ENERGY AUDIT – 2019-2020

SACRED HEART COLLEGE

CHALAKUDY, THRISSUR

EXECUTED BY

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February 2020

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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 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.

ACKNOWLEDGEMENTS

We express our sincere gratitude to the Sacred Heart College, Chalakudy, 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. Sr. Reena Ittyachan	Principal
2	Dr. Shirly Jose K	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

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   Certified Energy Auditor of Bureau of Energy Efficiency (BEE – Govt. of India)
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   Project Engineer

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   Project Engineer

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   Project Engineer

Yours faithfully

Managing Director
Athul Energy Consultants Pvt Ltd

EXECUTIVE SUMMARY

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 (90+30+46+22 nos) ceiling fan (70W) with BLDC (28W)	7947	58521	658000	135
	Total	**7947**	**58521**	**658000**	**135**

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 , Hostels	Change the existing old ceiling fans with BLDC fans	Power Consumption will get reduced
2	Energy consumption – Set temperature of AC in between 24 – 27 °C		Change the temperature using the remote	Power consumption will reduce. Increase the life time of AC.
3	Sanctioned Load enhancement	UG Hostel, PG Hostel, Pump	Sanctioned load needs to be enhanced to 20 kW, 16kW and 6kW W	Total connected load at college were observed as 18.12 kW, 14.35kW and 4.85 kW

PRESENT ANNUAL ENERGY CONSUMPTION

The present annual energy consumption has been analysed in table below

TABLE 3: PRESENT ANNUAL ENERGY CONSUMPTION

Particulars	Location	Unit	Quantity	Gross calorific value (kCal)	Million kCal (Toe)	Percentage of distribution (%)
Electricity	College	kWh	30795	860	2.65	46
Electricity	Self-financing Block	kWh	1244	860	0.11	2
Electricity	UG Hostel	kWh	7995	860	0.69	12
Electricity	PG Hostel	kWh	14139	860	1.22	21
Electricity	Pump	kWh	217	860	0.02	0.32
LPG		kg	683	10500	0.72	12
Diesel		L	420	9500	0.40	7
Total					**5.79**	**100**

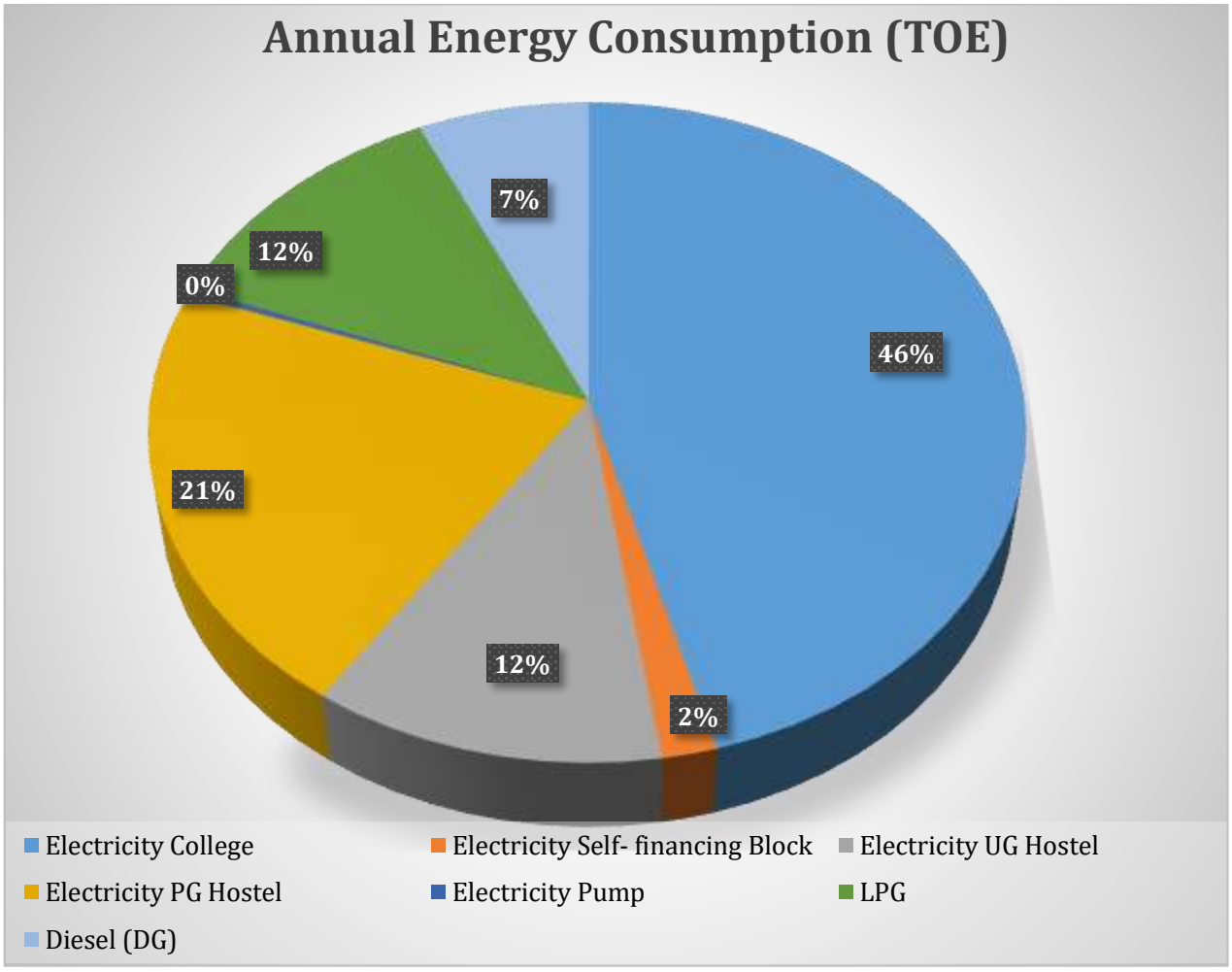


FIGURE 1: ANNUAL ENERGY CONSUMPTION

ENERGY PERFORMANCE INDEX (EPI)

EPI was based on the energy consumption in February 2019 to February 2020. The projected energy consumption after the implementation of energy saving proposals is given in the table below.

TABLE 4: ENERGY PERFORMANCE INDEX – COLLEGE

Sl. No:	Energy Performance	Unit	Baseline	Projection
1	Annual Electricity Consumption *	kWh	32039	28229
2	Annual Diesel Consumption	Litre	420	420
3	Annual LPG Consumption	kg	342	342
4	Energy Performance Index	TOE/m^2	0.00019	0.00017
5	Specific Energy Consumption	TOE/Head	0.00287	0.00260
6	Carbon Footprint - Electricity	Ton CO_2	25.31	22.30
7	Carbon Footprint - Diesel	Ton CO_2	1.01	1.01
8	Carbon Footprint - LPG	Ton CO_2	1.02	1.02
9	Annual Carbon Footprint	Ton CO_2	27.34	24.33

**Annual energy consumption (kWh)of college and self-financing block is considered*

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)
Liters of Diesel	=	9500 kCal (BEE energy audit manual)
kWh of electricity	=	860 kCal (BEE energy audit manual)

ANNUAL CARBON FOOTPRINT OF APPLIANCES

The present carbon dioxide generation by appliances and the projected value after the implementation of the energy conservation measures is given in the figure below

