Criterion I
Curricular Aspects

1.3.1 Energy Audit Report

Assessment Period (2016 – 2021)

VIMALA COLLEGE (AUTONOMOUS), THRISSUR

ENERGY AUDIT - 2018

VIMALA COLLEGE
THRISSUR

Audited by

ATHUL ENERGY CONSULTANTS PVT LTD.
4th FLOOR, CAPITAL LEGEND BUILDING,
ROUND NORTH, THRISSUR-680020
Ph : +917356111990-96
Web : www.athulenergy.com
E-Mail : info@athulenergy.com

March 2018

Assessment Period (2016 – 2021)

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ENERGY PERFORMANCE INDEX

Parameters	Unit	Values
Annual electricity consumption (for last 12 months)	kWh	180648
Construction area	M^2	13752.5
Specific Electricity Consumption	kWh/ M^2	13.13
Specific electricity cost at Rs.5/Kwh	Rs./ M^2	65.6
After Energy Saving Implementation		
Annul electricity consumption	kWh	118704
Specific Electricity Consumption	kWh/ M^2	8.63
Specific Energy cost	Rs. / M^2	**43.1**
% Energy savings	%	**34**

TABLE 1: ENERGY INDEX

EXECUTIVE SUMMARY

ENERGY SAVING OPPORTUNITIES:

Sl.no	Recommendations	Annual kWh Savings	Annual Financial Savings (Rs)	Investment (Rs)	Simple payback period (Months)
1	Power factor improvement	-	34044		
2	Replacement of existing old fan regulators with new electronic one	2136	11107	4450	5 months
3	Replacement of t-8 fluorescent tubes with led lights at office and department, convent	7776	40435	89100	27 months

4	Replacement of t-8 with led lights at Library, class rooms, lab	8640	44928	178200	48 months
5	Replacement of ceiling fans with BLDC fans at office, departments and convent	13392	69638	372000	64 Months
6	Installation of 25 kw grid connected system	30000	156000	17,50,000	11 Years
Total		**61944**	**356152**	**643750**	

TABLE 2: EXECUTIVE SUMMARY

ACKNOWLEDGEMENTS

We are extremely thankful to the Officers and employees of for extending their wholehearted cooperation in successfully completing our Energy Audit. We have the Vimala college for conducting the detailed Energy Audit in between 17hJanuary to 18thJanuary2018.

ENERGY AUDIT TEAM

1. **Santhosh A**
   Registered Energy Auditor of Bureau of Energy Efficiency (BEE – Govt. of India)
   Energy Auditor No – EA 7597
1. **Ashok KMP**
   Registered Energy Manager of Bureau of Energy Efficiency (BEE – Govt. of India)
   Energy Auditor No – EA 25612
1. **Jaideep P P**, Project Engineer
M.Tech, Energy Engineering
1. **Maqbool M,** Project Engineer
M.Tech, Energy Engineering

GENERAL DETAILS

S.NO	PARTICULARS	DETAILS
1	Name & Address of Company	Vimala college ,thrissur
2	Year of establishment	
3	Telephone No.	0481-2578393,2578323
5	No. of Employees	230 No:
6	No: of students	2500
6	Construction area of college	13752.5
7	Annual Electricity Consumption	180648 kWh
	Contract Demand	100kVA
	Maximum Demand Average	81 kVA
10	Total Area	12097.87

TABLE 3: GENERAL DETAILS

OBJECTIVE

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. **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. **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 Vimala collegeas per the request from the company 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 and 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 analysis
3. Identification of Energy saving opportunities.
4. Cost Benefit Analysis.

DESCRIPTION OF VIMALA COLLEGE

Vimala College Thrissur, a first grade women's College under the Congregation of Mother of Carmel (CMC) Management of the Nirmala Province, Thrissur, is affiliated to the University of Calicut. It was established in 1967 following a bifurcation from St Mary's College, Thrissur. The Vision of the institution is the total transformation of young women for their enrichment and of the society at large and the nation as a whole. The Mission is to dedicate ourselves to the mission of training women for academic excellence, development of skill and character formation based on the love of God and service to the society and the country. It should be noted that the founding Sisters had drafted a CMC Educational Policy that beautifully encapsulates the educational policies of the nation, the UGC and the NAAC.

