ENERGY AUDIT

2020-21

MES COLLEGE MARAMPALLY

Aluva, Ernakulam

Kerala

EXECUTED BY

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March 2021

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ACKNOWLEDGEMENTS

We express our sincere gratitude to the **MES College Marampally, Aluva**, 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. The energy audit conducted in the month of March 2021.

1. Jb. M A Mohammed — Chairman, College Managing Committee
2. Adv. A A Abul Hassan — Secretary & Correspondent, College Managing Committee
3. Jb. V A Pareed — Treasurer, College Managing Committee
4. Dr. Ajims P Mohammed — Principal
5. Dr. Manzur Ali P.P. — Vice Principal & IQAC Co-ordinator
6. Shri K. P. Mohammed Shareef — Junior Superintendent

Also congratulating 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 – AEA-0275

2. **Mr. Ashok KMP**
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   Energy Auditor No – EA 25612

3. **Mr. Jaideep P P,** M Tech, Energy Engineering.

Yours faithfully

Managing Director
Athul Energy Consultants Pvt Ltd

1. GENERAL DETAILS

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

Table 1 GENERAL DETAILS

SL. NO	PARTICULARS	DETAILS
1	Name & Address of college	MES College Marampally, Aluva, Ernakulam Kerala 683107
2	Contact person	Dr. Raphika P M Associate Professor MES College Marampally.
3	Location: Latitude & Longitude	10.1066° N, 76.4115° E
4	No. of Teaching staff	136
5	No. of Non-Teaching staff	54
6	No of students	2784
7	Building area	18885m^2
8	Land area	25 acres
9	Number of UG programs	17nos
10	Number of PG programs	09 nos
11	Number of departments	19nos
12	Hostel mates	150 nos
13	Average annual working days	263 days, (139 for odd and 124 for even semester)
14	DG Set	50 kVA (2 each)
15	Transformer	200 kVA (1 No)

2. ENERGY SAVING PROPOSALS

The following table shows the energy saving proposals

Table 2 ENERGY SAVING PROPOSALS

Sl no	Particulars	Annual energy Savings (kWh)	Annual Financial Savings (Rs.)	Investment (Rs)	Simple payback Period (Months)
1	Replacement of ceiling fans with BLDC Super fans -20 No;	1600	11440	60,000	63
2	Replace od conventional fans with Energy Efficient fans 20 Nos	750	5363	34,000	76
3	Replacement of existing Tube fitting with LED. T-12, CFL-23 and CFL -18	3712	26541	30500	14
	Total	6062	43344	1,24,500	34

3. AUDIT SUMMARY - ACTIONS

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

Table 3 ENERGY AUDIT SUMMARY -ACTIONS

Sl No:	Particulars	Location	Action to be taken	Remarks
1	Replacement of ceiling fans with BLDC fans	Classrooms, Staff rooms	Change the existing old ceiling fans with BLDC fans	Energy consumption will come down
2	Replacement of old split AC with New 5 star rated ones	Computer Labs, Office Rooms	Change the old existing ACs with 5 star ACs.	Energy consumption will come down
3	Replacement of Fluorescent lights with LED	Class rooms, Staff rooms	Replace with LED lights.	Energy consumption will come down

4. ENERGY AUDIT SUMMARY & RECOMMENDATIONS

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

1. **Electricity consumption analysis:**

- Presently 1 LT connection in the college premises. Which they are going to convert into HT connection
- College is benefitted with space in its roof top hence they can go for more solar installations in their facility and go for zero billing and claimed as solar powered college or Green college**.**
- **Air conditioners:** Replacement of old AC's with new energy efficient star rated AC's.
- **Light loads:** Majority of the lighting fixtures are fluorescent type (T12). By replacing these loads with LED light fittings will reduce the overall power consumption.
- **Ceiling fan loads:** Ceiling fans are installed in majority of the areas by replacing it with Brushless DC fans which consumes in the range of 25 to 30W at full speed, instead of 70W in normal fans, will reduce the power consumption considerably. Also while purchasing new fans priority should be given for BLDC.

ENERGY AUDIT

OBJECTIVES

An energy audit is a key to assessing the energy performance of 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 energyconsumption."

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 mes Marampally as per the request, 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.

Details 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.

ABOUT MES COLLEGE MARAMPALLY

M.E.S College -Marampally, situated in the KSRTC Route of Aluva-Perumabavoor route., is

the dream child of the MES Group of institutions in the field of Higher education. MES Group foreseen that this college requirement would cater to the educational needs of the suburban villages, in and around Aluva and Perumbavoor. M.E.S. College Marampally is a Government Aided college affiliated to Mahatma Gandhi University, Kottayam, established in the year 1995. The College has reaccredited by NAAC with A+ Grade (CGPA, 3.38) which is the first ever highest grade in the State as per the revised process of accreditation.