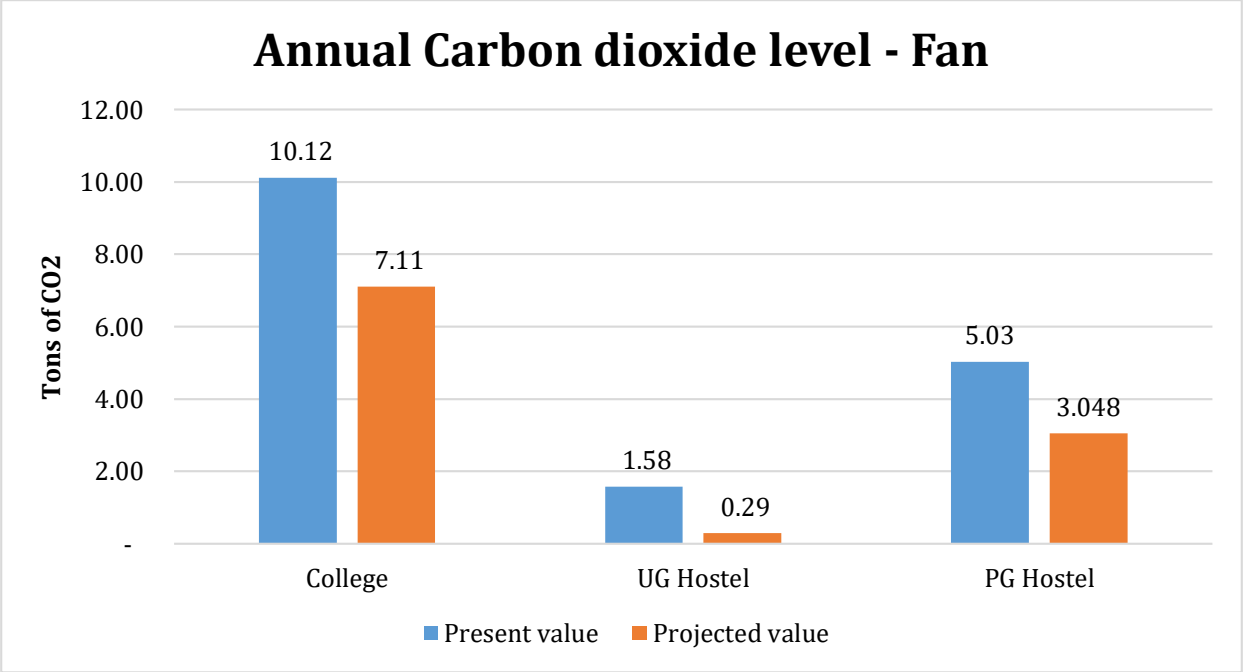


FIGURE 2: ANNUAL CO_2 EMISSION -

CARBON FOOT PRINT

Carbon foot print is often used as short hand for the amount of carbon emission (usually in Tonnes) 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. 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.
4. Installation of 25 kW solar power plant in the college

TABLE 5 CARBON FOOT PRINT

Particulars	Energy consumption reduction (kWh)	Carbon Emission reduction	% of total
Replacement of 181 numbers Tube light with LED	2346	1.85	9
Replacement of 383 numbers CFL with 9W LED	2234	1.76	8
Replacement of 150 numbers CFL with 12W LED	583	0.46	2
Solar power 25 kW installation	22400	17.70	81
Total	**27563**	**21.77**	**100.00**

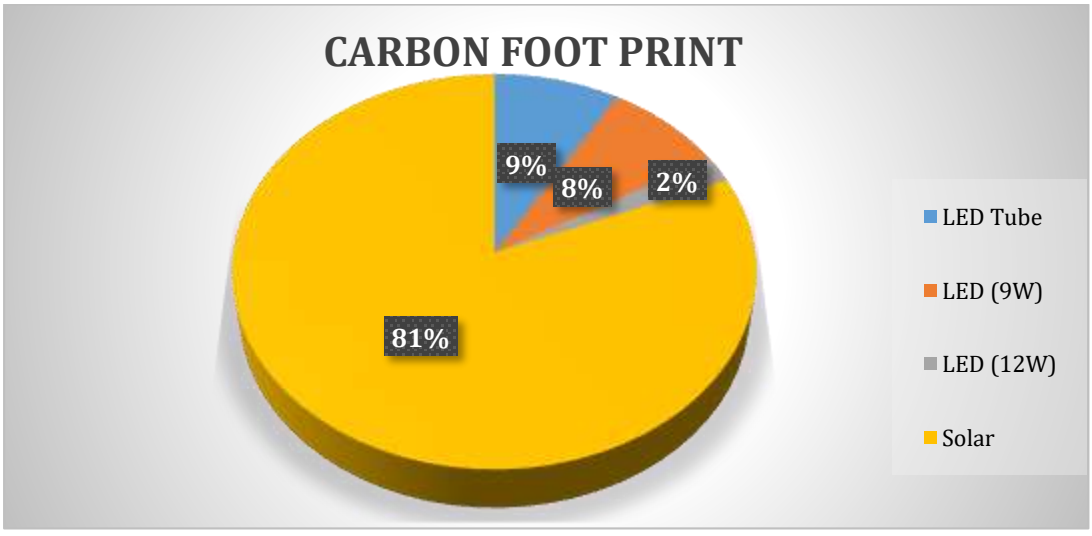


FIGURE 3: CARBON FOOT PRINT

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.
3. Power Quality Analysis.

II. SACRED HEART COLLEGE, CHALAKUDY

Sacred Heart College, Chalakudy is the realization of a long-cherished dream of the people of Chalakudy and the suburbs. The will of the people assisted by the blessings of heaven played a marvelous role in starting the college. The profound fellow feeling of the Clarist Sisters paved the way for the starting of the college in 1980 by the Alvernia Province of Franciscan Clarist Congregation. The college is affiliated to the University of Calicut and is aided by the Government of Kerala. Located within the municipal limits of Chalakudy with a 25.28-acres serene campus, the college provides a congenial ambience for the overall advancement of the students. In 1991, the college was upgraded to a first grade College by the Government of Kerala. At present the College offers 9 UG Programmes, 8 PG Programmes and 1 integrated PG programme (B Sc. & M Sc. Psychology). The College has completed 41 years of serving our nation in education.

Mission

The sacred mission of the college enshrines creative scholarship and enrichment of young minds not merely in acquired knowledge, but in the spirit of enquiry, harmonizing the spiritual and intellectual adventures. Fostering an excellent 'espirit de corps' (feeling of togetherness), we aspire to mould competent persons armed with academic excellence, ethical principles, social sensitivity and spiritual sublimity equipped for innovative leadership enabling their "Lux in Tenebris Lucet" (Light shines in Darkness)

Vision

That the people shall know, for, knowledge is power. Education opens one's inner eye to the inestimable glory and enduring beauty of wisdom. Committed to serving the nation and humanity, this college founded in His name, envisages the academic pursuit of truth and the search for righteous living as the supreme task"

FIGURE 4: COLLEGE LAYOUT

III. GENERAL DETAILS

The general details of the College are given below.

TABLE 6: GENERAL DETAILS

Sl.No:	Particulars	Details
1	Name of the College	Sacred Heart College, Chalakudy
2	Address	Sacred Heart College Railway Station Road, Chalakudy, Thrissur, Kerala - 680307 Ph: +91 480 2701159, +91 480 2704048
3	Contact Person	Mr.Nijo, Ph: 9496805788
4	E-mail ID	shcollegecky@gmail.com principalshcollegecky@gmail.com
5	Website Details	sacredheartcollege.ac.in
6	No: of Shifts	01 (9:00AM -4:00PM)
7	No: of students	1136
8	No: of teaching staff	68
9	No: of non-teaching staff	21
10	Total campus area	25.28 acres
11	Total built up area(M^2)	College – 15636 m^2 UG Hostel – 1835 m^2 PG House – 1050 m^2 Self-financing Block – 3257m^2