Ever since its inception, the Institution has been in the forefront of higher education in the State. The University of Calicut declared Vimala as a LEAD college soon after its inception. The Institution submitted itself to the First Accreditation in the year 2000 and was bestowed with Five Star status in 2001. The Institution opted for the 2nd cycle of Accreditation in the year 2008, and was subsequently reaccredited with the highest grade of A with a CGPA of 3.3, and the third cycle of reaccreditation was in the year 2014 with a CGPA of 3.5 on 4 point scale. The Institution was accorded autonomy in 2015 and conferred the status of College with Potential for Excellence in 2016 by UGC.

The college offers 16 Undergraduate programmes (14 regular, 2 self financing), 13 Post Graduate Programmes (6 regular, 7 self financing), and is a Centre for Research in English, Commerce, Physics and Social Work. The college also offers one PG Diploma and an advanced diploma programme. The college is a vibrant participant in all Government initiatives like the ASAP, DCA, WWS, SSP. The enrichment of the curriculum is of primary importance, and the Institution has several Add on courses, funded by the UGC, nongovernmental organizations and departments initiated. The Value education courses are institutionalized with a prescribed syllabus and course assessment. The students also benefit from national level coaching classes like the IPERT Sponsored Civil Services coaching; the college is the nodal centre for IDP, Australia and British Council, and so forth.

The institution has a strength of 2494 students with more than one-third belonging to the under privileged classes. The institution witnessed a steep rise in research scholars seeking registration at various Research Centers. Currently there are 23 scholars, 10 having registered last academic year and 2 were awarded Ph.D in the last year. Down the years, the college has maintained high pass percentage and low dropout rate. This year, the college has 8 university toppers to her credit. There are 79 regular faculty, 62 guest faculty and 30 non teaching staff. There are 45 faculty members with Ph.D and 22 with M.Phil. Six were awarded Ph.D in the year 2017-18. In 2016-17, two faculty members were selected for FLAIR internship by the Govt. of Kerala, the NCC coordinator was ranked as Lieutenant, a faculty member was honoured with a national award and the principal was conferred the Dalit Sahitya Academy Award for her committed leadership and management. The research output of the faculty in the year 2016-17 includes 9 International and 6 national publications, besides 28 International, 39 National, 4 State level seminar presentations. In the year 2017-18 the research output of the faculty is 34 International and 4 National Publications, besides 27 International, 21 National, and 10 State level seminar presentations. The faculty members have been invited as resource persons at International, National and state level forums. The departments have conducted 12 seminars and 16 workshops out of which 3 were sponsored by UGC and 2 by the KSCSTE. The college has a major research project and 11 minor research projects, out of which two were sanctioned last year.

The Institution has made remarkable strides in curricular, co-curricular and extracurricular activities. The college has won the best performing Women's college title in D Zone (2016-17, 2017-18) and Inter Zone (2017-18). Student progression is closely monitored and documented. 123 students were placed last year through on-campus recruitment drives and off campus placement programmed. Excellence in sports and games is one of the major strengths of the college: this year, 59 students represented various sport events at All India Inter University and National levels. They have bagged 5 gold, 5 silver and 4 bronze medals.