The Principal, the teaching staff, and the non-teaching staff work together as a well-knit team. The dedication, competence, and diligence of the staff have raised the reputation of the college within a short span of time. The college encourages many co-curricular activities, thus playing a major role in molding the personality and empowering the young ladies to rise to the challenges in their daily life. The main thrust is to make them respond creatively and positively to the various needs of the society and the community they live in. Thus, the NSS, NCC, Career Guidance, AIDS Awareness Cell, Reader's Club and Nature Club function effectively. Apart from these, various Enrichment Programs are being planned and conducted for the holistic development of the students.

The Campus, spread out in a hilly stretch surrounded by lush greenery, is a sure sight of delight for a lover of nature. The College is also in close vicinity to the river Periyar and very near to the city of Kochi and the International Airport, the satellite view of the college is shown in the following Figure 1. The academic building of the college is marked with the college name. The college ground is located west of this building. There is a plantation of banana plants south of the college ground. The College hostel building is located south of this plantation. Other main buildings are located south of the academic building.

The College offers Seventeen UG Programmes such as Computer Applications (BCA), B.Sc. Electronics, Business Administration (BBA), B.Com. (Model II), B.Com. (Taxation), B.Sc. Biotechnology, B.Sc. Microbiology, B.Sc. Physics (Model II) B.Sc. Mathematics (Model II), B.A. English, (Three Main) B.A. Arabic (Model II), B.Sc. Psychology, B. Voc. Logistics Management, B. Voc. Animation & Graphic Design, B. Voc. Software Development & System Administration, B. Voc. Fashion Designing & Management and B. Voc. Industrial Instrumentation & Automation and Nine Post Graduate programmes viz. M.Sc. Biotechnology, M.Sc. Electronics, M.Com. M.Sc. Microbiology, M.Sc. Biochemistry, M.A. English Language and literature, M.Sc. Computer Science, MHRM and M.Sc. Physics.

ELECTRICITY CONSUMPTION ANALYSIS

1. ELECTRICITY BILLS ANALYSIS

The Electricity bills analysis of the college and other buildings are given below:

College Building

Table 4 EB BILL SUMMARY COLLEGE

Base Line Data (Based on last Financial year 2020-21)		
1	Electricity provider	KSEBL
2	Tariff	LT-6A/Three
3	Consumer number	1155846010859
4	Connected Load (kW)	81.832 kW
5	Average monthly electricity consumption (kWh)	4920
6	Average Fixed charges	6300
7	Energy charge (Rs / kWh)	6.3
8	Fixed charge (Rs / kW)	65
9	Average monthly electricity cost (Rs)	39,577

College Hostel

Table 5 EB BILL SUMMARY -COLLEGE HOSTEL

Base Line Data (Based on last Financial year 2020-21)		
1	Electricity provider	KSEBL
2	Tariff	LT-6A/Three
3	Consumer number	1155841015860
4	Connected Load (kW)	15.898 kW
5	Average monthly electricity consumption (kWh)	932
6	Average Fixed charges	1040
7	Energy charge (Rs / kWh)	6.5
8	Fixed charge (Rs / kW)	65
9	Average monthly electricity cost (Rs)	7730

2. BILL ANALYSIS

The average monthly energy consumption details of the college are given below:

Table 6 EB BILL ANALYSIS COLLEGE

Month	Consumption	Energy Charge	Fixed Charge	Electricity Duty	Surcharge/GST	Meter Rent	Total
Apr-20	4180	27170	5330	2717	2	65	35284
May-20	4520	29380	5330	2938	452	65	38100
June-20	9782	63586	5330	6359	0	65	75340
July-20	10810	69904	5330	6990	0	65	82056
Aug-20	3287	21366	5330	2136	0	65	28833
Sep-20	3287	21366	5330	2136	0	65	28833
Oct-20	3120	20150	5330	2015	77	65	27572
Nov-20	3100	20150	5330	2015	37	65	27532
Dec-20	2900	18850	5330	1885	0	65	26130
Jan-21	2220	14300	5330	1430	32	65	21092
Feb-21	6920	35620	5330	3562	0	65	44577

College Hostel

Table 7 EB BILL ANALYSIS COLLEGE HOSTEL

Month	Consumption	Energy Charge	Fixed Charge	Electricity Duty	Surcharge	Meter Rent	Total
Apr-20	516	3354	1040	335	3	15	4747
May-20	540	3510	1040	351	3	15	4919
June-20	440	2860	1040	286	46	15	4247
July-20	420	2730	1040	273	0	15	4058
Aug-20	350	2275	1040	228	10	15	3568
Sep-20	450	2925	1040	293	0	15	4273
Oct-20	700	4550	1040	455	0	15	6060
Nov-20	810	5265	1040	527	0	15	6847
Dec-20	712	4628	1040	463	2	15	6148
Jan-21	2160	14040	1040	1404	0	15	16499
Feb-21	3163	20560	1040	2056	0	15	23674

3. ENERGY CONSUMPTION ANALYSIS- COLLEGE

The below figure shows the monthly consumption of college.

