ENERGY AUDIT – 2021 -22

KRISTU JYOTI COLLEGE OF MANAGEMENT & TECHNOLOGY

CHETHIPUZHA, CHANGANACHERRY

KOTTAYAM

EXECUTED BY

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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 the systematic review and implementation of an organization's data records, records, operations and performance for a specific purpose. Energy audits are a systematic study or survey of how energy is used in one's own institution. Moreover, identifying opportunities for energy savings in the building behaviour change through student training can provide the greatest benefit at a lower cost. Even a little savings in each house brings dramatic changes in society and for the 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 with project engineers who are experienced in the area of energy, environment and management.

ACKNOWLEDGEMENTS

We express our sincere gratitude to Kristu Jyoti College of Management and Technology for giving us an opportunity to carry out the project of Energy Audit. We are extremely thankful to management and all the staffs for their support to carry out the studies and for input data, and measurements related to the project of Energy Audit.

Kristu Jyoti College – TEAM

Rev. Fr. Joshy Cheeramkuzhy CMI	***Principal***
Rev. Fr. Chacko Manackal CMI	**Bursar, Kristu Jyoti Group**
Dr. Anu Antony	**IQAC Coordinator**

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

2. **Mr. Jaideep P P**
   Senior Project engineer

ATHUL ENERGY CONSULTANTS PVT LTD THRISSUR 680 020

Yours faithfully

Managing Director
Athul Energy Consultants Pvt Ltd

EXECUTIVE SUMMARY

I. ENERGY SAVING PROPOSALS

TABLE 1: ENERGY SAVING PROPOSALS

Sl.	Energy conservation measures	Annual Energy Savings	Annual Financial Savings	Investment	Simple payback period
		kWh	Rs	Rs	Months
1	Changing the leading power factor to lagging power factor (College)	-	9,800	10,000	13
2	Replacement of Ceiling fans(60W) with BLDC fans 5 star rated(28W) – 35 nos	1,882	14,676	1,22,500	100
3	Replacement of Fluorescent tubes (T8-60 nos) with LED lights	1,613	12,580	21,000	20
Total Savings		**3,495**	**37,056**	**1,53,500**	
1	Changing the leading power factor to lagging power factor (Hostel)	-	23,520	5,000	03
Total Savings		**-**	**23,520**	**5,000**	

II. ENERGY AUDIT SUMMARY & RECOMMENDATIONS

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

1. **Baseline energy performance:**

Electricity consumption analysis

- **Demand analysis:** The recorded maximum demand was found to be 150kVA which is 60% of the contract demand.
- **Power factor**: The PF for past year is unity. Provide small divisions of capacitors (1, 2 kVAr) to the MSB for maintain the PF in low load conditions.

2. **Water Conservation**

Sub-metering: Sub metering of water in the major usage areas are to provide for better control. Also records shall be kept for all the sub meter to understood the variation in the consumption pattern in each section.

- Use advanced taps in washbasins in canteen, toilet and department, rooms etc. for reducing and controlling water usage.
- Change flesh system in departments (Dual flesh) for reduction in water consumption.

3. **Equipment and utility description**

Capacitors: All power factor can be improved at a unit to increase the incentives received by the college, provide small rating capacitors to the APFC panel.

- **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

4. **Behavioral Changes**

- Use of student volunteers for reducing electricity consumption in hostels and other college areas.
- Encourage student projects in connection with energy conservation areas such as in renewable energy area, use of terrain advantage of college buildings, automatic system for control the light, fan and air conditioning requirements
- Celebrate energy conservation month (November 14 to December 14) and energy conservation day December 14 with energy conservation programmes among college for creating awareness about importance of energy conservation.

III. ENERGY PERFORMANCE INDEX (EPI)

EPI was based on the energy consumption in Aug 2021 - Feb 2022. The projected energy consumption after the implementation of energy saving proposals is given in the table below.

TABLE 2: ENERGY PERFORMANCE INDEX

Sl. No:	Energy Performance and climate impact	Unit	Baseline	Projection
1	Annual Electricity Consumption	kWh	207,571	204,076
2	Annual electricity consumption	TOE	17.85	17.55
3	Annual Energy Cost	Rs in lakhs	24.20	23.83
4	Annual Specific Electricity Consumption	kWh/Student	120.82	118.79
5	Annual Specific Electricity Consumption	TOE/Student	0.010390632	0.010215679
6	Annual Carbon Footprint- Electricity	Ton CO_2	163.98	161.22

Note: Unit conversions:

TOE = 10 million kCal (BEE energy audit manual)

MWh of electricity = 0.79 Ton of CO_2 (www.cea.gov.in)

kWh of electricity = 860 kCal (BEE energy audit manual)

Liters of Diesel = 9500 kCal (BEE energy audit manual)

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 Kristu Jyoti 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.
5. Cost Benefit Analysis.

II. KRISTU JYOTI COLLEGE OF MANAGEMENT & TECHNOLOGY

The Kristu Jyoti Group of educational institutions came into fruition with the Monastic Council of CMI Fathers of Chethipuzha led by rev. Fr. James Kozhimattom CMI having setup the Kristu Jyoti School linked to Sacred Heart Monastery in the year 1982. In the month of June 1982 marked the coming into being of KristuJyoti English Medium School as well. In order to cater to the needs of the students and the parents, Placid Vidya Vihar Seniour Secondary School of CBSE mode got formed in 1988. In 2002 Kristu Jyoti College of Management and Technology was put into operation along with the novel institutions such as KristuJyoti Kindergarten and Play School. The ICSE oriented school, the Kristu Jyoti, Vidyaniketan commenced functioning in the academic year 2005-2006 onwards.

Kristu Jyoti College of Management & Technology was established in the year 2002 at Chethipuzha, Changanacherry, Kottayam, Kerala, India. Since its inception, it has been affiliated to Mahatma Gandhi University and does have the approval of All India Council for Technical Education, New Delhi (AICTE). The first course, which was provided by the college, was MCA in the year 2002. The college also extended courses such as M.Sc Bioinformatics and B.Com Computer Applications in the year 2004. The year 2010 paved the way for the college inducting into its scheme of things two more courses viz BCA and BBA. In the subsequent year 2011, the college introduced the courses such as BCom (Finance and Taxation) and MCom Finance. The other courses, the college incorporated into its fold are BSc Psychology in 2014, BSc Geology and BA English in 2015, MHRM and MSc Psychology in 2020.

VISION

Empowering students to meet needs of the society by focusing on academic, technological and professional excellence.

MISSION

To provide quality education through an effective teaching –learning process, skill development and integrated personnel progression.

III. GENERAL DETAILS

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

TABLE 3: GENERAL DETAILS

Sl. No:	Particulars	Details
1	Name of the College	Kristu Jyoti College of Management and Technology, Changanacherry
2	Address	Kristu Jyoti College of Management and Technology Chethipuzha, Changanacherry Kottayam
3	Contact Person	Rev. Fr. Joshy Cheeramkuzhy CMI (Principal) Ph: 9496101681
4	Contact Number & E mail of the college	0481-2720696/62351011681 kjcmt@kjcmt.ac.in, kjc@kjcmt.ac.in
5	Web site	www.kjcmt.ac.in
6	Type of Building	Educational Institution
7	Annual Working Days	210
8	No: of Shifts	Day Shift (One) (9:00 AM -4:00 PM)
9	No: of students enrolled	1716
10	No: of teaching & non-teaching staff	Teaching - 78 non-teaching - 22
11	No: of departments	06
12	Total Land Area	05 Acres
13	Total Build up area	
14	No: of Programmes	UG – 07 and PG -04
15	Average power consumption per month. (kWh/month)	17298
16	Average electricity charges per month. (Rs. /month)	201674

IV. LOAD BALANCE- ELECTRICAL

The details of the loads in the college at the audit time are given below:

TABLE 4: LOAD BALANCE

Sl. No:	*Particulars*	*Total Power*
		kW
1	Light & Fan Loads	38.743
2	AC Loads	13.136
3	PC & Other Loads	31.92
4	Miscellaneous Loads	10
Total		***99.096***

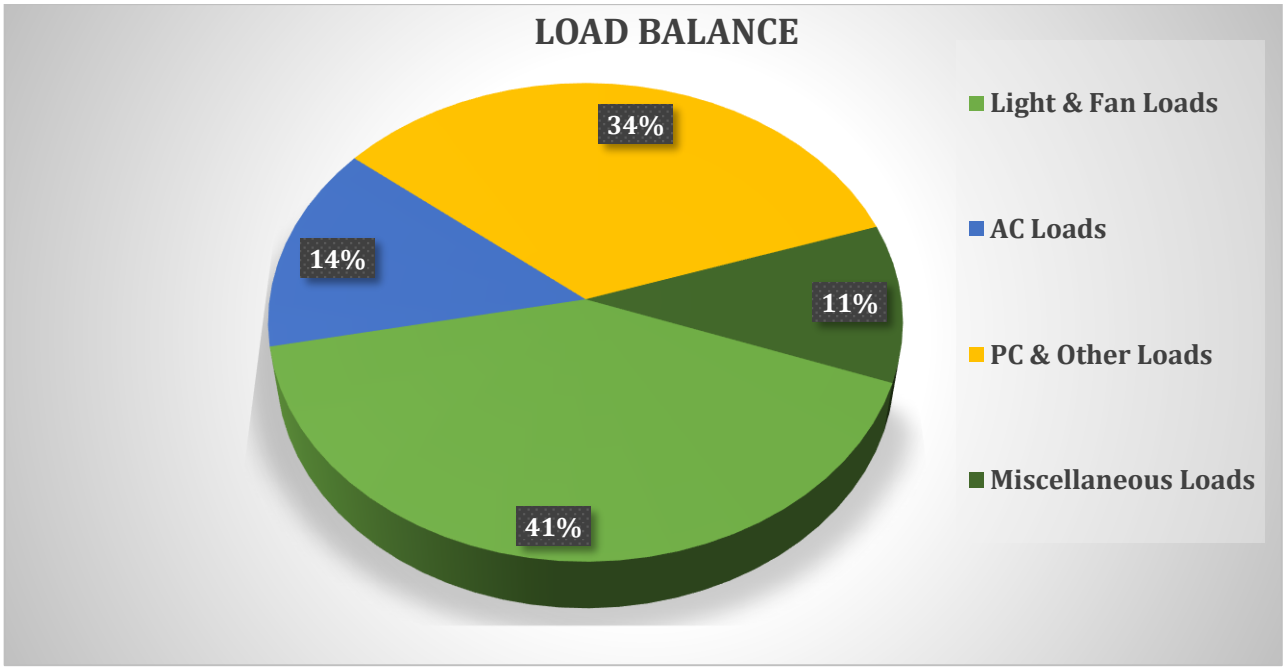


FIGURE 1: LOAD BALANCE – ELECTRICAL

ENERGY & UTILITY DESCRIPTION

The single line diagrams of electricity and water are given which provides an overview of the energy flow in the building.