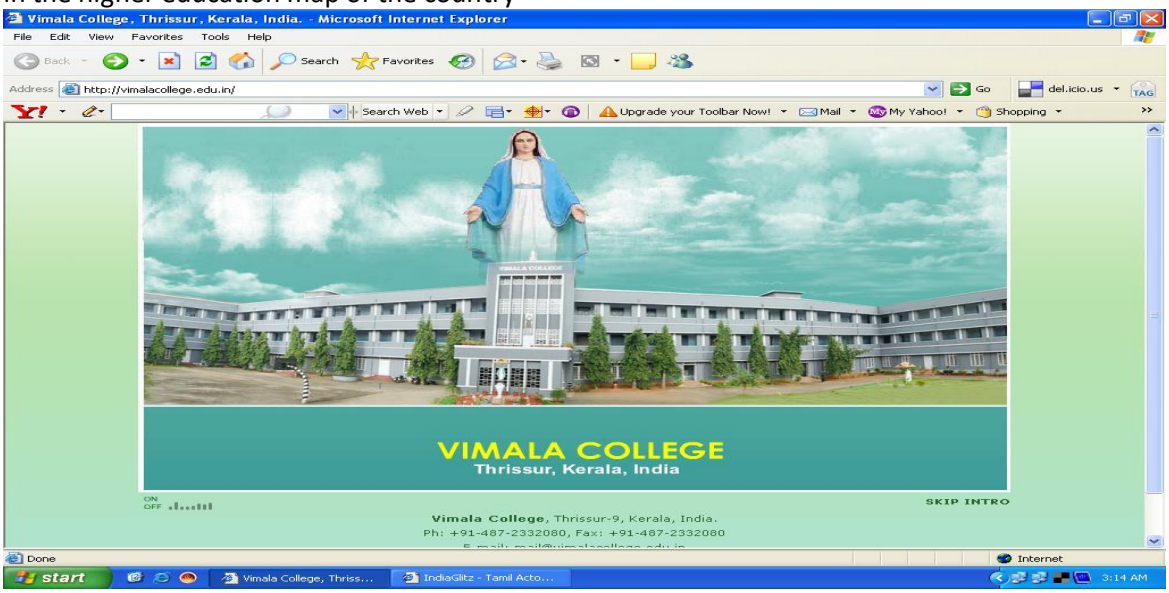
The Institution can boast of excellent student support system. The library resources are known to be the best in the region. The Alumnae, PTA and the retired staff community have instituted numerous scholarships and prizes for the deserving and the best performing students. The college ensures that students avail the scholarships funded by the government and other agencies. In 2016-17 Rs. 10, 52,490 /- was released as scholarship amount to various students. The PTA and Alumnae are an integral part of the Institution and make significant contribution to both infrastructural expansion and academic enrichment. The last academic year witnessed the inauguration of the Golden Jubilee Memorial Marian Hall and the International Aquatic Academy extended its services to the public and hosted national level competitions.

Several other initiatives feature in the campus keeping with the mission and vision of the college are: UGC sponsored Centre for Women Studies, Women Development Cell, NCC, NSS, Alumnae Association and so forth. The extension activities of the college bracketed under the Vimala Community Extension Centre (VCEC) includes the FCC, CHILDLINE, VCASS, Vimala College Educational and Charitable Trust.

The year 2016-17 unfolded a series of activities and events as a part of the Golden Jubilee of the Institution. Besides various cultural and social events, the Institution stepped up the extension services to the community. Some of the outreach programmes included Kanivu (Financial support for students of terminally ill parents), Unarvu (Providing bicycle for students who come from far-off places) and Mizhivu (support for housing). In the year 2017-18, a South Indian Level cultural fest SPANDAN2K18 was conducted by the college union.

With the conferring of autonomous status, the college seized the opportunity to revise the curriculum with the objective of enhancing quality, employability and sensitivity to environment. An academic calendar was designed and all efforts were made to abide by the prescribed schedule.

In brief, all efforts are made to sustain and enhance quality through the synchronization of innovative measures and traditional values which makes Vimala College an Institution to be reckoned in the higher education map of the country



BASELINE DATA & CONSUMPTION: 6 MONTHS

The baseline data based on electrical consumption analysis for available six months' electricity bills. From these data's it is understand about the present scenario of the consumption pattern. Moreover, it is very easy to identify the areas, which need improvements.

