electricity Consumption kWh	Number of Students Number	Building Area m ²	SEC kWh/Student	SEC kWh/ m ²
Mar-22	1820	1235	6927	1.47	0.26
Apr-22	1324	1235	6927	1.07	0.19
May-22	994	1235	6927	0.80	0.14
Jun-22	1755	1235	6927	1.42	0.25
Jul-22	1329	1235	6927	1.08	0.19
Aug-22	1493	1235	6927	1.21	0.22
Sep-22	1391	1235	6927	1.13	0.20
Oct-22	1731	1235	6927	1.40	0.25
Nov-22	1596	1235	6927	1.29	0.23
Dec-22	1844	1235	6927	1.49	0.27
Jan-23	1860	1235	6927	1.51	0.27
Feb-23	2002	1235	6927	1.62	0.29
Average	1594.9	1235	6927	1.29	0.23
Annual Specific Electricity consumption				15.5	2.8
Annual Electricity Consumption(kWh)				19139	

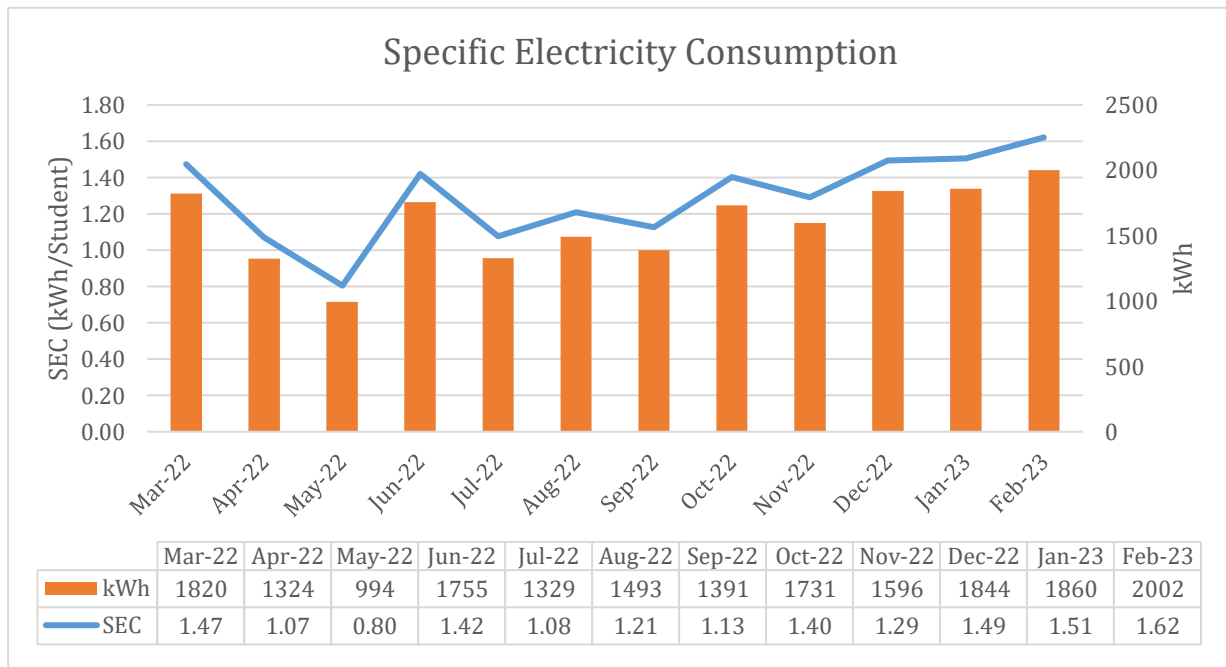


FIGURE 17: SPECIFIC ELECTRICITY CONSUMPTION (kWh/STUDENTS)