I. SINGLE LINE DIAGRAM – ELECTRICAL

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

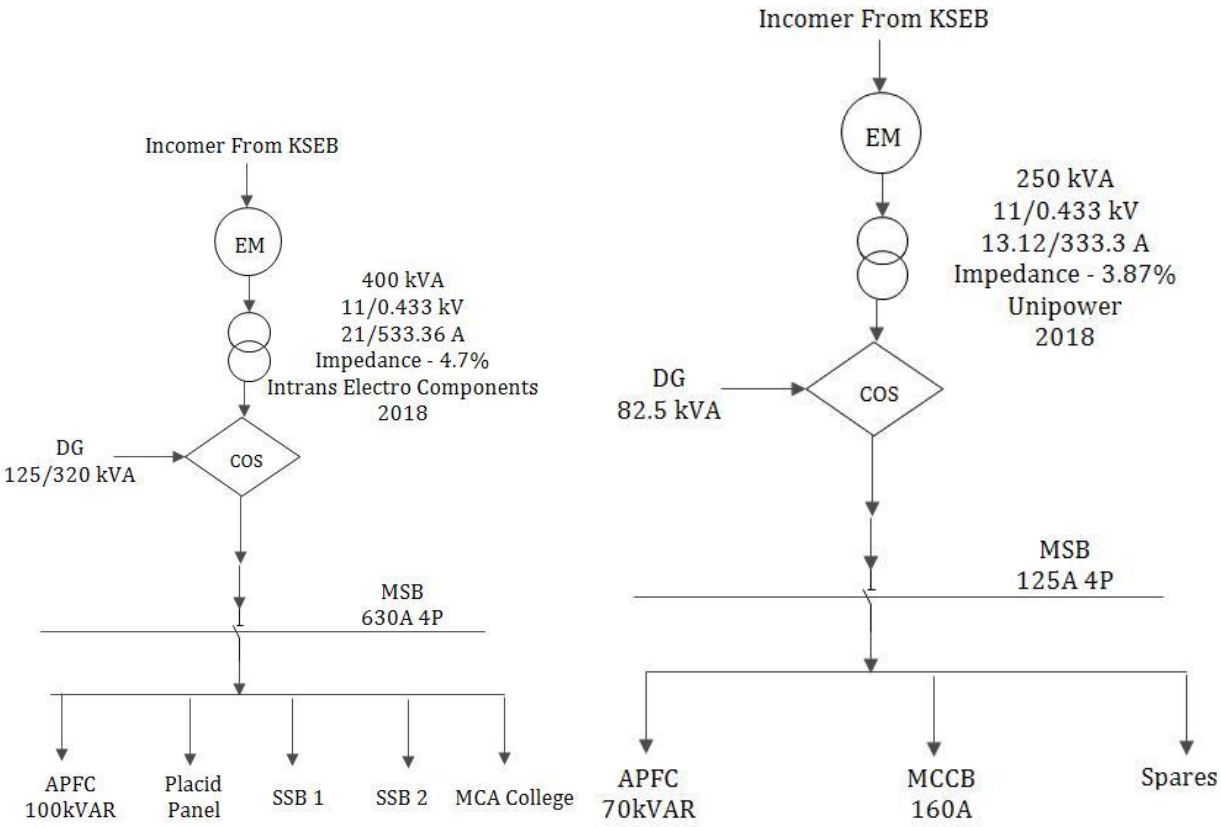


FIGURE 2: SINGLE LINE DIAGRAM – COLLEGE & HOSTEL

II. SINGLE LINE DIAGRAM – WATER

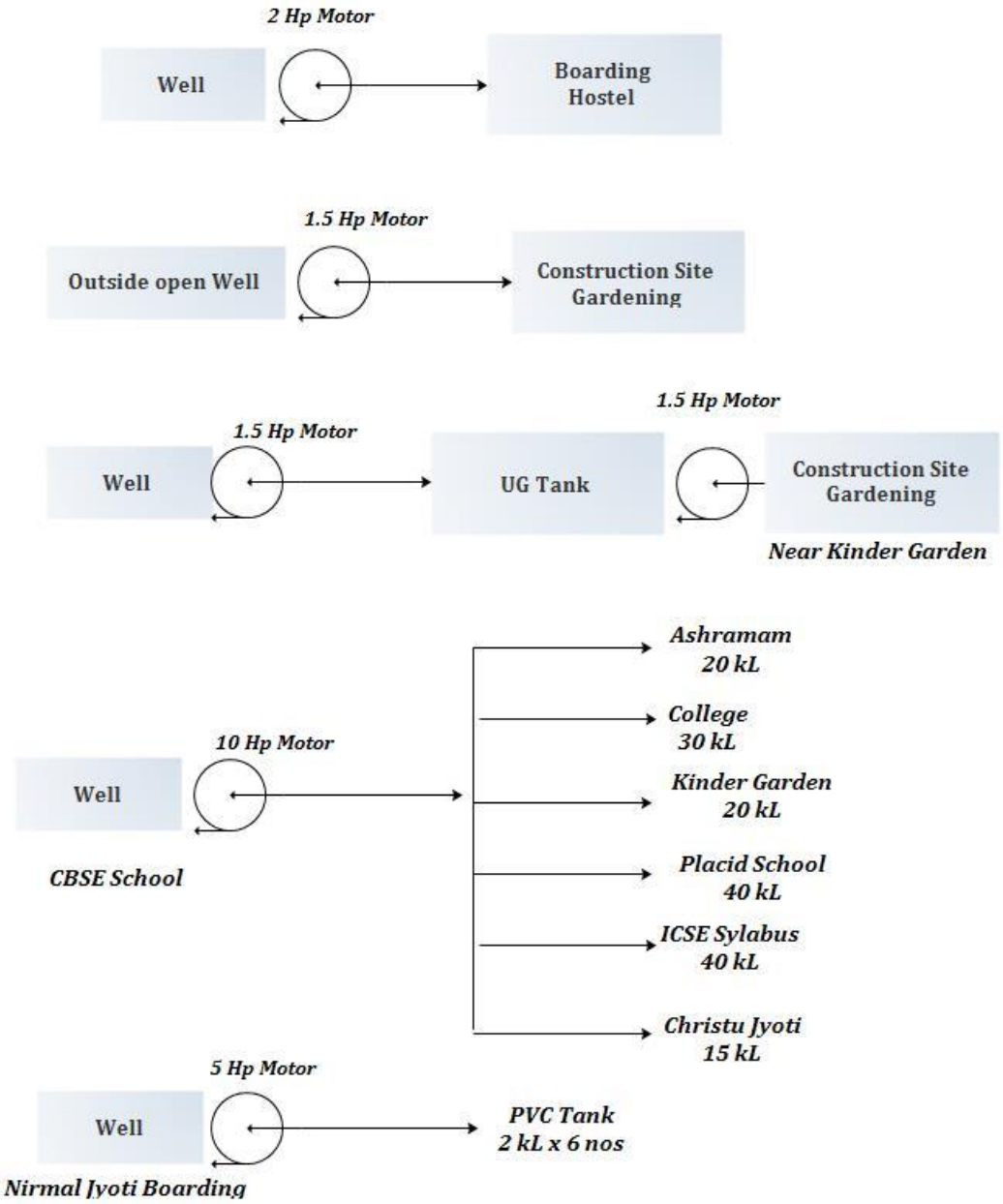


FIGURE 3: WATER LINE DIAGRAM – COLLEGE & HOSTEL

ENERGY ANALYSIS

Energy consumption of various types is reported in this section. The major source of energy to the college is electricity. Other forms come in the form of diesel.

ELECTRICITY CONSUMPTION ANALYSIS - COLLEGE

The major source of electricity to the college is the electrical connection from the KSEBL Diesel generators are provided in the college, but it is used only during power outages in critical days like college exams or events.

I. DESCRIPTION OF ELECTRICITY BILL

Base line data given below based on the Electricity bill provided by the supplier of electricity to the College. Details obtained from the KSEBL bill for the month of Aug 2021-Feb 2022 is as follows in the Table.

TABLE 5: KSEBL BILL ANALYSIS

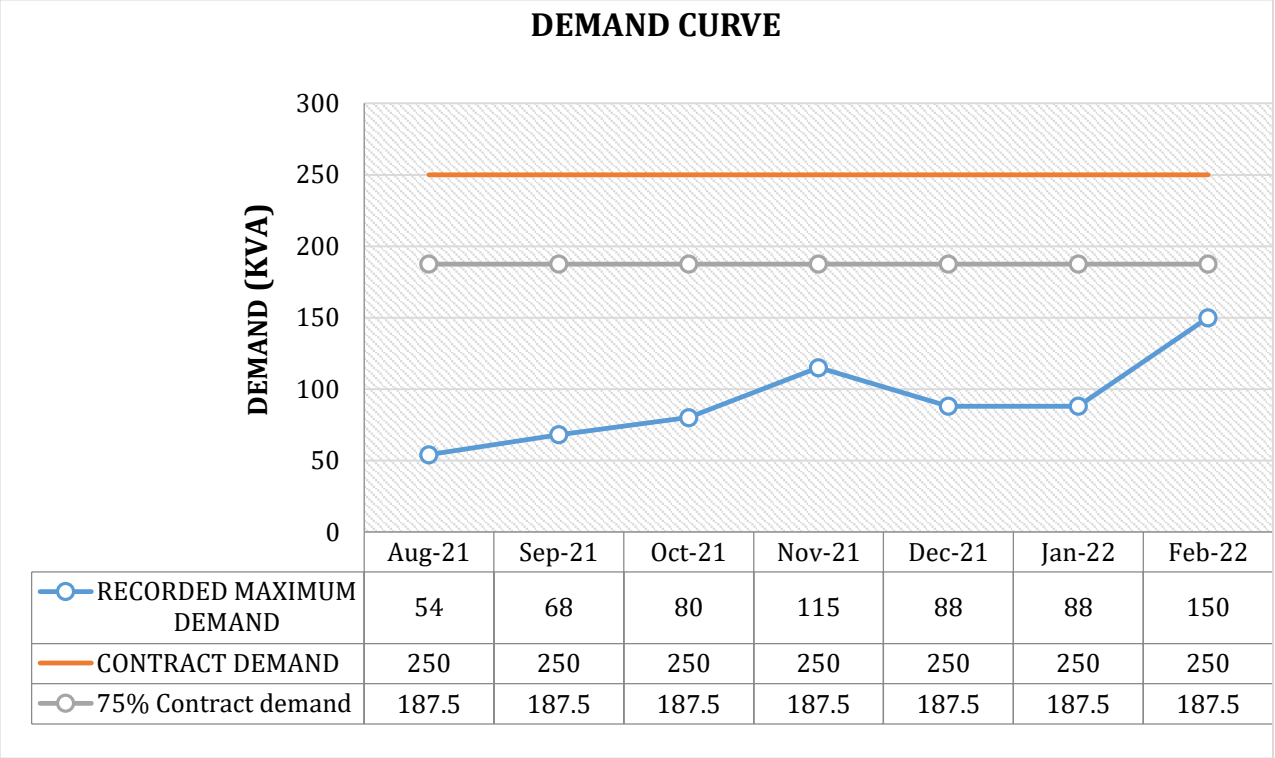
Particulars		Details
Consumer No		1346380059061
Contract Demand (kVA)		250
Connected Load (kW)		475
Tariff		HT II (B) General
Recorded maximum demand (kVA)		150
Average monthly electricity consumption (kWh/month)		17298
Average Power factor		0.99
Average Demand charges (Rs/month)		82720
Annual power factor penalty & Incentive (Rs/year)		Incentives - 2,667/-
Demand charge (Rs / kVA)		500
Energy charge (Rs/kWh)	Normal Period	6.2
	Peak Period	9.3
	Off – Peak Period	4.65
Average electricity cost (Rs/month)		2,01,674/-

Inference & Suggestions

- The average power factor should be 0.99. Leading of power factor in many months and there are no incentives for power factor when it is leading
- By avoiding the leading conditions, the college will get incentives for the power factor.
- Recorded maximum demand (RMD) during past 12 month was 150 kVA, It was recorded during the month of February 2022, which represents 60% of contract demand.

II. DEMAND ANALYSIS

This section analyses the trend for the maximum demand versus the Contract Demand (CD) over 12-month period (Aug 2021-Feb 2022).