Base Line Data

1	Electricity provider	KSEB
2	Supply Voltage	11KV
3	Tariff	HT-2A GENERAL
4	Contract demand (kVA)	100
5	Maximum demand registered (kVA)	81
6	Average monthly energy consumption (kWh)	15054
7	Average demand charges (Rs)	26950
8	Average power factor	0.9
9	Average power factor Incentive (Rs)	1037

TABLE 4 : BASELINE DATA

Feedback and Suggestions:

- APFC panel provided for the transformer yet the average power factor found to be **0.97**.
- Recorded maximum demand during the6months was **100 kVA**. It was recorded during the normal hours.
- Average incentive on power factor is about **Rs 7153** per month.

DEMAND ANALYSIS

The demand charge is a significant component of an electricity bill. The demand profile for a facility. Building, company or any user of electricity is simply record of the power supplied at any point of time. Its purpose is to provide detailed information about how the facility or separated metered portion uses energy means it is an electrical finger print of the facility. Effective demand management offers substantial energy saving and financial saving opportunities.

This section analyses the trend for the maximum demand versus the Contract Demand (CD) over a 12-month period (December -16 to November-17).

Maximum demand (MD)is the maximum recorded demand during the billing cycle. It is maximum recorded demand for a cycle of 30 minutes.

Contract demand (CD)is the demand signed by the industry with the utility for the electricity supply

Billing demand(BD) is demand based on the recorded maximum demand during the billing cycle or 75% of the contract demand whichever is higher.

Notes:

- The contract demand is **100 kVA**. In almost all, the Recorded maximum demand (RMD) comes less than 100 kVA.
- The demand pattern is almost constant in every month.
- Average demand charges came as**Rs.26950** and which is about 23**%** of the total electricity charge.

Suggestions:

- Also by improving the power factor, the demand will furtherhave reduced.

- Billing demand demand charges in certain months goes above the minimum billing demand of 75 % in certain months which can be stipulated to minimum demand charges by improving power factor tounity .
- The calculations and the savings are mentioned in the Annexure-1
- Recorded maximum demand in all the time zones in the last year found to be lessthan the contract demand.

POWER FACTOR ANALYSIS IN KSEB BILL

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

$PF = Active\ energykWh/Apparentenergy\ (kVAh)$

During the power transmission, maximum apparent power is transmitted through the power lines to have efficacy for the utility. However, all the major loads are inductive motors with range of power factor from 0.2 to 0.9 resulting in reduction of the electrical network capacity. Power factor correction is needed for the healthy electrical system.

Tariff structure of KSEB for Power factor

As per the latest KSEB (Utility) tariff structure vide order 1007/F&T/KSERC/2016 dated 17/04/2018, for every increase in power factor by 0.01 unit from 0.9 to 1 (unity),the incentive of 0.5% of energy charges is pay back to the customer. For every shortfall from 0.9, customer will receive a penalty of 1% for every 0.01 unit.

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

Month	PF
April-17	0.91
September-17	0.93
Januvary-18	0.85
Avg	0.90

TABLE 5: PF VARIATIONS FOR PAST ONE YEAR

Observations:

- The power factor during the past one year is found to be 0.90. Averageincentive in a month is about **Rs 1037**

Suggestions:

- PF fine-tuning is suggested to reduce the reactive component of the network and the total current from source end.
- Maintained the Power factor to unity to get more incentives.

TARIFF RATES ANALYSIS

The tariff rates on the KSEB can be divided mainly into three as energy charges, demand charges and others as power factor penalty or incentive, electricity duty, fuel surcharge, meter rent etc. The pattern of the electricity charges is shown below how the charges are distributed.