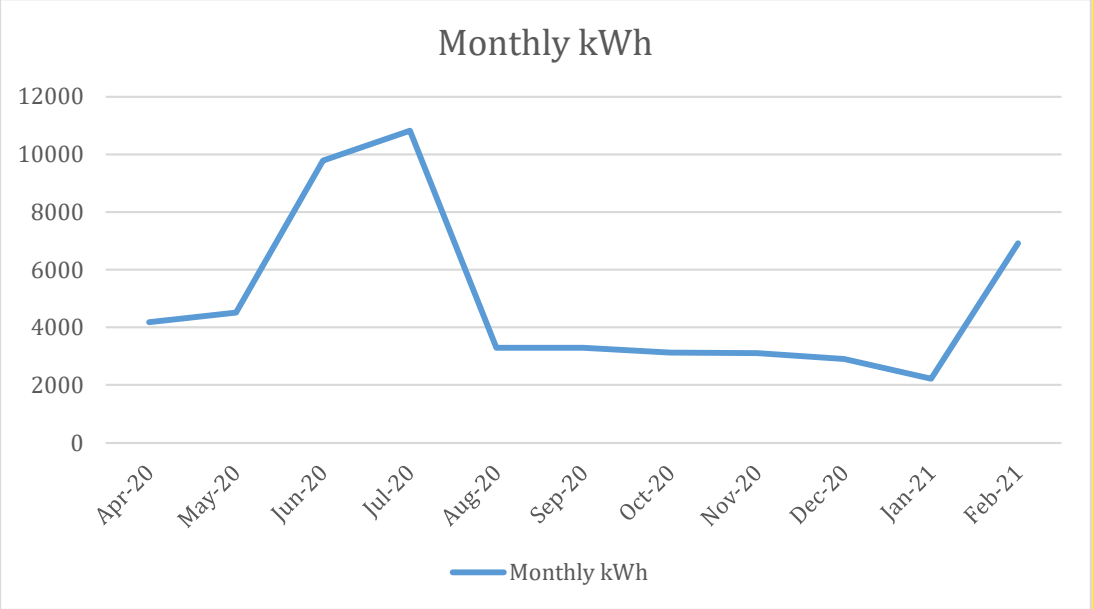


FIGURE 1: MONTHLY KWH VARIATION-COLLEGE

- During the last year, consumption is found to be higher in the month of July 2020 & less in the month of January 2021.
- kWh consumption varies as per the seasonal variation.

4. TARIFF RATES ANALYSIS- COLLEGE

The average monthly energy and demand charges for the past financial year is represented in Figure below.