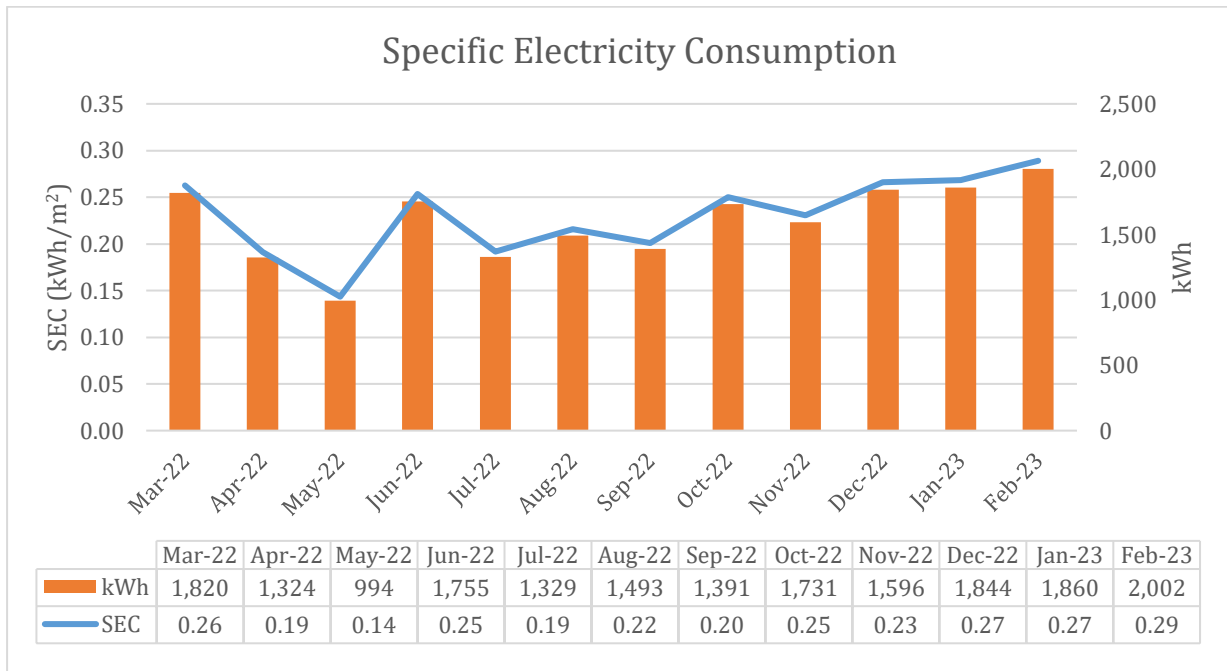


FIGURE 18: SPECIFIC ELECTRICITY CONSUMPTION (kWh/AREA)

IV. UNINTERRUPTIBLE POWER SUPPLY (UPS)

UPS are provided at different building for labs and office. Details of the UPS are given below:

TABLE 12: UPS DETAILS

Block	Floor	Room No	Location	UPS Details		Battery Details	
				Rated Power(kVA)	Make	Make/Type/Nos	Volt/A h
College	Ground	2	Office	3	Safe Power	Safe power/Tubular/4	12/110
		7	Computer Lab	5	Supra	Supra/Tubular/5	12/80

- Suggestions**
- i. Proper ventilation should be provided for UPS and batteries.
 - ii. UPS room should be kept neat and clean.
 - iii. Petroleum jelly should be applied to the battery terminals for better life.

II. LPG CONSUMPTION ANALYSIS

The LPG is used in canteen, Lab's and college hostel. The details of the LPG consumption in the last academic year are given in the table below.

TABLE 13: ANNUAL LPG CONSUMPTION

Sl.No	Particulars	Annual consumption (kg)	Calorific value (TOE)
1	Biology Lab	19	0.020
2	Botany Lab	19	0.020
3	Chemistry Lab	28.4	0.030
4	Hostel	556.5	0.584
5	Canteen	445.2	0.467
Total		1068.1	1.122

III. WOOD CONSUMPTION ANALYSIS

The wood is used in college hostel for cooking purpose. The details of the wood consumption in the last academic year are given in the table below.