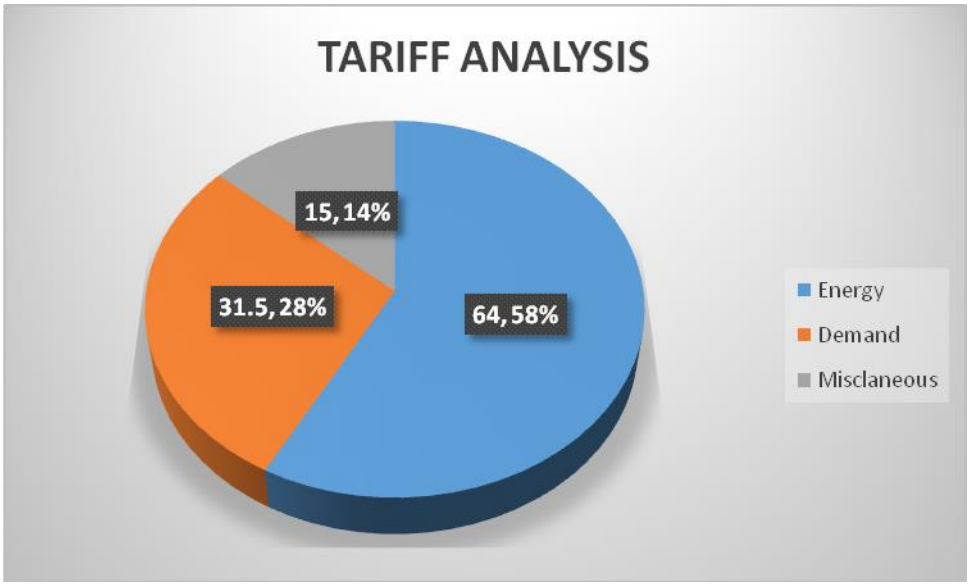


FIGURE 4: TARIFF RATE

LIGHTING SYSTEMS AND FAN LOADS

Effectivelightingisessentialforprocess and utility areas tocarryouttheirworkproperly,yetitispossibletoachievesignificantsavingsinthisareaandimprovethequalityofthelitenvironment.Goodlightingdesigncanreducecostsandhavetheaddedbenefitofdecreasinginternal heatgains,thusreducingtheneedforairconditioningtoo. The lighting details of the Vimala College at various buildings are given below:

TYPE LIGHTING FIXTURES	WATTAGE	NUMBER	TOTAL KW
INCANDESCENT LAMP	**60**	**22**	1.32
FLUORESCENT LAMP T-8 with copper chock	**50**	317	15.85
FLUORESCENT LAMP T-12 with copper chock	**54**	63	3.402
CFL	**15**	312	4.68
CEILING FANS	**70**	465	32.55

COMPUTER	**60**	109	6.54
TOTAL	**64.342 KW**		

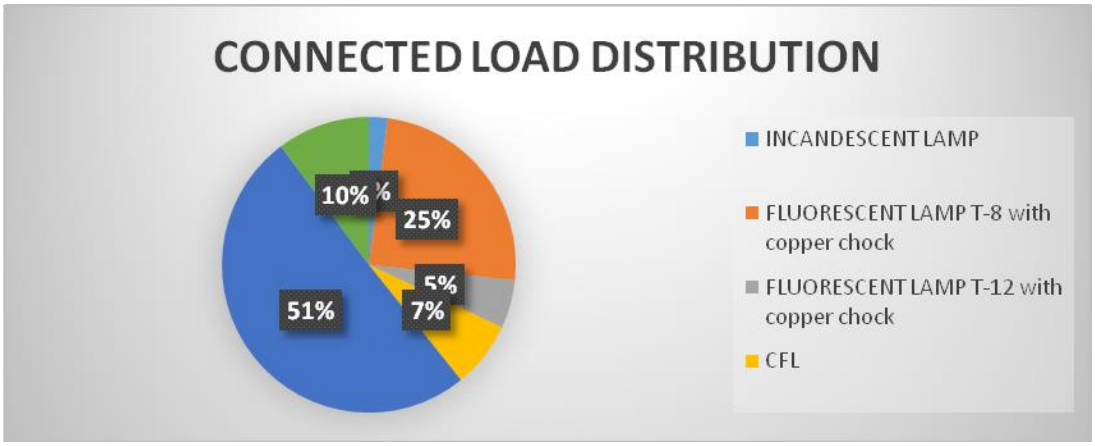
TABLE 16: LIGHT AND FAN LOADS SUMMARY

Notes:

- Here the power consumption is**64.342 KW**

Suggestions:

- Replace the CFL and Fluorescent tubes with LED's and the power consumption will be low and the calculations are given in the Annexure 1.
- Maximize the use of daylight.
- Switched off the unwanted lights inside the plant.
- Labelling should be done for lighting panels.
- Replace the existing ceiling fans with BLDC (Brush Less Direct Current) fans for energy saving.