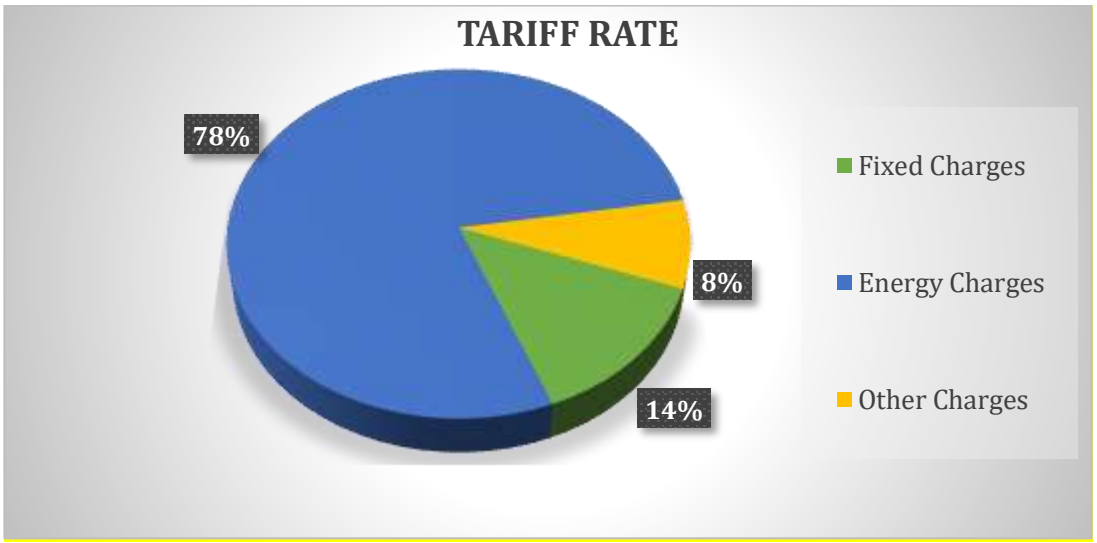


FIGURE 2: TARIFF RATE- COLLEGE

Inference

i. Average fixed charges for the past one year were Rs 5330/ per month and energy charges was Rs 31,076/ per month.

ii. The energy charges came about 85% of the total bill.

5. ENERGY CONSUMPTION ANALYSIS- HOSTEL

The below figure shows the monthly consumption of hostel.

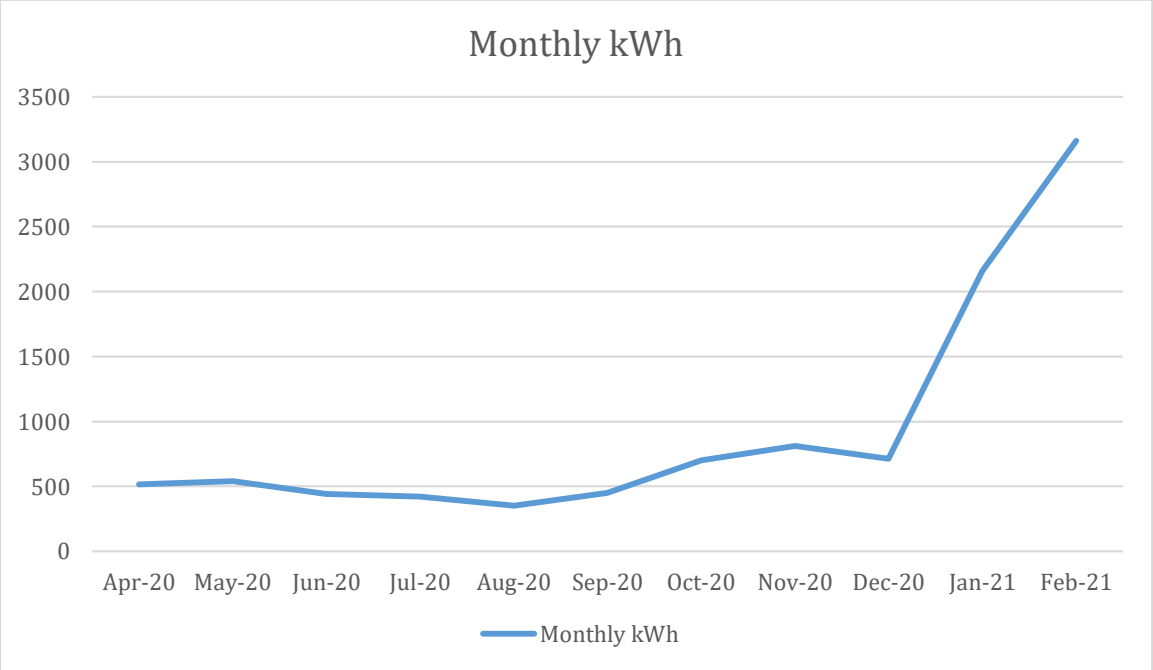


FIGURE 3: MONTHLY KWH VARIATION- HOSTEL

- During the last year, consumption is found to be higher in the month of February 2021 & less in the month of August 2020.

6. TARIFF RATES ANALYSIS- HOSTEL

The average monthly energy and demand charges for the past financial year is represented in Figure below.