	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22
RECORDED MAXIMUM DEMAND	54	68	80	115	88	88	150
CONTRACT DEMAND	250	250	250	250	250	250	250
75% Contract demand	187.5	187.5	187.5	187.5	187.5	187.5	187.5

FIGURE 4: DEMAND IN VARIOUS TIME ZONE

Inference

- Average demand charges per month came as Rs. 82,720 /- for the college.
- The recorded maximum demand was found to be 150 kVA which is 60% of the contract demand.
- RMD came as almost less than billing demand in last 12 months.

Suggestion

- Maintaining the power factor to near unity in lagging mode yields the incentives for the power factor.
- Remove the direct connected capacitors from the APFC panel and provide small rated capacitors to the panel.

III. ELECTRICITY DEMAND IN VARIOUS TIME ZONES

The variations of demands in the time zones are given below in figure.

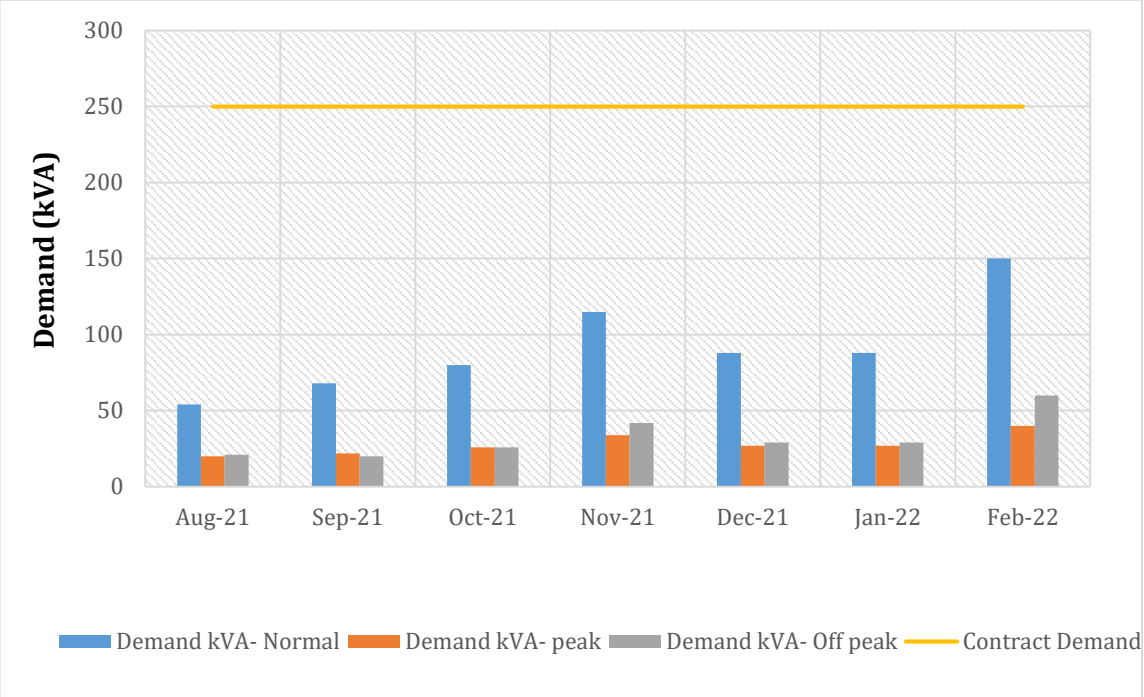


FIGURE 5: ELECTRICITY DEMAND IN VARIOUS TIME ZONE

Inference

- The average demand registered during the normal, Peak and off-peak period with respect to the contract demand (250 kVA) were 36.74%, 11.20% and 12.97% respectively.
- The maximum demand registered during the normal, Peak and off-peak period with respect to the contract demand (250 kVA) were 60%, 16% and 24% respectively.

IV. POWER FACTOR ANALYSIS IN KSEBL BILL

The Power factor is the ratio of Active power (kW) and apparent power (kVA).

$$PF = Active\ energy kWh / Apparent energy\ (kVAh)$$

The power factor variations in past one year is given below in figure.

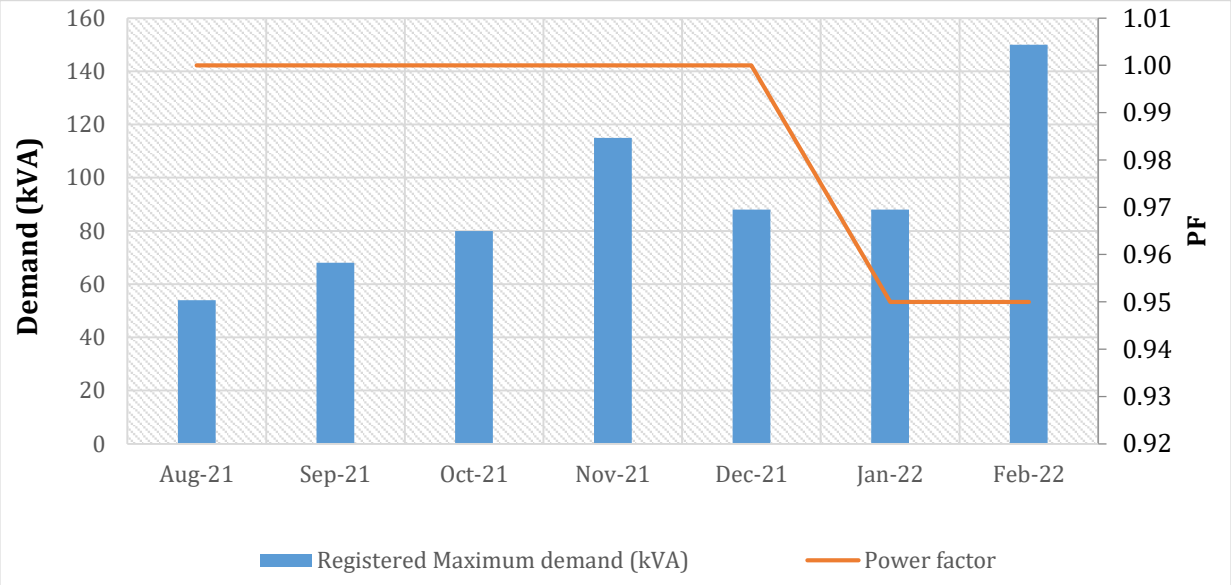


FIGURE 6: POWER FACTOR ANALYSIS

Inference

- The PF for past year varies from 0.95 to 1.
- Found leading of power factor in some months.

Suggestion

- College has not getting any incentives due to leading of power factor
- Provide small divisions of capacitors (1, 2 kVAr) to the MSB for maintain the PF in low load conditions.