IV. 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

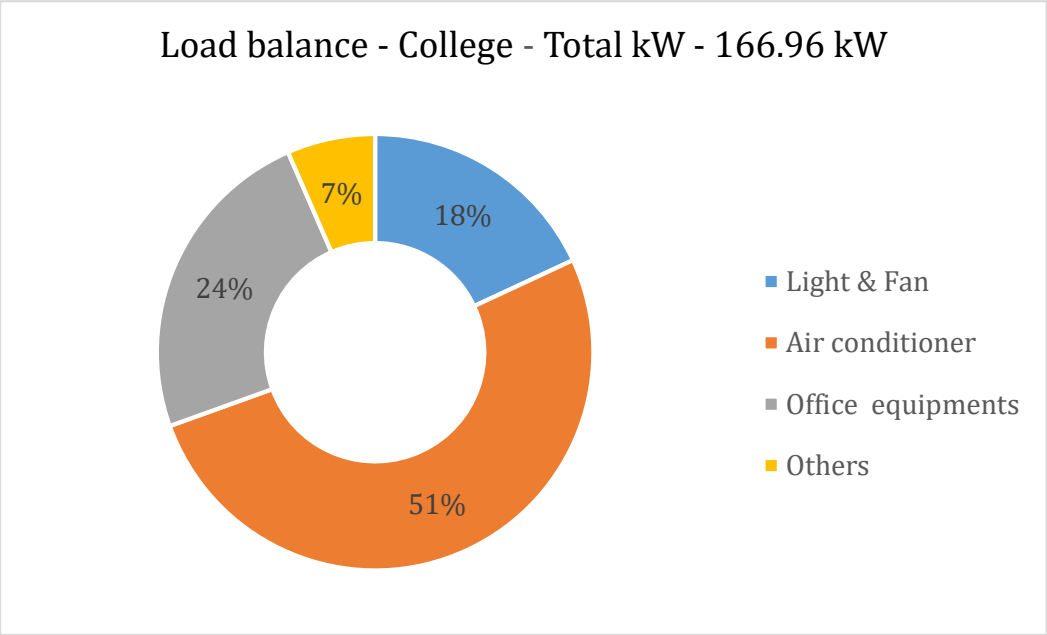


FIGURE 5: LOAD BALANCE-COLLEGE

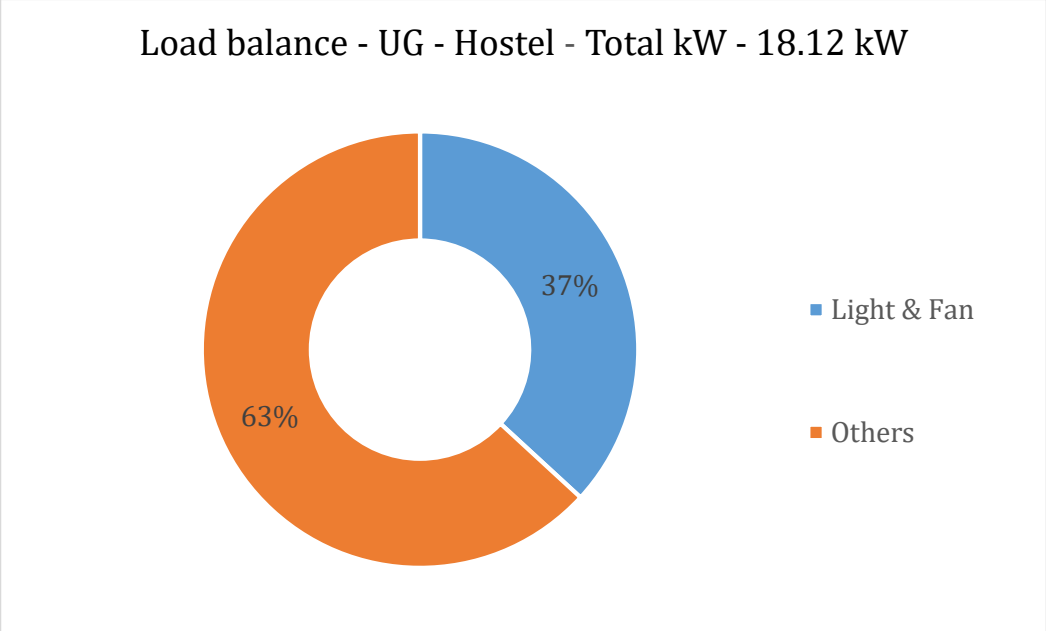


FIGURE 6: LOAD BALANCE- UG – HOSTEL

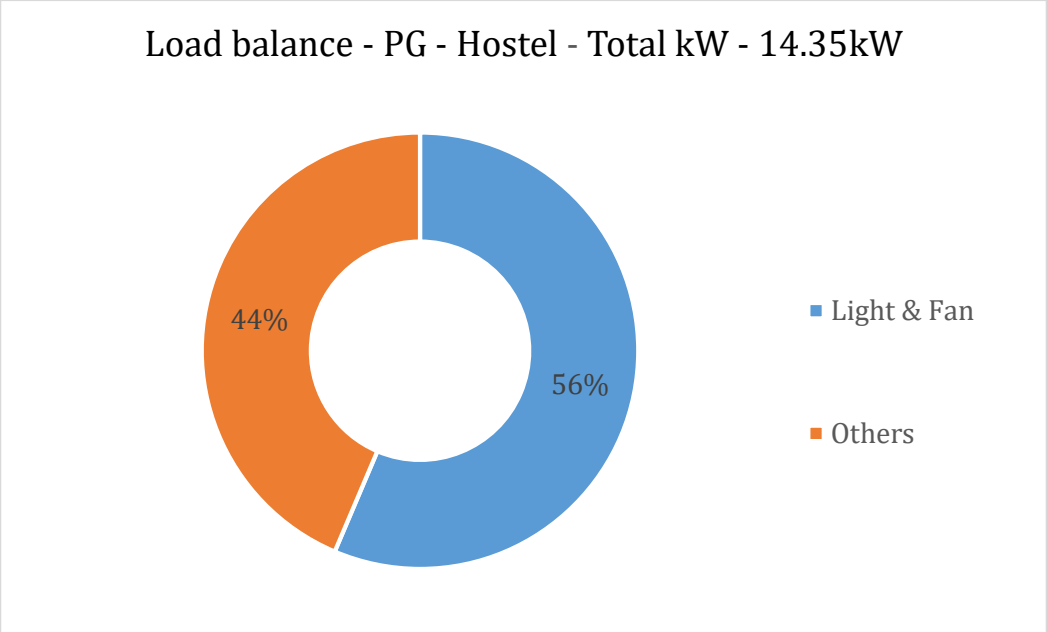


FIGURE 7: LOAD BALANCE- - PG– HOSTEL

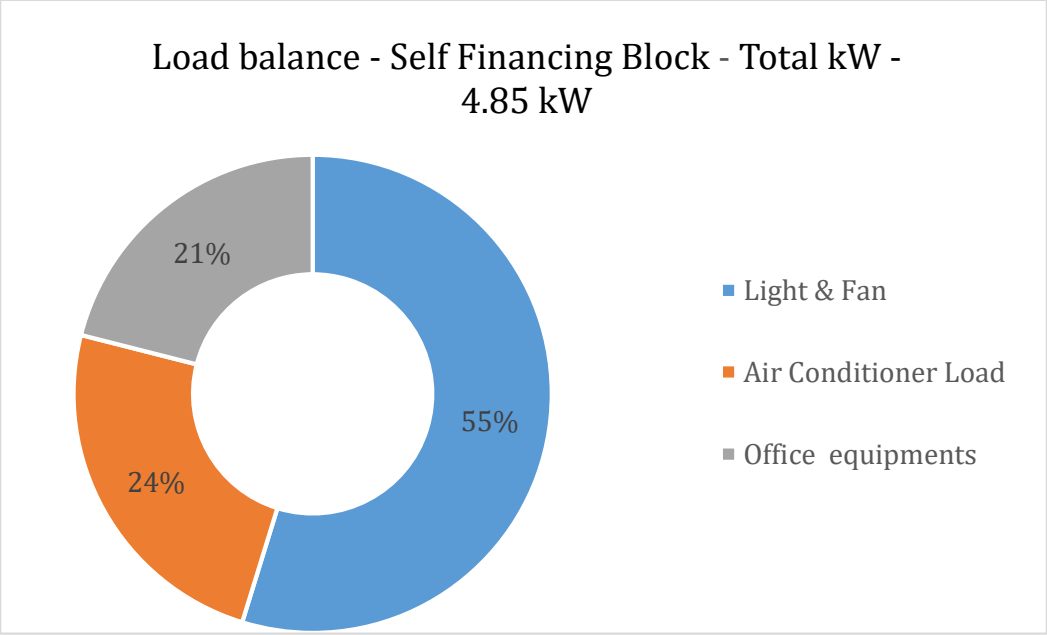


FIGURE 8: LOAD BALANCE- SELF FINANCING BLOCK

ENERGY & UTILITY DESCRIPTION

In this section 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:

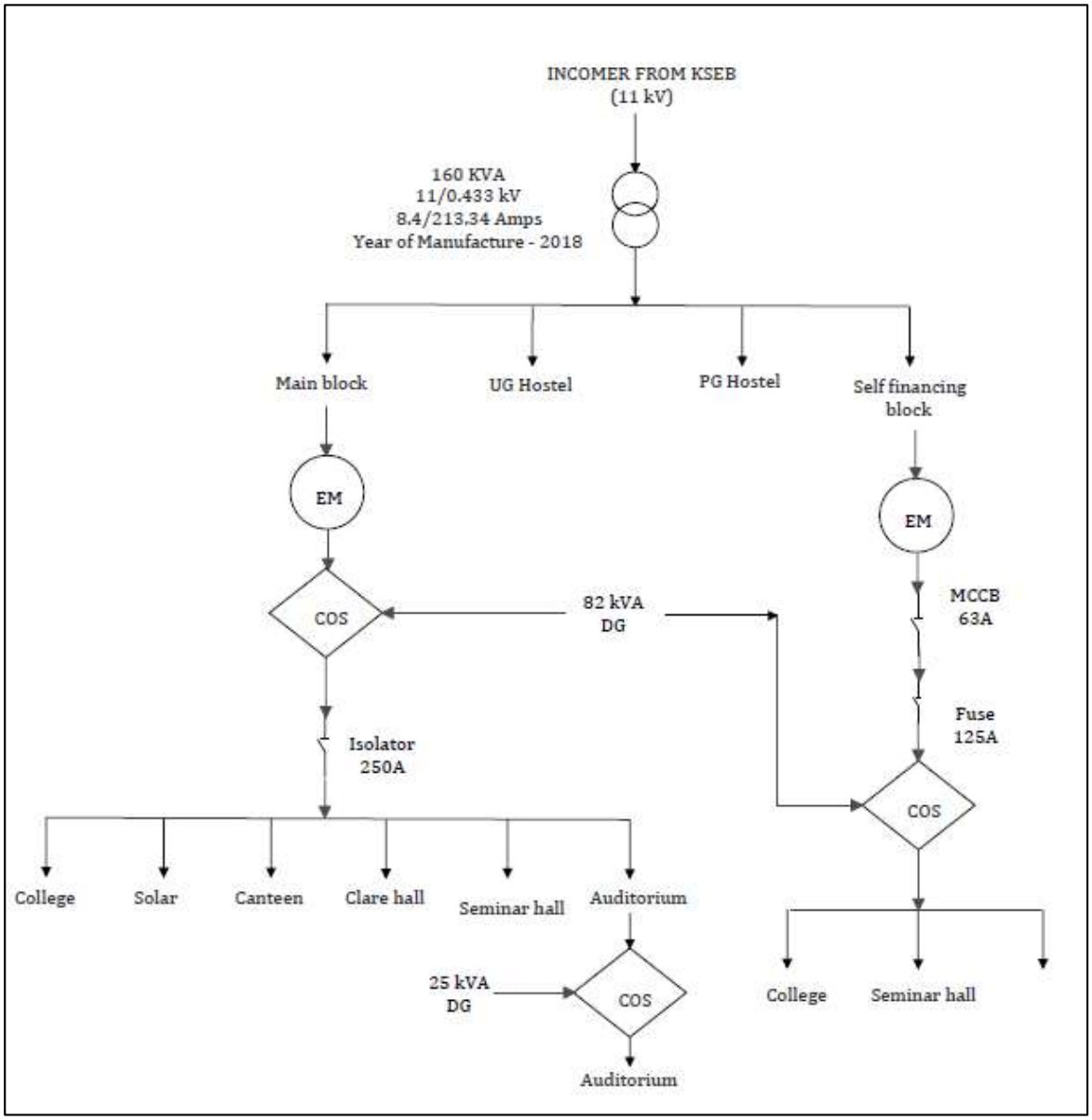


FIGURE 9: SINGLE LINE DIAGRAM – ELECTRICAL

II. SINGLE LINE DIAGRAM – WATER

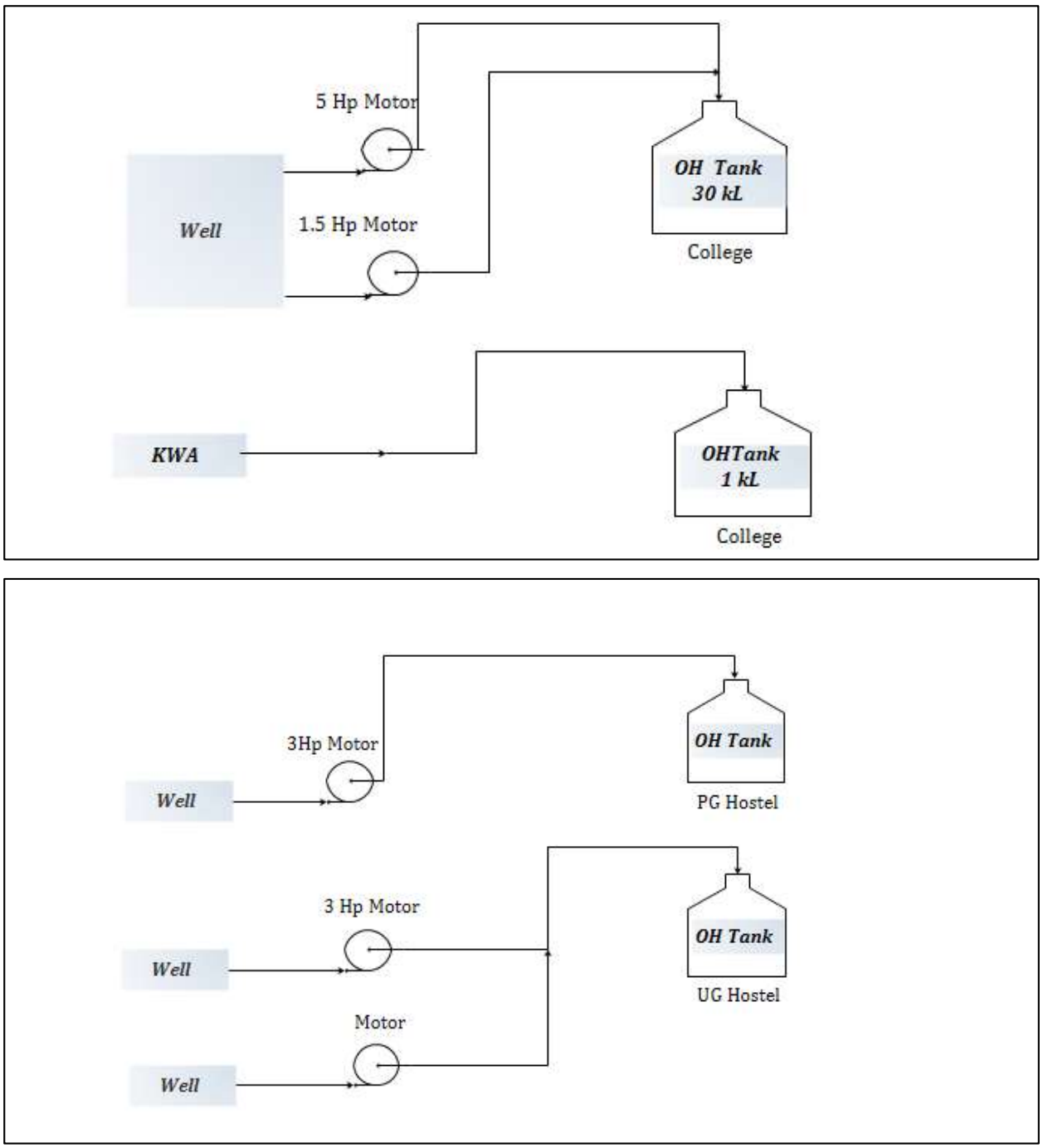


FIGURE 10: SINGLE LINE DIAGRAM - WATER

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 diesel for which the pattern of consumption described below.