TABLE 14: ANNUAL WOOD CONSUMPTION

Sl.No	Particulars	Annual consumption (kg)	Calorific value (TOE)
1	Ladies Hostel	1750	0.613
Total		1750	0.613

MEASURED DATA

The measured parameters which we taken at the audit period at the college energy meter is tabulated below:

TABLE 15: MEASURED DATA

Parameters Checked	Test Point	Readings Recorded	Normal Range at the branch
Voltage at incoming Panel (V)	L1-L2:	416	322 to 440
	L2-L3:	417	322 to 440
	L1-L3:	384	322 to 440
	L1-N:	240.1	186 to 254
	L2- N	240.5	186 to 254
	L3-N:	221.6	186 to 254
	N-E:	1.2	06 V at the farthest load point.
Current Reading at incoming Panel (I)	L1:	6.6	
	L2:	6.95	
	L3:	26.123	
	N:	19.35	
Power Consumed per phase (kW)	L1:	1.58	
	L2:	1.67	
	L3:	5.78	
Frequency of supply (Hz)	L-N:	50	47.5 to 50.5

DIESEL GENERATOR

Diesel generator used in the college as backup supply. The following table gives the basic details of diesel generator in the facility.

TABLE 16 DG DETAILS

Sl. No	Generator Details			Engine Details		
	Rated kVA	Make	Serial No	Rated kW	Make	Serial No
1	20	Cumins	G278869	16	Cumins	D21626

Inference & Suggestions | *I. The diesel consumption for DG is not recorded properly. A log book to monitor the diesel consumption (L) and unit consumption(kWh) shall be maintained and record it after its running.*

RENEWABLE ENERGY INTEGRATION

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 humankind will again depend upon the sun as dominant energy source. We are aware that fossil fuels are not going to last forever. Of the numerous renewable sources of energy known to mankind, Solar Photo Voltaic or SPV is one that has the potential to supply power for our future needs. The advantages of solar power are:

- 1) The solar energy is more evenly distributed in the world than wind or biomass.
- 2) It is well proven and demonstrated technology
- 3) It promises to be most cost-effective renewable power at high volumes.

I. GENERAL REQUIREMENT FOR ROOF TOP SOLAR PV PLANT INSTALLATION

Space Requirement for Panel Mounting:

A minimum shadow free space of 10 m² is required for the solar panel mounting for the capacity of 1kW. The panel must be mounted facing south with appropriate inclination for maximum output from installation. Suitable structure according to wind speed and roof structure must be used without shading the panel surface.

Solar PV modules and Inverter:

Solar PV panels of 300 W or above must be selected for the rooftop installation above 10kW. The efficiency of individual panel must not be less than 16%.

String inverter with MPPT charge controllers is more suitable for the solar power plant installation in roof top. Equipment and installation must be complied with CEA grid regulations-2013.

Location:

Open terrace on roof top is available in the main building of the college and main premises approximately around 1348.4 m² area.

II. CALCULATION

On grid system of 05 kW can be installed in this location without any shades.

TABLE 17: RENEWABLE ENERGY INTEGRATION

Particular	Units	Value
Proposed system	kW	5
Estimated generation capability @4 kWh/m ² /day	kWh/day	20
Estimated annual unit generation @ 300 days per annum	kWh/Year	6,000
Annual cost savings @ Rs 7.32 Rs/unit	Rs/Year	43,920
Total expenses with GRID tied solar PV system (5 kWp)	Rs	275,000
Payback period	Years	6



Figure 19 SOLAR POWER PLANT IN THE COLLEGE

ANNEXURE - 1

I. ENERGY SAVING PROPOSAL - 1

REPLACEMENT OF CEILING FANS IN THE OFFICE 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, classrooms and in hostels the calculation for the savings is given in the table.

TABLE 18: EC PROPOSAL 1

Particulars	Units	Replacement with BLDC fan	
		College	Hostel
Existing Ceiling Fans	Watts	60	60
Proposed BLDC Fans	Watts	28	28
Difference in Wattage	Watts	32	32
Avg No: of working hours/day	Hrs.	6	10
No: of working days per year (Average)	Days	220	220
Number of Fans operating	Nos	49	25
Energy Saving per Annum	kWh/annum	2,070	1,760
Cost per kWh	Rs/kWh	7.32	7.87
Annual Financial Savings	Rs/annum	15,151	13,851
Cost of BLDC Fans	Rs/no	3,500	3,500
Investment for Fans	Rs	171,500	87,500
Simple Payback period	Months	136	76
SUMMARY			
Annual unit savings	kWh/annum	3,830	
Total savings	Rs/annum	29,002	
Total investment	Rs	259,000	
Payback period	Months	107	