V. TARIFF RATES ANALYSIS

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

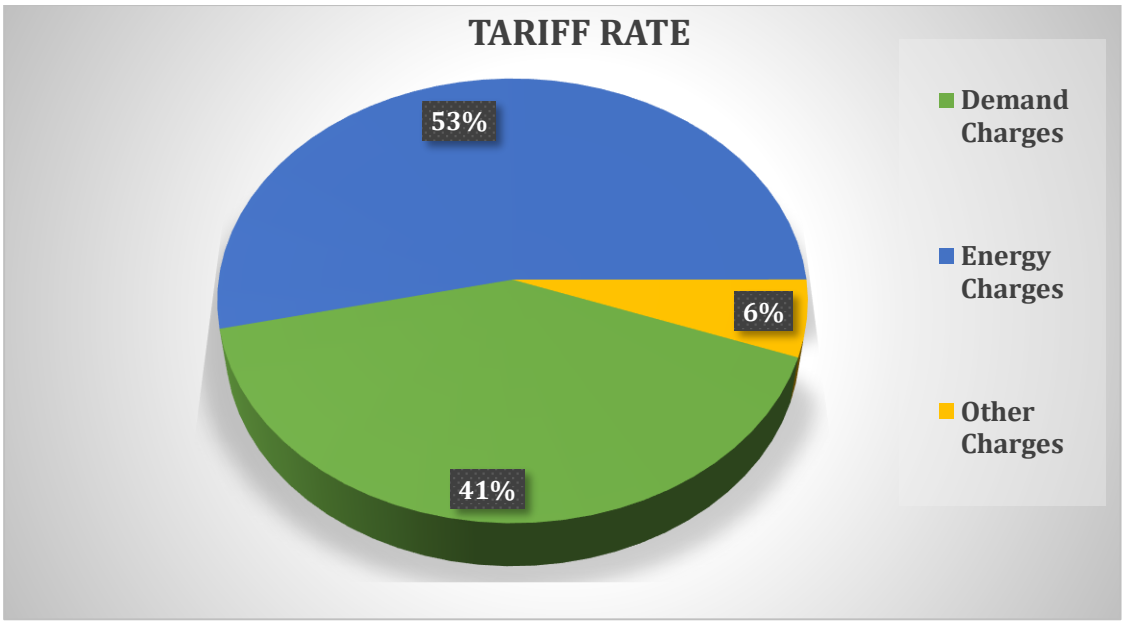


FIGURE 7: TARIFF RATE ANALYSIS

Inference

- Average demand charges for the past one year were Rs 82,720/-per month and energy charges was Rs. 1,08,093/- per month.
- The energy charges come about 53% of the total bill for the college.

VI. SPECIFIC ELECTRICITY CONSUMPTION

The electricity consumption from the Aug 2021-Feb 2022 has been taken for the benchmarking. Here the comparison is done with electricity consumption and the number of students. The below table shows the specific electricity consumption of the college.

TABLE 6: SPECIFIC ELECTRICITY CONSUMPTION

Month	Electricity Consumption	Number of Students	SEC
	kWh	Number	kWh/Student
Aug-21	11535	1716	6.72
Sep-21	13335	1716	7.77
Oct-21	16653	1716	9.70
Nov-21	21216	1716	12.36
Dec-21	17068	1716	9.95
Jan-22	17068	1716	9.95
Feb-22	24208	1716	14.11
Average	**17297.6**	1716	**10.08**
Annual Specific Electricity consumption			**70.6**
Annual Electricity Consumption(kWh)			**121083**

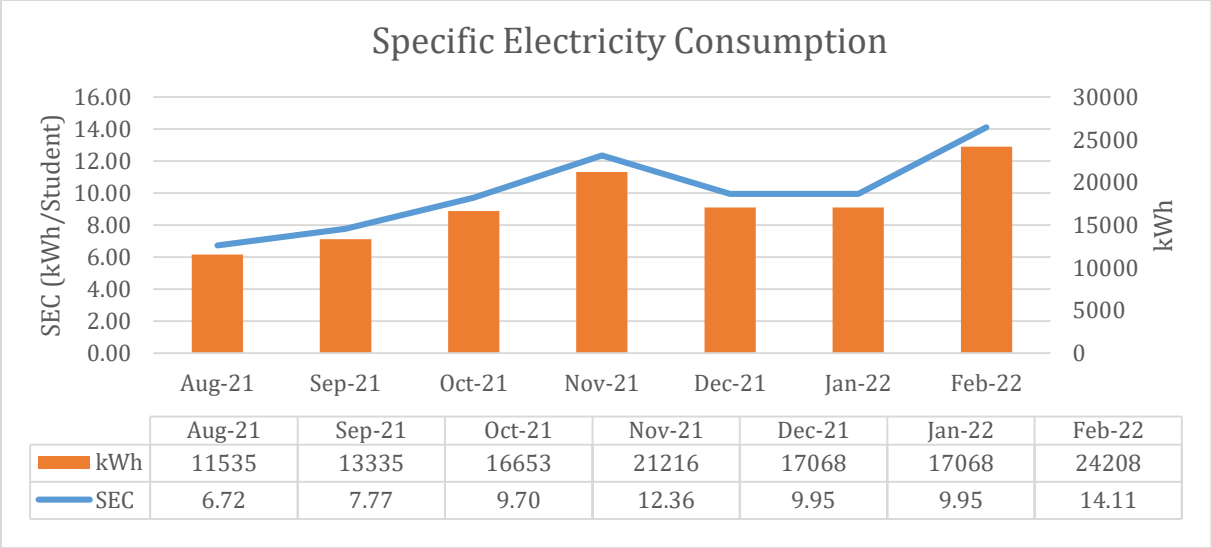


FIGURE 8: SPECIFIC ELECTRICITY CONSUMPTION (KWH/STUDENTS)

ELECTRICITY CONSUMPTION ANALYSIS – NIRMAL JYOTHI BOARDING HOUSE

The major source of electricity to the hostel is the electrical connection from the KSEBL. Diesel generators are provided in the college, but it is only used during the power failures in critical days like examinations or college events.

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 KSEBL bill for the month of Mar 2022-Feb 2023 is as follows in the Table.

TABLE 7: KSEBL BILL ANALYSIS

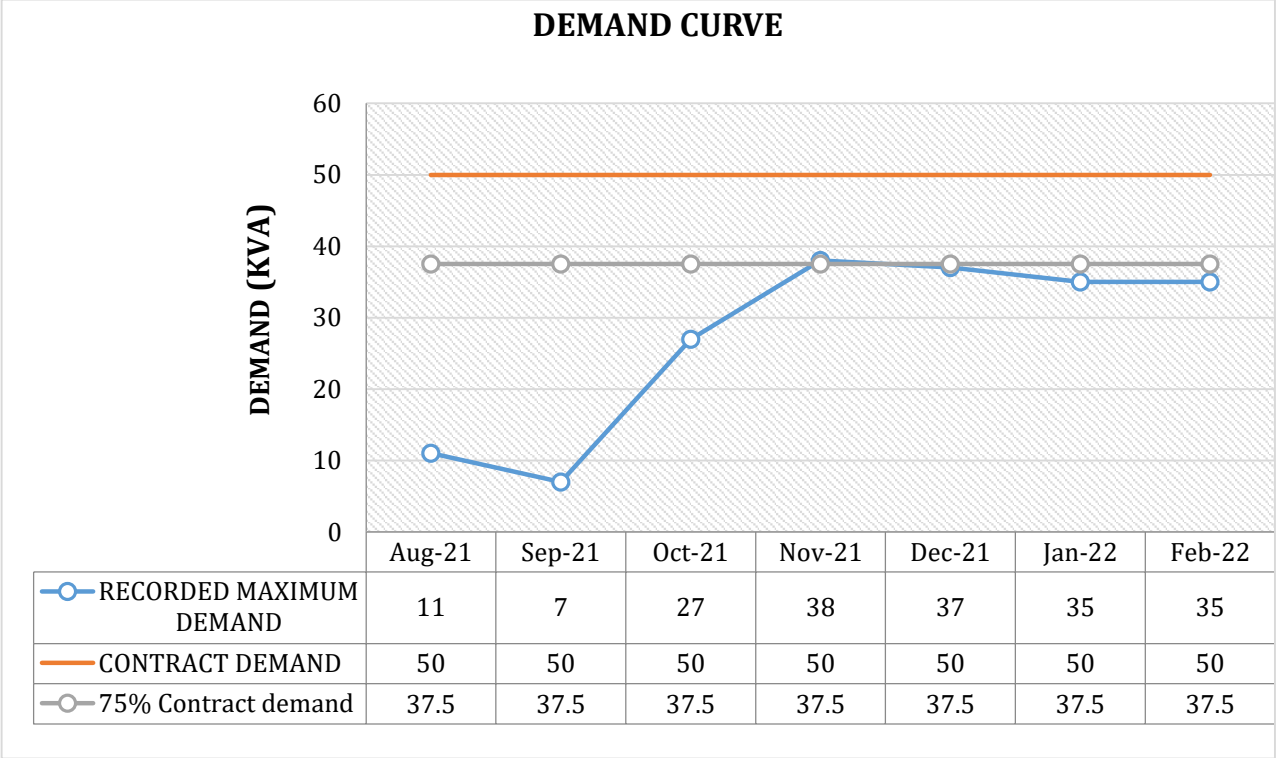
Particulars		Details
Consumer No		1346360062381
Contract Demand (kVA)		50
Tariff		HT II (B) General
Recorded maximum demand (kVA)		38
Average monthly electricity consumption (kWh/month)		8792
Average Power factor		0.96
Average Demand charges (Rs/month)		16720
Annual power factor penalty & Incentive (Rs/year)		Nil
Demand charge (Rs / kVA)		500
Energy charge (Rs/kWh)	Normal Period	6.2
	Peak Period	9.3
	Off – Peak Period	4.65
Average electricity cost (Rs/month)		77,822/-

Inference & Suggestions

- Average Power factor is found to be 0.96. Leading of power factor in so many months and there are no incentives for power factor.
- By avoiding the leading conditions, the hostel will get incentives for the power factor.
- Recorded maximum demand (RMD) during past year was 38 kVA. It was recorded during the month of Nov 2021, which is 76% of contract demand.