ELECTRICITY CONSUMPTION ANALYSIS

The major source of electricity to the college is electrical connection from the KSEBL. Two diesel generators are 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 7: KSEBL BILL ANALYSIS

Particulars	College	Self-financing Block	Pump	UG - Hostel	PG - Hostel
Consumer No	1156510005283	1156519035264	1156515003680	1156514005282	1156515006233
Electrical section	Chalakkudy	Chalakkudy	Chalakkudy	Chalakkudy	Chalakkudy
Approved connected Load	209	10	2	14	13
Measured connected load	166.96	4.85	4.85	18.12	14.35
Tariff	LT-6A/Three	LT-6F/Three	LT-6A/Three	LT–6B /Three	
Average monthly consumption (kWh)	1173(KSEB)+1393(Solar)	104	18	666	1178
Average monthly electricity charges (Rs)	-	2146	327	6203	10136

II. SPECIFIC ELECTRICITY CONSUMPTION

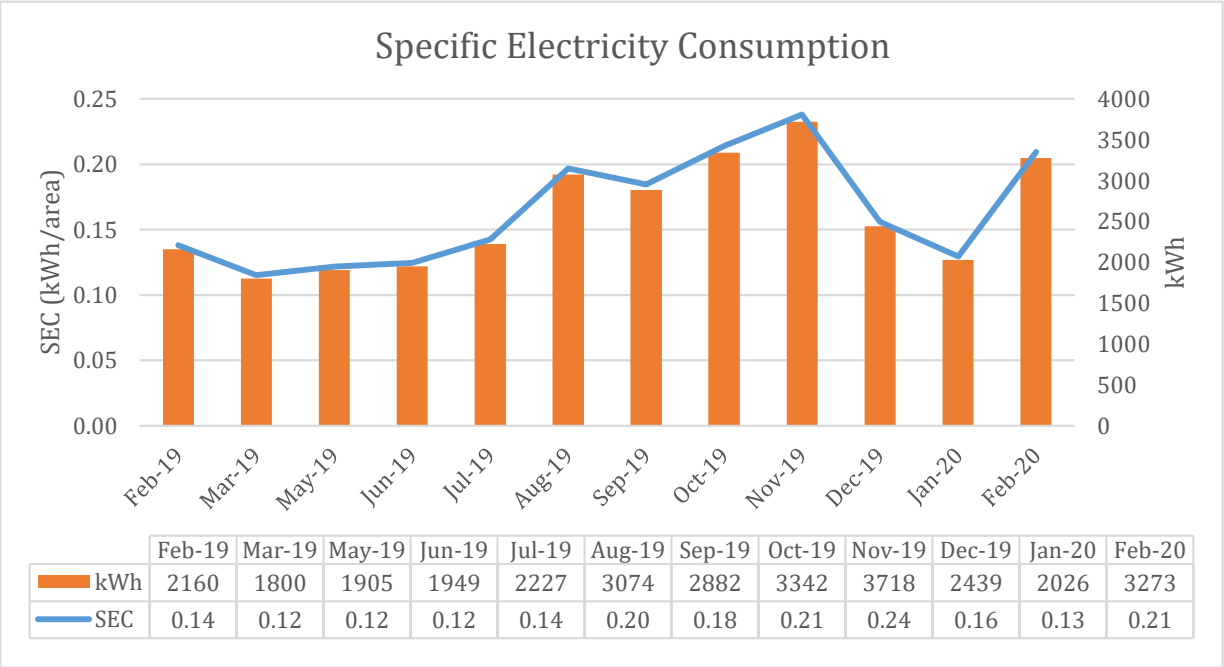
The electricity consumption from February 2019 to February 2020 has been taken for the benchmarking. Here the comparison is done with electricity consumption and the number of students and building area. The below table shows the specific electricity consumption of the college.

TABLE 8: SPECIFIC ELECTRICITY CONSUMPTION – COLLEGE

Month	Electricity Consumption	Number of Students	Build – up Area	SEC	SEC
	kWh	Number	m^2	kWh/Student	kWh/ m^2
Feb-19	2160	1136	15636	1.90	0.14
Mar-19	1800	1136	15636	1.58	0.12
May-19	1905	1136	15636	1.68	0.12
Jun-19	1949	1136	15636	1.72	0.12
Jul-19	2227	1136	15636	1.96	0.14
Aug-19	3074	1136	15636	2.71	0.20
Sep-19	2882	1136	15636	2.54	0.18
Oct-19	3342	1136	15636	2.94	0.21
Nov-19	3718	1136	15636	3.27	0.24
Dec-19	2439	1136	15636	2.15	0.16
Jan-20	2026	1136	15636	1.78	0.13
Feb-20	3273	1136	15636	2.88	0.21
Average	**2566**	**1136**	**15636**	**2.26**	**0.16**
Annual Specific Electricity consumption				**27.11**	**1.97**
Annual Electricity Consumption(kWh)				**30795**	

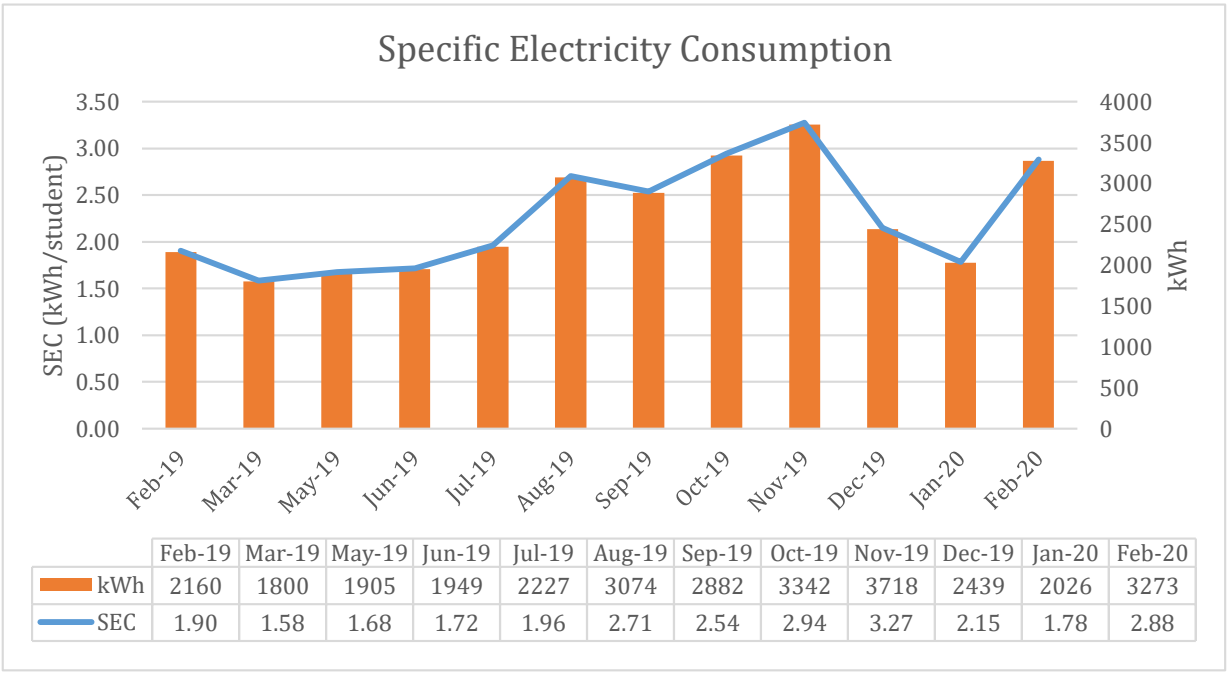
TABLE 9: SPECIFIC ELECTRICITY CONSUMPTION – SELF-FINANCING BLOCK

Month	Electricity Consumption	Total build-up area	SEC
	kWh	m^2	kWh/ m^2
Mar-19	40	3257	0.01
May-19	199	3257	0.06
Jul-19	351	3257	0.11
Sep-19	253	3257	0.08
Nov-19	199	3257	0.06
Jan-20	202	3257	0.06
Average	**207**	**3257**	**0.06**
Annual Electricity Consumption(kWh)			**1244**
Annual Specific Electricity consumption			**0.38**