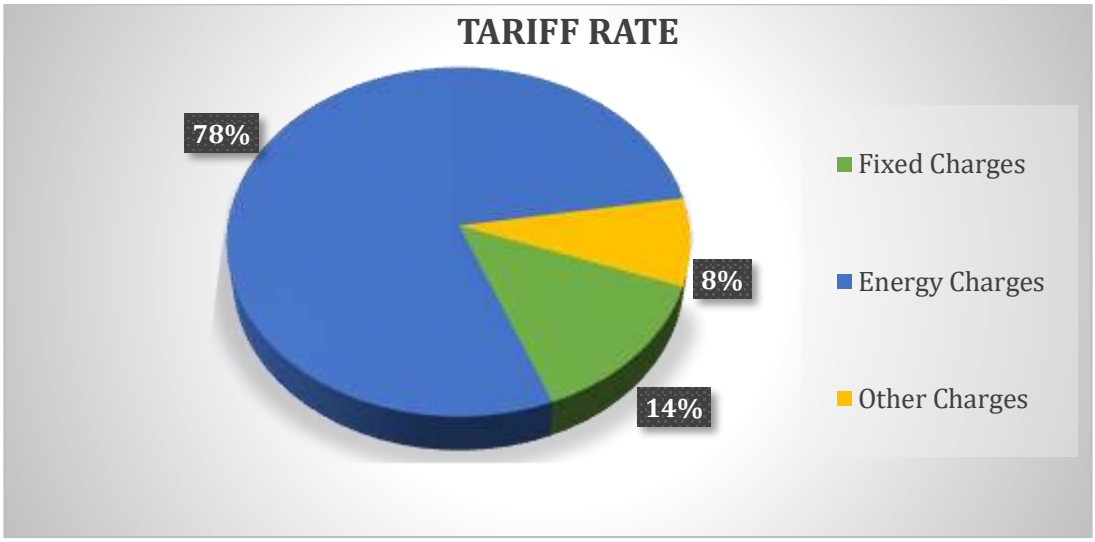


FIGURE 4: TARIFF RATE- HOSTEL

Inference

iii. Average fixed charges for the past one year were Rs 1,030 per month and energy charges was Rs 6,063 per month.

iv. The energy charges came about 78% of the total bill.

7. CONNECTED ELECTRICAL LOAD

The connected load details of MES College -Marampallly are given below in the Table:

Table 8 CONNECTED ELECTRICAL LOAD DETAILS

Sl.No:	Particulars	Power in kW
1	Lighting load	20.21
2	Ceiling Fan	13.86
3	UPS	20
4	Computer and Printer load	15.75
5	Air conditioner	6.3
6	Pumps	9.5
7	Miscellaneous	8.9
	Total	94.52

LIGHT AND FAN LOADS

The light and fan details in the college building are given below:

Table 9 LIGHT AND FAN LOADS

Particulars	Total Power	Quantity	Total Power
	Watts	Nos	kW
T8	40	180	**7.2**
T12	20	140	**2.8**
CFL	15	40	0.6
CFL	08	20	0.16
LED	8	90	0.72
LED	15	50	0.75
LED Tube	18	180	**3.24**
Ceiling fan	60	224	**13.44**
Metal Halide	150	06	**0.9**
Total			29.81

COMPUTER AND UPS LOAD

UPS Load

Table 10 UPS LOAD

Sl. No:	Location	UPS		Battery		
		Rated kVA	**Make**	**Rating**	**Nos**	**Make**
1	Electrical Room	12.5	Igatech	12V, 60Ah	20	Exide
2	Electrical Room	2	Igatech	12V, 100Ah	6	Exide
3	Project Management Lab	10	Unitek	12V, 48Ah	20	Exide
4	Library	10	Igatech	12V, 60Ah	20	Exide
5	BCA Computer Lab	20	Igatech	12V, 100Ah	12	Exide
6	BCA Computer Lab	20	Igatech	12V, 100Ah	12	Exide
7	Instrumentation Lab	10	Igatech	12V, 100Ah	12	Exide

Computer loads

Table 11 COMPUTER LOADS

Particulars	**Rated Power**	**Quantity**	**Total Power**
Printer	**120**	53	5.83
Desk top Computers	**50**	315	15.75
Total			41.58

OTHER LOADS

In this section the canteen loads, small equipment's in labs etc. to be included and the details are given below:

Table 12 OTHER CONNECTED LOADS

Particulars	**Rated Power**	**Qty**	**Total Power**
	Watts	Nos	kW
Pump motor	3000	2	6
Bore well pump	2500	01	2.5
Submersible pump	1000	01	1
Mixer	350	1	0.35
Refrigerator	250	4	1
Water Steamer	1000	1	1
Water cooler	300	12	3.6
LED Projectors	200	15	3
Air conditioners	2300	20	46
Air conditioner	2500	01	2.5
Total			**66.95 kW**

LUX MEASUREMENTS

According to National Lighting code-2010 BIS to determine the overall energy efficiency of lighting system using measurements and methods, which is applicable to all commercial buildings. One of the methods is Illuminance method, which is the most practicable one. Details are given in the section. Lux levels of some areas are given in the Table 15. The lux levels mentioned as satisfactory need to be improved.