II. DEMAND ANALYSIS

This section analyses the trend for the maximum demand versus the Contract Demand (CD) over last months' period (Aug 2021-Feb 2022).



	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22
RECORDED MAXIMUM DEMAND	11	7	27	38	37	35	35
CONTRACT DEMAND	50	50	50	50	50	50	50
75% Contract demand	37.5	37.5	37.5	37.5	37.5	37.5	37.5

FIGURE 9: DEMAND IN VARIOUS TIME ZONE

Inference

- Annual demand charges came as Rs. 16,720 /- for the hostel.
- The recorded maximum demand was found to be 38 kVA which is 76% of the contract demand.
- RMD came as almost less than contract demand in last months.

Suggestion

- Maintaining the power factor to near unity in lagging mode yields the incentives for the power factor.

III. ELECTRICITY DEMAND IN VARIOUS TIME ZONES

The variations of demands in the time zones are given below in figure.

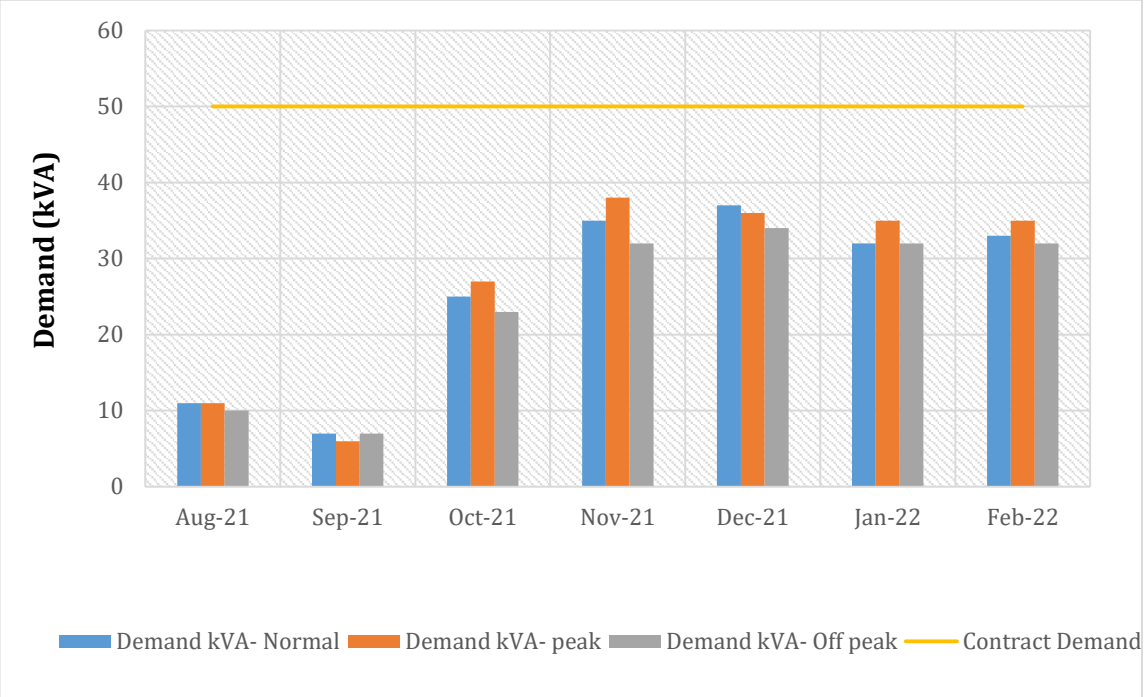


FIGURE 10: ELECTRICITY DEMAND IN VARIOUS TIME ZONE

Inference

- The average demand registered during the normal, Peak and off-peak period with respect to the contract demand (50 kVA) were 51.43%, 53.71% and 48.57% respectively.
- The maximum demand registered during the normal, Peak and off-peak period with respect to the contract demand (50 kVA) were 76%, 76% and 68% respectively.

IV. POWER FACTOR ANALYSIS IN KSEBL BILL

The Power factor is the ratio of Active power (kW) and apparent power (kVA).

$$PF = Active\ energy kWh / Apparent energy\ (kVAh)$$

The power factor variations in past one year is given below in figure.

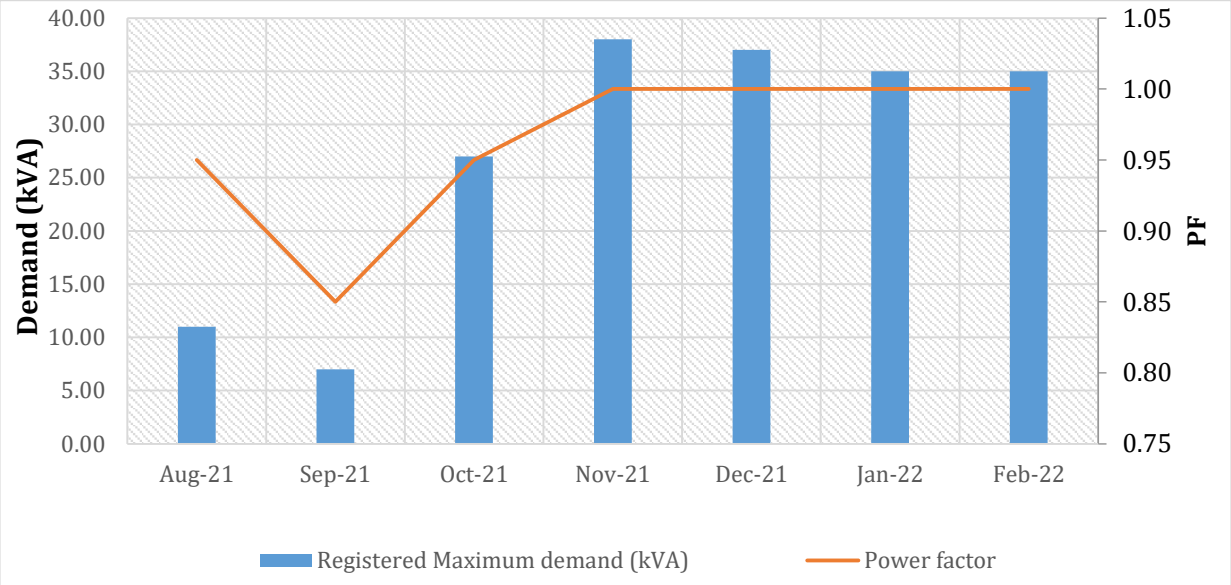


FIGURE 11: POWER FACTOR ANALYSIS

Inference

- The PF for past year varies from 0.85 to 1.

Suggestion

- Hostel has not getting any incentives due to leading of power factor
- Provide small divisions of capacitors (1, 2 kVAr) to the MSB for maintain the pf in low load conditions.

V. TARIFF RATES ANALYSIS

The average monthly energy and demand charges for the period Aug 2021-Feb 2022 is represented in Fig.