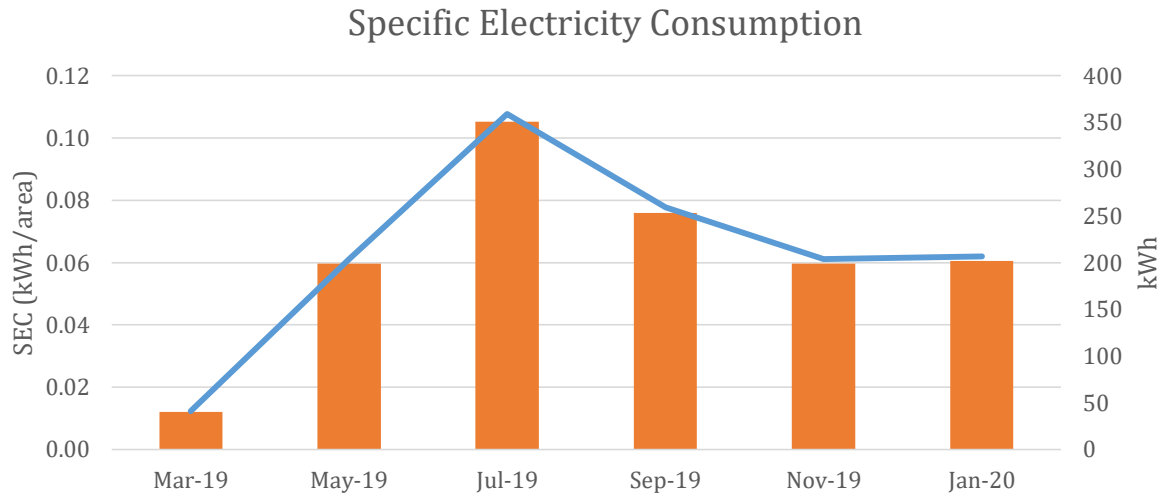
	Feb-19	Mar-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20
kWh	2160	1800	1905	1949	2227	3074	2882	3342	3718	2439	2026	3273
SEC	0.14	0.12	0.12	0.12	0.14	0.20	0.18	0.21	0.24	0.16	0.13	0.21

FIGURE 11:SPECIFIC ELECTRICITY CONSUMPTION(KWH/AREA) – COLLEGE



	Feb-19	Mar-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20
kWh	2160	1800	1905	1949	2227	3074	2882	3342	3718	2439	2026	3273
SEC	1.90	1.58	1.68	1.72	1.96	2.71	2.54	2.94	3.27	2.15	1.78	2.88

FIGURE 12:SPECIFIC ELECTRICITY CONSUMPTION(KWH/STUDENT) – COLLEGE



	Mar-19	May-19	Jul-19	Sep-19	Nov-19	Jan-20
kWh	40	199	351	253	199	202
SEC	0.01	0.06	0.11	0.08	0.06	0.06

FIGURE 13: SPECIFIC ELECTRICITY CONSUMPTION (KWH/AREA) – SELF-FINANCING BLOCK

III.UNINTERRUPTIBLE POWER SUPPLY (UPS)

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

TABLE 10: UPS DETAILS

Block	Floor	Location	Rated kVA	Make
Main Block	Ground Floor	PG Dept. of Physics	1.05	Beacon
		Dept. of Chemistry	1.05	Beacon
		Stair room	3	Beacon
	First Floor	Server Room	10	Numeric
		Language Lab	5	-
			5	-
		MSc Physics lab	3	APC
		Common	2.2	APC
		Common	5	MPPT
		Zoology Lab	2.2	APC
	Second Floor	Audio Visual Room	1	
Library Block	Ground Floor	Library	2.2	APC
	First Floor	Library	1.5	Luminious
Auditorium	Ground Floor		4	Beacon
PG Hostel	Ground Floor		1	-
	First floor		1	-
UG Hostel	Ground Floor		1	Amaron
	First floor		1	-

Suggestions

i. UPS room should be ventilated properly.
ii. Petroleum jelly should be applied to the battery terminals.
iii. Battery water checking should be done periodically.
iv. UPS room should be kept neat and clean.

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 11: ANNUAL LPG CONSUMPTION

Particulars	Annual consumption (Kg)	Calorific value* (TOE)
Canteen & Lab	342	0.36
PG Hostel	170	0.18
UG Hostel	170	0.18
Total	**683**	**0.72**

**Calorific value of LPG is 10500Kcal/Kg and 1 TOE means 1,00,00,00Kcal.*

DIESEL CONSUMPTION ANALYSIS

The Diesel is used mainly for generators. The details of the diesel consumption in the last academic year and generator details are given in the table below.

TABLE 12: ANNUAL DIESEL CONSUMPTION

Particulars	Annual consumption (Kg)	Calorific value (TOE)
Generator	420	0.40
Total	**420**	**0.40**

**Calorific value of Diesel is 9500Kcal/Kg and 1 TOE means 1,00,00,00Kcal.*

TABLE 13: GENERATOR DETAILS

Sl. No:	Rated kVA	Engine	Generator
1	82.5	Kirloskar	Kirloskar
2	25	Kirloskar	Kirloskar

MEASURED DATA

The measured parameters which we taken at the audit period are tabulated below:

TABLE 14: MEASURED DATA

Parameters Checked	Test Point	Readings Recorded	Normal Range at the branch
Voltage at incoming Panel (V)	L1-L2:	420.2	322 to 440
	L2-L3:	424.3	322 to 440
	L1-L3:	419.2	322 to 440
	L1-N:	242.6	186 to 254
	L2- N	244.95	186 to 254
	L3-N:	242.04	186 to 254
	N-E:	1.5	06 V at the farthest load point.
Current Reading at incoming Panel (I)	L1:	8.97	
	L2:	8.126	
	L3:	9.47	
	N:	1.18	
Power Consumed per phase (kW)	L1:	2.15	
	L2:	1.97	
	L3:	2.26	
Frequency of supply (Hz)	**L-N:**	50	47.5 to 50.5

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.

The institute has installed a **25kW** on grid solar system on top of building. The details of the solar system are given below:

FIGURE 14 : ROOFTOP SOLAR PV SYSTEM

TABLE 15 : SOLAR PV INVERTER SPECIFICATIONS

Particulars	Value
Inverter Make	Fronius
Power Rating	25 kW
DC Input Voltage	580 - 1000V
MPP Voltage	580-850 V
Short Circuit Current	71.6A
AC output Voltage	230/400V
Maximum output current	44.2A

TABLE 16 : SOLAR PV MODULE SPECIFICATIONS

Particulars	Value
Module Make	Waaree
Wattage of Module	320 W
Total number of Module	80
Open circuit voltage	45.3 V
Short circuit current	9.42 A
Maximum peak Voltage	36.8 V
Maximum peak Current	8.7 A

The total units generated by the solar PV system during the time period from February 2019 to February 2020 is summarized in the table below.