Table 13 LUX MEASUREMENT

Sl. No.	AREA	Measured Lux	Required Lux	Remarks
1	Department of Bio science	140	150	Satisfactory
2	Bsc Bio technology	170	150	Good
3	Lab of BCA	140	150	Satisfactory
4	Office	170	150	Good
5	B com Ist	165	150	Good
6	Entrance	145	150	Good
7	Department of Electronics	145	150	Good
8	Chemistry 2nd	156	150	Good
9	Chemistry Lab	195	150	Good
10	Bio Technology lab	121	150	Satisfactory
11	Chemistry Department	140	150	Good
12	Principal office	135	150	Good
13	1st MSC Maths	145	150	Good
14	Department MSC Maths	150	150	Good
15	Physics lab	180	150	Good
16	Bsc Psychology	190	150	Good
17	1st BA English	165	150	Good
18	Electronic lab	160	150	Good
19	Physics computer lab	135	150	Satisfactory
20	English computer lab	185	150	Good
21	English Department	185	150	Good
22	Auditorium	165	150	Good

WOOD AND LPG

The LPG and wood is the main fuel in canteen and college hostel. The details of the LPG consumption in the last academic year is given in the Table 13.

Table 14 WOOD AND LPG CONSUMPTION

Location	**Wood consumption**	**LPG consumption**
	TONS	**Kg**
Canteen	10	600
Hostel	06	300
TOTAL	16	**900**

RENEWABLE ENERGY

MES Marampally college installed 10kWp on grid solar power plant on theire main building roof top of 30 numbers of 325Wp, Waree make mono crystalline panels. K star invertor is used. By using this solar power utilization approximately 12000 kWh electrical energy is aved per annual in electricity. 10% of KSEB power is reduced by using solar power plant

Figure 5 SOLAR POWER PLANT

PV Details

Table 15 PV DETAILS

Sl. No.	Particulars	Details
1	PV capacity	10 KWP
2	Wattage of module	325 wp
3	Module make	Waree
4	Module type	mono-crystaline silicon perc
5	Open circuit voltage	45.35 V
6	Short circuit current	9.55 A
7	Maximum peak Voltage	36.85 V
8	Maximum peak Current	8.82 A

Invertor Details

Sl. No.	Particulars	Details
1	Make	K Star
2	Model no	KSG-10K
3	Max PV array open voltage	1000 Vdc
4	Nominal Input Voltage	620 Vdc

ANNEXURE-1

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 and in security cabin and in hostels the calculation for the savings is given in the table.

Table 16 EC PROPOSAL NO1

Particulars	Units	BLDC fan	With BEE star rated
Existing Ceiling Fans	Watts	60	60
Proposed BLDC Fans	Watts	28	45
Difference in Wattage	Watts	32	15
Avg No: of working hours/day	Hrs	10	10
No: of working days per year (Average)		250	250
No: of working hours per annum	Hrs	2500	2500
Number of Fans operating	Nos	20	20
Energy Saving per Annum	**kWh**	1600	750
Cost per kWh	Rs	7.15	7.15
Annual Financial Savings	**Rs**	11440	5363
Cost of BLDC Fans	Rs	3200	1900
Salvage value of fan	Rs	200	200
Investment for Fans	Rs	60000	34000
Simple Payback period	Months	63	76

ENERGY SAVING PROPOSAL – 2

REPLACEMENT OF FLUORESCENT TUBES WITH ENERGY EFFICIENT LED LIGHTS

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

Table 17 EC PROPOSAL NO:2

Particulars		T-12	T-8	CFL
Existing Fluorescent lights	Watts	40	36	15
Proposed LED light	Watts	18	18	8
Difference in Wattage	Watts	22	18	7
Avg No: of working hours/day	Hrs	8	8	8
No: of working days per year (Average)	Nos	200	200	200
No: of working hours per annum	Hrs	1600	1600	1600
Number of Lights operating	Nos	50	60	20
Energy Saving per Annum	**kWh**	1760	1728	**224**
Cost per kWh (Average)	Rs	7.15	7.15	7.15
Annual Financial Savings	**Rs**	12584	12355.2	**1602**
Cost of LED light	Rs	250	250	150
Investment for LED lights	Rs	12500	15000	3000
Simple Payback period	Months	12	15	23

Summary

Annual Energy Savings	kWh	3712
Total Financial Savings	Rs	26541
Total investment	Rs	30500
Payback period	Months	14

Reason for change in the lighting system

- Lighting quality can have a dramatic influence on the attitude and performance of working persons, if they have an environment that with proper uniform lighting.
- In addition to the lumens per watt which is a lighting quantity calculation lighting quality and life of lighting system is also to be considered.
- Lighting quality can be divided into Uniformity, Glare, Colour rendering Index, coordinated colour temperature.
- In case of consistency and in uniformity, the life time of LED is far better than CFL s and FTLs.
- Deterioration of lumens or lux level in FTLs and CFL are more as compared with LED which is consistent during in its life time.
- Considering VCP (Visual Comfort Probability) LED is better option than FTLs and CFL because the glare value is lesser.
- The LED are whitish in colour than FTLs which is giving a better feeling of brightness to the persons occupied or working
- CCT of LED is 5000k which is white as compared with lesser CCT for FTLS of 4500 k
- There is no mercury content in the LED as compared with CFL and FTL s hence it is environmentally supportive.
- The life cycle data of tube lights with LED is given in the table below.