ANNEXURE 2

CONNECTED ELECTRICAL LOADS

I. COLLEGE

➤ Light and Fan load

TABLE 19: LIGHT AND FAN LOADS - COLLEGE

Particulars	Ceiling Fan	Wall Fan	Pedestal Fan	Exhaust Fan	T12	T8	T5	LED Tube Light	LED	CFL	LED
Watts	60	60	60	30	40	36	28	20	9	11	18
Nos	109	27	5	2	2	37	6	111	28	6	2
Total (W)	6540	1620	300	60	80	1332	168	2220	252	66	36
Net total (W)	12674										

➤ Computer and Other Equipment

TABLE 20: COMPUTER AND OTHER EQUIPMENT - COLLEGE

Particulars	PC	LCD Monitor	Printer	3 In 1	Xerox	Scanner	Fridge	Projector	Water purifier	Freezer	Laminar Air Flow
Watts	120	85	120	300	600	80	150	80	120	120	300
Nos	54	1	4	14	2	1	5	6	1	1	1
Total (W)	6480	85	480	4200	1200	80	750	480	120	120	300
Net total (W)	44925										

**II. PUMP HOUSE**

TABLE 21: LOAD MATRIX-PUMP HOUSE

Particulars	Motor
Watts	1119
Nos	2
Total (W)	2238
Net total (W)	2238

III. LADIES HOSTEL

TABLE 22: LOAD MATRIX-LADIES HOSTEL

Particulars	Ceiling Fan	T8	LED Tube Light	LED	Motor
Watts	60	36	20	9	746
Nos	50	21	35	24	2
Total (W)	3000	756	700	216	1492
Net total (W)	6164				

IV. CANTEEN

TABLE 23: LOAD MATRIX-CANTEEN

Particulars	Ceiling Fan	Wall Fan	LED	Fridge	Mixi	Freezer
Watts	60	60	9	150	750	120
Nos	2	1	11	2	1	1
Total (W)	120	60	99	300	750	120
Net Total(W)	1449					

V. SPORTS HOSTEL

TABLE 24: LOAD MATRIX-SPORTS HOSTEL

Particulars	Ceiling Fan	LED Tube Light
Watts	60	20
Nos	5	6
Total (W)	300	120
Net Total(W)*	420	

* Gymnasium was not accessible during audit time, so the load is not considered

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
KSEBL	:	Kerala State Electricity Board Limited
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.



III. CERTIFICATES


I. BEE Accreditation Certificate



BUREAU OF ENERGY EFFICIENCY

Examination Registration No.: **EA- 7597**

Accreditation Registration No.: **AEA-0275**



Certificate of Accreditation

This is to certify that Mr./Ms..... **Santhosh. A**having its trade/registered office at **Kerala** has been given accreditation as accredited energy auditor. The certificate shall be effective from **2nd** day of **November, 2017**


The certificate is subject to the provisions of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

This certificate shall be valid until it is cancelled under regulation 9 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

On cancellation, the certificate of accreditation shall be surrendered to the Bureau within fifteen days from the date of receipt of order of cancellation.

Your name has been entered at AEA No..... **0275** in the register of list of accredited energy auditors. Your name shall be liable to be struck out on the grounds specified in regulation 8 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

Given under the seal of the Bureau of Energy Efficiency, Ministry of Power, this **12th** day of **February, 2018**


Secretary,
Bureau of Energy Efficiency
New Delhi



II. EMC Empanelment certificate



Energy Management Centre - Kerala (Department of Power, Govt of Kerala)

CERTIFICATE OF EMPANELMENT

This is to certify that M/s.Athul Energy Consultants Pvt Ltd(4/2, Capital Legend Building, Korapath Lane, Round North, Thrissur)is empanelled as Energy Audit firm in Energy Management Centre Kerala to conduct mandatory energy audit as per Government of Kerala G.O (Rt) No.2/2011/PD dated 01.01.2011.

Empanelment No:
EMCEEA-0811F-3

Scope/Area	Building	Industry -Electrical	Industry Thermal
	Yes	Yes	Yes

This empanelment is valid up to 01/02/2024

Issuing Date: 02/02/2021

Place: Thiruvananthapuram

Director,
Energy Management Centre - Kerala