TABLE 17 : SOLAR PV SYSTEM - UNITS GENERATED AND CONSUMED

Month & Year	Units Generated (kWh)	Units Consumed from the Solar PV system in the building
Feb-19	0	0
Mar-19	0	0
May-19	2225	1065
Jun-19	1749	1069
Jul-19	1587	1107
Aug-19	3274	1994
Sep-19	3322	1962
Oct-19	2942	2302
Nov-19	3130	2402
Dec-19	2740	1744
Jan-20	1915	1122
Feb-20	2720	1953
Avg Generation	**2134**	**1393**
Total units generated	**25604**	**16720**

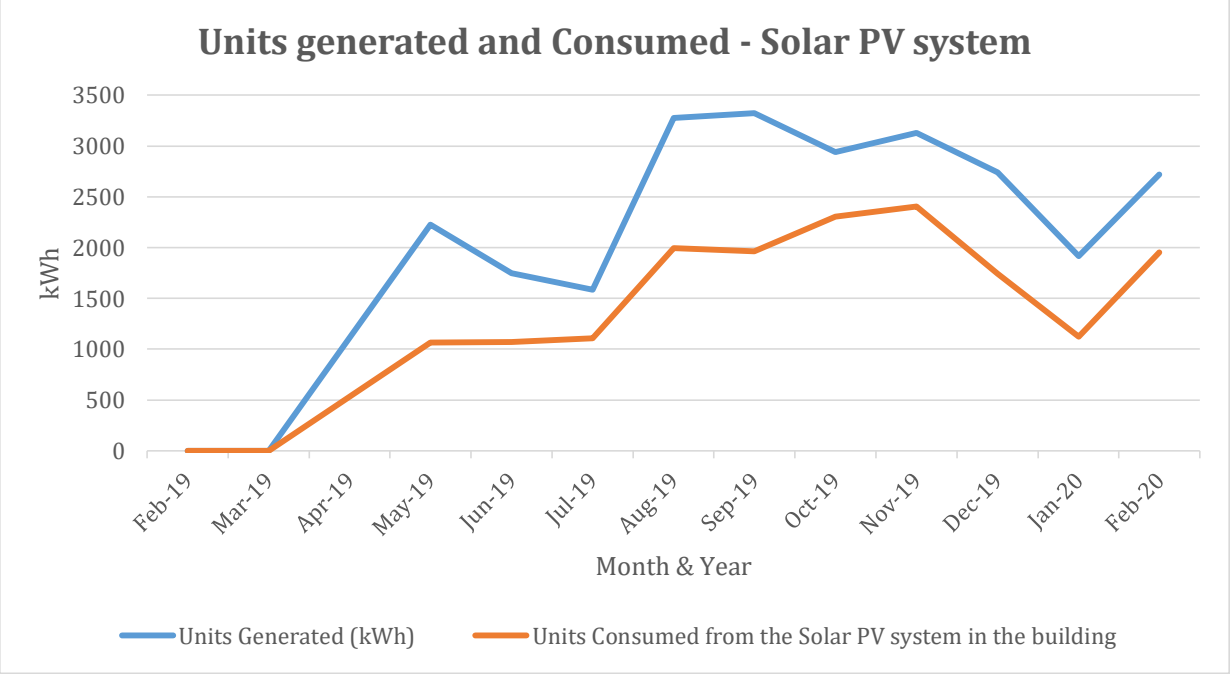


FIGURE 15 : SOLAR PV SYSTEM PERFORMANCE

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	UG Hostel	PG Hostel	Self-financing
Existing Ceiling Fans	Watts	70	70	70	70
Proposed BLDC Fans	Watts	28	28	28	28
Difference in Wattage	Watts	42	42	42	42
Avg No: of working hours/day	Hrs.	5	8	8	5
No: of working days per year (Average)	Days	162	162	162	162
Number of Fans operating	Nos	90	30	46	22
Energy Saving per Annum	**kWh/annum**	**3062**	**1633**	**2504**	**748**
Cost per kWh	Rs/kWh	7.15	7.70	7.70	6.38
Annual Financial Savings	**Rs/annum**	**21892**	**12574**	**19280**	**4775**
Cost of BLDC Fans	Rs/no	3500	3500	3500	3500
Investment for Fans	**Rs**	**315000**	**105000**	**161000**	**77000**
Simple Payback period	**Months**	**173**	**100**	**100**	**194**

SUMMARY

Annual unit savings	kWh/annum	7947
Total savings	Rs/annum	58,521
Total investment	Rs	658,000
Payback period	Months	135

ANNEXURE 2

CONNECTED ELECTRICAL LOADS

I. COLLEGE

- ***Air Conditioner Load***

TABLE 19: AIR CONDITIONER LOADS – COLLEGE

Block	Floor	Location	Make	Type	Capacity (Tr)	EER	Star rating	Working condition	Rated power (W)
Main Block	Ground	Guest Room	Whirlpool	Split	1.5	3.41		Good	1173
		Luminous Hall	Carrier	Duct	11			Good	13750
			Carrier	Duct	11			Good	13750
	First	MSc CS lab	Whirlpool	Split	1.5	3.41		Good	1173
		Server Room	LG	Split	2	2.6	2	Good	1970
		BSC CS Lab	Whirlpool	Split	1.5		3	Good	1314
			Whirlpool	Split	1.5		3	Good	1314
		Principal Room	Carrier	Duct	3			Good	3750
		Conference Hall	Blue Star	Split	1		3	Good	1250
			Blue Star	Split	1		3	Good	1250
		Centre of Excellence	LG	Split	2	2.6	2	Good	1970
			LG	Split	2	2.6	2	Good	1970
Library	First	Clare Hall	Bluestar	Duct	11			Good	13750
			Bluestar	Duct	11			Good	13750
			Bluestar	Duct	11			Good	13750
Total (W)									**85884**

- ***Fan Load***

TABLE 20: FAN LOADS – COLLEGE

Particulars	Ceiling Fan	Wall Fan	Wall Fan	Pedestal Fan	Exhaust Fan	Exhaust Fan
Watts	**70**	**30**	**60**	**60**	**30**	**120**
Nos	262	4	35	5	6	4
Total (kW)	18.34	0.12	2.1	0.3	0.18	0.48
Net total (kW)	**21.52**					

- ***Light load***

TABLE 21: LIGHT LOADS – COLLEGE

Particulars	LED Strip	LED Tube Light	LED	LED	LED	LED	LED	LED SPOT	LED SPOT	CFL	T12	T8
Watts	**23**	**20**	**15**	**9**	**5**	**12**	**25**	**150**	**50**	**14**	**40**	**36**
Nos	1	87	12	230	82	150	7	3	2	7	22	20
Total (kW)	0.0235	1.74	0.18	2.07	0.41	1.80	0.18	0.45	0.10	0.10	0.88	0.72
Net total (kW)	**8.64645**											

- ***Computer and Other Equipment***

TABLE 22: COMPUTER AND OTHER EQUIPMENT – COLLEGE

Particulars	PC	Projector	Interactive Panel	Xerox	Printer 3 in 1	Printer	Scanner	Amplifier	Amplifier	TV	Water Dispenser	Weighing M/c	Kettle	Fridge	Induction Cooker	Freezer
Watts	**120**	**100**	**150**	**750**	**300**	**120**	**80**	**150**	**700**	**80**	**120**	**80**	**1500**	**165**	**1500**	**335**
Nos	143	29	14	4	9	13	1	4	3	3	4	1	1	4	3	1
Total (kW)	17.16	2.9	2.1	3	2.7	1.56	0.08	0.6	2.1	0.24	0.48	0.08	1.5	0.66	4.5	0.335
Net total (kW)	**39.995**															