Table 18 LIGHT LIFE DETAILS

Type of lamp	Typical life in Hours	Cost per lamp	No: of lamps required during LED lifetime (led 60,000 Hours)	Replacement cost per lamp	Approximate maintenance expense for replacement	Total cost per lamp
T12	5000	45	12	540	500	1040
T8	5000	45	12	540	500	1040
T5	5000	100	12	1200	500	1700
LED	60000	800	1	800	0	800

1. LED specification

The Department of Electronics and information technology issued "Electronics and information Technology goods order 2012" on 3rd October 2012 the following standards for LED lamps are covered.

1. IS 15885 (Part -2/section 13)
2. IS 16102 (Part-1): 2012

As per this order LED manufactures to get their product tested from BIS recognised labs.

Thus, the following electrical parameters and standards should ensure while purchasing LED in future based on the BIS standards. These are the minimum technical requirements for the acceptance of LED. Also, the LED test certificates as per the various standards mentioned below should be examined while purchasing.

Table 19 LED SPECIFICATION

Sl no	Parameters	Requirements	Applicable IS
1	Light source	SMD LED chip	LM 80/IS 16106
2	System Efficacy	>= 110 lumen /watt	IS 16106:2012
3	LED Driver Efficiency	Minimum 85%	
4	**Harmonics**	**Maximum 10%**	**IS 16102-2-2012**
5	**Power factor**	**Minimum 0.95**	**IS 16102-2**
6	Frequency	50 Hz ±3%	LM-79 report
7	Operating voltage	110V – 320V	LM 79 report
8	Surge voltage	>4 kV	LM 79 report
9	Ambient temp	-10 to 50 deg C	LM 79 report
10	Degree of protection	IP 66	IS 10322
11	CRI	Minimum 70	IS 16102 - 2

2. BLDC SPECIFICATION

Normal trend of one ceiling fan working hours with present cost while replacing with BLDC fan and the payback period is given in below table.

Number of working hours/day for a single ceiling fan	**Hours**	9	10	11	12	13	14	15	16	17	18	19	More than 20
Simple payback period after replacement with BLDC	**Years**	5	5	4	4	4	3	3	3	3	3	3	2

The BLDC fan test certificates as per the various standards mentioned below should be examined while purchasing.

Table 20 BLDC SPECIFICATION

Sl no	Parameters	Requirements	Applicable IS
1	Air delivery	215 CMM	IS 374 - 2019
2	Harmonics	Maximum 10%	IS 374 - 2019
3	Power factor	Minimum 0.95	IS 374 - 2019
4	Frequency	50 Hz ±3%	IS 374 - 2019
5	Insulation resistance	>2 MΩ	IS 374 - 2019
6	Speed	350 rpm	IS 374 - 2019
7	Maximum temperature rise	70 deg C	IS 374 - 2019
8	Degree of protection	IP 65	IS 10322

ABBREVIATIONS

APFC	:	Automatic Power Factor controller
AVG	:	Average
BDV	:	Breakdown voltage
BEE	:	Bureau of energy efficiency
CEA	:	Central electrical authority
CFL	:	Compact fluorescent lamp
CFM	:	Feet cube per minute
DB	:	Distribution Board
DG Set	:	Diesel Generator Set
EC	:	Energy Conservation
FD	:	Forced draft
HPSV	:	High-pressure sodium vapour
HT	:	High Tension
ID	:	Induced draft
IEC	:	International electro technical commission
IEEE	:	The Institute of electrical and electronics engineers
IS	:	Indian Standard
KG	:	Kilogram
KVA	:	Kilo Volt Ampere
KVAH	:	Kilo volt Ampere Hour
KVAR	:	Kilo volt-ampere
KW	:	Kilo Watts
KWH	:	Kilowatt-hour
LED	:	Light emitting diode
MAX	:	Maximum
MH	:	Metal halide
NEMA	:	National Electrical Manufacturers Association
OLTC	:	On load tap changer
ONAN	:	Oil natural air natural
PCC	:	Point of common coupling
PSI	:	Pound square inch
RMD	:	Registered Maximum demand
SEC	:	Specific electricity consumption
SFU	:	Switch Fuse Unit
SLD	:	Single Line Diagram
TDD	:	Total demand distortion
THD	:	Total harmonics distortion
TOE	:	Tonne of oil equivalent
UPS	:	Uninterruptible power supply
VFD	:	Variable frequency drive