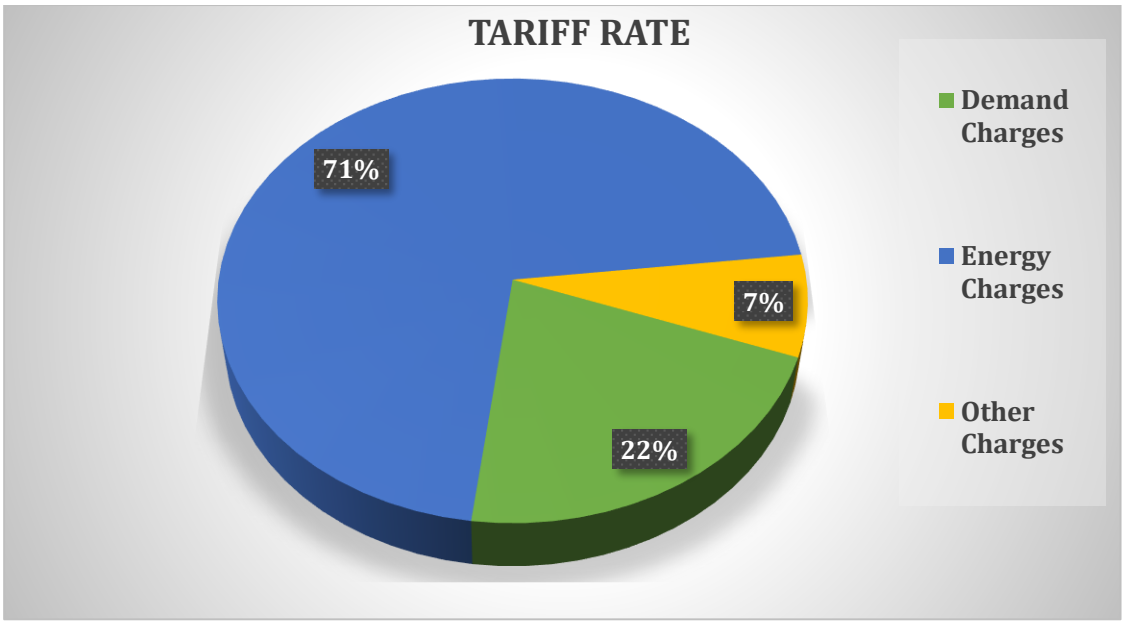


FIGURE 12: TARIFF RATE ANALYSIS

Inference

- Average demand charges for the past one year were Rs 16,720/-per month and energy charges was Rs. 55,348/- per month.
- The energy charges come about 71% of the total bill for the hostel

UNINTERRUPTIBLE POWER SUPPLY (UPS)

TABLE 8: UPS DETAILS

Location	Rated Capacity	Make	Battery Details		
	kVA		Rating	Nos	Make
Computer Lab 2	20	APC	12V 40Ah	32	Exide
Computer Lab - Server	6	Emerson	12V 60Ah	16	Exide
Chavara Block	6	APC	12V 40Ah	16	Exide
Lab	20	APC	12V 40Ah	32	Exide

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.

REACTIVE POWER COMPENSATION - ANALYSIS

APFC panels are installed at the secondary side of the transformer. The rated details and performance of the installed units of capacitors is given below:

TABLE 9: CAPACITOR DETAILS

Name	Rated kVAr	Design Voltage	Measured Voltage	Measured kVAr	kVAr wrt to Volts	% of deterioration
	A	B	C	E	F= E*(B/C)²	G= (A-F)*(100/A)
College						
C1	25	440	390	24.48	31.16	-24.64
C2	20	440	390	16.5	21.00	-5.01
C3	20	440	390	16.34	20.80	-3.99
C4	15	440	390	8.11	10.32	31.18
C5	10	440	390	12.09	15.39	-53.89
C6	10	440	390	7.96	10.13	-1.32
C7 (Direct)	10	440	390	Not Working		
Ladies Hostel						
C1	5	440	400	3.34	4.04	19.17
C2	15	440	400	12.21	14.77	1.51
C3	5	440	400	4.21	5.09	-1.88
C4	10	440	400	8.47	10.25	-2.49
C5	15	440	400	12.51	15.14	-0.91
C6	20	440	400	16.92	20.47	-2.37

Inference

1. All Power factor can be improved to unity so as to increase the incentives received by the college.

Suggestion

1. Provide small rating capacitors to the APFC panel especially in college to fine tune the power factor
2. Remove the direct connected capacitor from the MSB to avoid leading power factor during low load(night and holidays)

DIESEL GENERATOR

Diesel generator used in the college as backup supply. There are three DG's provided in the facility. The following table gives the basic details of diesel generator in the facility.

TABLE 10 DG DETAILS

Location	Rated Capacity	Engine	Alternator
	kVA		
College	380	Volvo	Leroy Somer
College	125	Cummins	Stamford
Ladies Hostel	82.5	Kirloskar	Kirloskar

Inference & Suggestions	*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

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. The fossil fuels are depleting at a rapid rate. A growing worldwide concern for conservation of energy has reignited the 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.

Kristu Jyoti College have installed solar of 120 kW and is under installation.

ANNEXURE – 1

ENERGY SAVING PROPOSALS - 1

CHANGING THE LEADING POWER FACTOR TO LAGGING POWER FACTOR

Background

By referring the last year bills, it is clear that the average power factor was 1 (lead) in college and hostel. Direct connected capacitor is provided in the MSB.

Proposal

Replace the direct connected capacitors from the APFC panel to improve the PF to unity and gain incentives.

Calculations for the energy saving proposal is given in the table below.

TABLE 11: EC PROPOSAL 1

Particulars	Units	College	Hostel
Present PF		0.99 (Lead)	0.96(Lead)
Proposed PF		1 (Lag)	1 (Lag)
Present average energy consumption/month	kWh/month	17298	8792
Present average energy charge/month	Rs/month	108093	55348
Last year Incentives	Rs/annum	2667	Nil
Incentives for improving the PF from leading to lagging	Rs/annum	12467	23520
Annual incentive increment **(Annual Savings)**	**Rs/annum**	**9800**	**23520**
Investment	**Rs**	**10,000**	**5000**
Payback period	**Months**	**13**	**03**

ENERGY SAVING PROPOSALS - 2

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 and in class rooms, the calculation for the savings is given in the table.

TABLE 12: EC PROPOSAL 2

Particulars	Units	Value
Present Power Consumption	Watts	60
Proposed Power Consumption	Watts	28
Reduction in power	Watts	32
Operating hours per day	Hr/day	8
No: of working days per year (Average)	Nos	210
No: of working hours per annum	Hrs	1680
Number of Fans operating	Nos	35
kWh Saving per Annum	**Rs**	**1882**
Cost per kWH (Average)	Rs	7.8
Annual Financial Savings	**Rs**	**14676**
Cost of BLDC Fans	Rs	3500
Investment for BLDC Fans	**Rs**	**122500**
Simple Payback period	**Months**	**100**
SUMMARY		
Annual unit savings	kWh	**1882**
Total savings	Rs	**14676**
Total investment	Rs	**122500**
Payback period	months	**100**

ENERGY SAVING PROPOSALS - 3

REPLACEMENT OF FLOURESCENT TUBES WITH LED LIGHTS

Replace the continues working fluorescent lights with LED lights.