- ***Lab Equipment***

TABLE 23: LAB EQUIPMENT – COLLEGE

Particulars	Water Bath	Hot Air Oven	Furnace	Motor	Shaker	Centrifuge	Weighing M/C	Calorimeter	Hot Air Oven	Incubator	Distillation Unit	Hot Air Oven	Luminar Air Flow
Watts	**2000**	**1000**	**1500**	**186**	**110**	**250**	**20**	**20**	**2500**	**500**	**350**	**300**	**400**
Nos	1	1	2	1	3	1	3	2	1	1	1	1	1
Total (kW)	2	1	3	0.186	0.33	0.25	0.06	0.04	2.5	0.5	0.35	0.3	0.4
Net total (kW)	**10.916**												

II. PUMP

TABLE 24: LOAD MATRIX-PUMP HOUSE

Particulars	Pump-1	Pump-2
Watts	**1119**	**3729**
Nos	1	1
Total (kW)	1.12	4
Net total (kW)	**4.487**	

III. UG HOSTEL

TABLE 25: LIGHT & FAN LOAD -UG - HOSTEL

Particulars	Ceiling Fan	Wall Fan	Pedestal Fan	CFL	LED Tube Light	LED Tube Light	LED	LED	T12	T8	Exhaust Fan
Watts	**70**	**60**	**60**	**14**	**10**	**20**	**9**	**5**	**40**	**36**	**50**
Nos	50	8	2	24	1	27	61	4	14	10	4
Total (kW)	3.5	0.48	0.12	0.336	0.01	0.54	0.549	0.02	0.56	0.36	0.2
Net total (kW)	**6.675**										

TABLE 26: LOAD MATRIX -UG - HOSTEL

Particulars	PC	Amplifier	Water Dispenser	Fridge	Incinerator	Iron box	Mixi	Motor
Watts	120	150	120	165	1500	1500	790	2237
Nos	2	1	3	1	2	3	1	1
Total (kW)	0.24	0.15	0.36	0.165	3	4.5	0.79	2.24
Net total (kW)	11.422							

IV. PG HOSTEL

TABLE 27: COMPUTER AND OTHER EQUIPMENT – PG – HOSTEL

Particulars	PC	Amplifier	TV	Water Dispenser	Fridge	Iron box	Freezer	Mixi	Motor
Watts	120	150	120	120	165	1500	335	790	2237
Nos	3	1	2	4	1	1	1	1	1
Total (kW)	0.36	0.15	0.24	0.48	0.165	1.5	0.335	0.79	2.24
Net total (kW)	6.257								

TABLE 28: LIGHT & FAN LOAD -PG - HOSTEL

Particulars	Ceiling Fan	Ceiling Fan	Wall Fan	Pedestal Fan	CFL	CFL	LED Tube Light	LED	LED	LED tube	T8	LED	spot light
Watts	70	30	60	60	36	14	20	9	5	36	36	25	9
Nos	79	1	2	1	2	2	58	77	43	3	1	1	2
Total (kW)	5.53	0.03	0.12	0.06	0.072	0.028	1.16	0.693	0.215	0.108	0.036	0.025	0.018
Net total (kW)	8.095												

V. SELF-FINANCING BLOCK

TABLE 29: LOAD MATRIX -SELF FINANCING BLOCK

Particulars	Ceiling Fan	Wall Fan	Pedestal Fan	Exhaust Fan	LED Tube Light	LED	LED	T8	PC	Projector	Printer 3 in 1	Interactive panel
Watts	**70**	**60**	**60**	**50**	**20**	**9**	**5**	**36**	**120**	**100**	**300**	**150**
Nos	24	2	1	2	9	15	4	10	1	3	1	2
Total (kW)	1.68	0.12	0.06	0.1	0.18	0.135	0.02	0.36	0.12	0.3	0.3	0.3
Net total (kW)	**3.675**											

ANNEXURE-3

I. ABBREVIATIONS

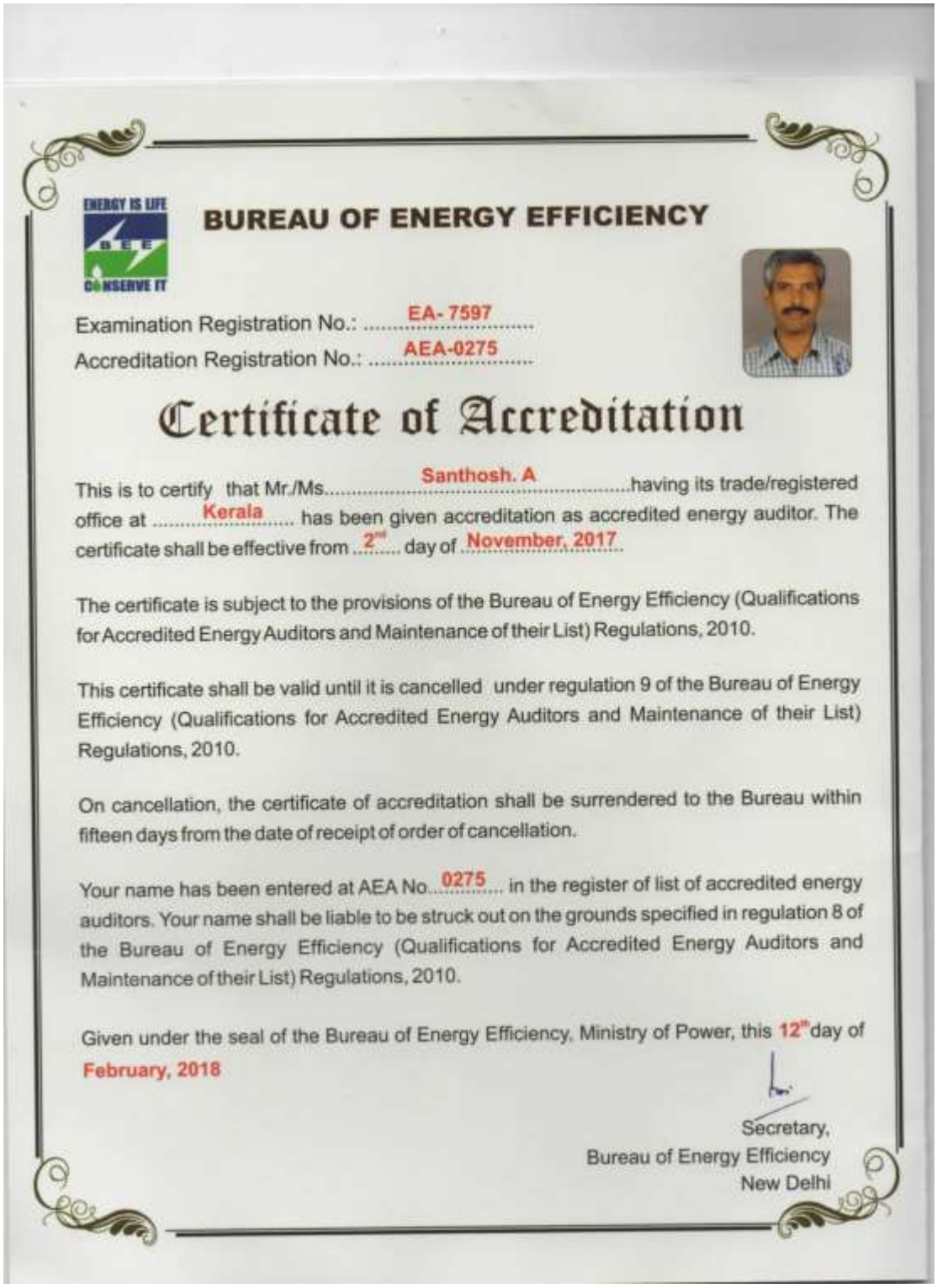
AVG	:	Average
BEE	:	Bureau of energy efficiency
CO_2	:	Carbon dioxide
KSEB	:	Kerala State Electricity Board.
DB	:	Distribution Board
EC	:	Energy Conservation
IEEE	:	The Institute of electrical and electronics engineers
IS	:	Indian Standard
kL	:	kilo Liter
KSEBL	:	Kerala State Electricity Board Limited
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, 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