INSTRUMENTS USED

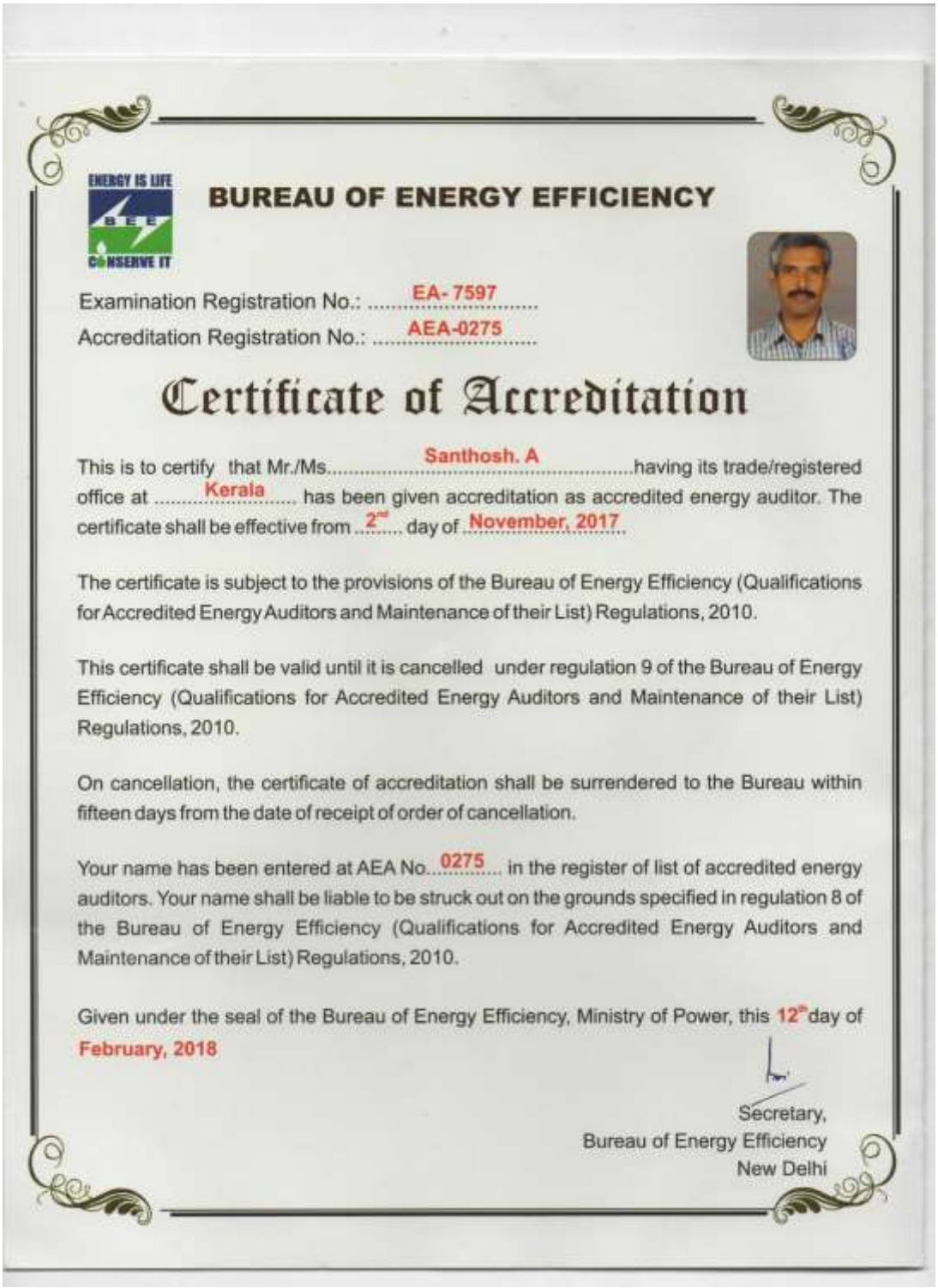
SL.NO	EQUIPMENT DESCRIPTION	MAKE & MODEL
1	Power energy & harmonic Analyser	Krykard ALM 35
2	Thermal Imager	FLIR E50

TABLE 21: INSTRUMENTS USED

REFERENCES

1. BEE energy audit books
2. CEA regulations of grid connectivity-2007
3. IEEE Std. 519-1992.
4. National lighting code – 2010

BEE 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

EMC EMPPANNELED 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