TABLE 13: EC PROPOSAL 3

Particulars	Units	Values
Power of Fluorescent lights	Watts	36
Power of proposed LED tube	Watts	20
Difference in Wattage	Watts	16
Avg No: of working hours/day	Hrs	8
No: of working days per year (Average)	Nos	210
No: of working hours per annum	Hrs	1680
Number of Lights operating	Nos	60
kWh Saving per Annum	**Rs**	**1613**
Cost per kWH (Average)	Rs	7.8
Annual Financial Savings	**Rs**	**12580**
Cost of LED tube	Rs	350
Investment for LED lights	**Rs**	**21000**
Simple Payback period	**Months**	**20**
Summary		
Annual unit savings	**kWh**	**1613**
Total savings	**Rs**	**12580**
Total investment	**Rs**	**21000**
Payback period	**months**	**20**

ANNEXURE-2

I. CONNECTED LOAD

I. LIGHT & FAN LOAD

Location	*T8*	*LED Tube*	*LED*				*LED ceiling light*										*Ceiling Fan*
Watts	*36*	*22*	*3*	*7*	*9*	*14*	*3*	*7*	*8*	*14*	*15*	*22*	*28*	*36*	*100*	*200*	*60*
Chavara Block																	
Ground Floor	34			3		1											33
First Floor	36			2					10			12					45
Second Floor	33			4										4			40
Third Floor	31			3													32
Fourth Floor	1		55		1									21			43
MCA Block																	
Ground Floor	45			6				6					9	10	2	2	45
First Floor	41			2			21	1	8		6			4			44
Second Floor	39	5		2						11							58
Third Floor	2	50		1										12			65
Total Nos	***262***	***55***	***55***	***23***	***1***	***1***	***21***	***7***	***18***	***11***	***6***	***12***	***9***	***51***	***2***	***2***	***405***
Total kW	***9.43***	***1.21***	***0.17***	***0.161***	***0.009***	***0.014***	***0.063***	***0.049***	***0.144***	***0.154***	***0.09***	***0.264***	***0.252***	***1.836***	***0.2***	***0.4***	***24.3***
Total kW - 38.743																	

II. AIR CONDITIONER LOAD

Location	Make	Type	Capacity	EER	Star rating	Rated Power	Year
			TR			Watts	
Server Room	General	Split	1.5	3.83	3	1086	2021
Server Room	Totalline	Split	1.5			1400	
Principal Room	General	Ductable	5			4500	2021
Conference Hall	Voltas	Ductable	5			4500	2014
Chapel - Ladies Hostel	Bluestar	Split	2			1650	2020

III. OTHER POWER LOAD

Sl.No:	*Particulars*	*Rated Power (Watts)*	*Nos*	*Total Power (kW)*
1	PC	110	108	11.88
2	Laptops	100	7	0.7
3	Laser Printers	200	2	0.4
4	Printer with Scanner	300	4	1.2
5	Printer with Scanner and Copier	350	2	0.7
6	Coffee Machine	250	2	0.5
7	Water Cooler	1100	5	5.5
8	Water Filter	20	2	0.04
9	Water Filter	250	2	0.5
10	LCD Projector	200	28	5.6
11	LED TV	100	2	0.2
12	Mic Set	700	1	0.7
13	Mic Set	2000	2	4
Total				***31.92***

ANNEXURE-3

I. LIST OF INSTRUMENTS

SL.NO	EQUIPMENT DESCRIPTION	MAKE & MODEL
1	POWER ENERGY & HARMONIC ANALYZER	KRYKARD ALM 31

II. ABBREVIATIONS

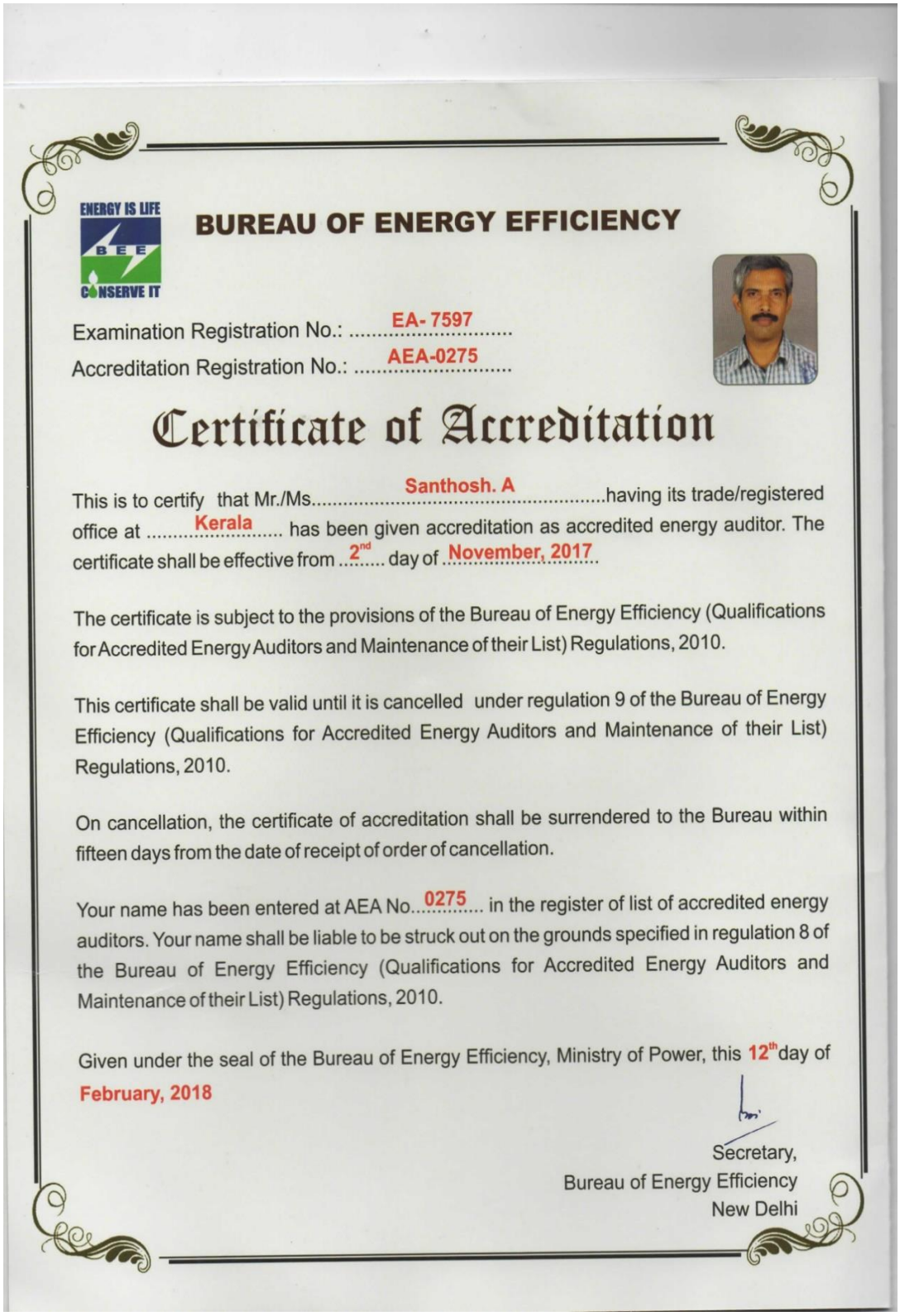
APFC	:	Automatic Power Factor Control
AVG	:	Average
BEE	:	Bureau of energy efficiency
BH	:	Boys Hostel
CO_2	:	Carbon dioxide
KSEB	:	Kerala State Electricity Board.
DB	:	Distribution Board
EC	:	Energy Conservation
IEEE	:	The Institute of electrical and electronics engineers
IS	:	Indian Standard
kL	:	kilo Liter
KVA	:	kilo Volt Ampere
kVAh	:	kilo volt Ampere Hour
kVAr	:	kilo volt ampere
kW	:	kilo Watts
kWh	:	kilo watt hour
LH	:	Ladies Hostel
LPG	:	Liquefied Petroleum Gas
LT	:	Low tension
MAX	:	Maximum
NSS	:	National Service Scheme
SLD	:	Single Line Diagram
THD	:	Total Harmonic Distortion
TR	:	Transformer

III. REFERENCES:

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

IV. CERTIFICATES

I. BEE Accreditation Certificate



ENERGY IS LIFE
BEE
CONSERVE IT

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, Rouund 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