DISTRIBUTION OF LAMPS, FANS AND COMPUTERS IN THE COLLEGE BUILDINGS

lOCATION	FLUORESCENT LAMP T-8 with copper chock	FLUORESCENT LAMP T-12 with copper chock	INCANDESCENT LAMP	CFL	CEILING FANS	COMPUTER
Chavara	41	0	4	34	82	42
Main	118	4	15	21	112	34
Liessux	24	6		88	47	85

Euphrasia	29			42	44	22
Hostel	8			4	16	0
Libraray	58	53		14	99	15
Convent	39		3	109	65	1
Total	317	**63**	22	312	465	109

DISTRIBUTION OF LAMPS AND FANS IN THE COLLEGE

LOCATION	FLUORESCENT LAMP T-8 with copper chock	FLUORESCENT LAMP T-12 with copper chock	INCANDESCENT LAMP	CFL	CEILING FANS
Class room	70			50	120
Lab	57		14	8	40
Dept	33			9	44
Office	16	4		1	15
Convent	39	0	3	109	65
Corriddoe	2			25	2
Libraray	58	53	0	14	99
Misclaneous		6	5	38	11
Auditorium	42			58	69

ENERGY SAVING PROPOSALS:

Sl.no	Recommendations	Annual kWh Savings	Annual Financial Savings (Rs)	Investment (Rs)	Simple payback period (Months)
1	Power factor improvement	-	34044		
2	Replacement of existing old fan regulators with new electronic one	2136	11107	4450	5 months
3	Replacement of t-8 fluorescent tubes with led lights at office and department, convent	7776	40435	89100	27 months
4	Replacement of t-8 with led lights at Library, class rooms, lab	8640	44928	178200	48 months
5	Replacement of ceiling fans with BLDC fans at office, departments and convent	13392	69638	372000	64 Months
6	Installation of 25 kw grid connected system	30000	156000	17,50,000	11 Years
Total		**61944**	**356152**	**643750**	

TABLE 27: SAVING OPTIONS

ANNEXURE-1: ENERGY SAVING PROPOSALS

ENERGY SAVING PROPOSAL-1

POWER FACTOR IMPROVEMENT AND CONTRACT DEMAND REDUCTION

In Vimala college, the contract demand is **100 kVA**, and then the billing demand is 75% of the contract demand and is about **75kVA**In every month, the Pf comes in the range of 0.90 If the power

factor improved to unity. Incentive amount from power factor is increased to maximum level and maximum demand will reduced.

Annual incentives by power factor	**Rs12432**
Annual incentives if power factor improved to unity	Rs.46476
Total Savings per year	Rs 34044

TABLE 25: SUMMARY OF PF IMPROVEMENT

ENERGY SAVING PROPOSAL-2

REPLACEMENT OF EXISTING OLD FAN REGULATORES WITH NEW ELECTRONIC REGULATORES

Calculations:

Number og old regulators used in office, convent and departments	**89**
Power consumption of old regulators	12W
Power consumption of new regulators	2W
Energy saving per regulator	10
No: of working hours/day	10
No: of working days per year (Average)	300
Number of Lights operating for Annual factor	0.8
Annual energy saving of kWh for (10*300*92*.0.9*32/1000	2136kWh
Cost per kWh (Average Rs /kWh)	Rs.5.2
Annual Financial Savings (8 x 17,739)	**Rs** 11107
Cost of LED light	Rs 50
Investment for LED (90*990)	**Rs 4450**
Simple Payback period	**5 Months**

ENERGY SAVING PROPOSAL-3

REPLACEMENT OF T-8 FLUORESCENT TUBES WITH LED LIGHTS AT OFFICE AND DEPARTMENT, CONVENT

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

Calculations:

Existing Fluorescent lights(T-8 with Copper chock)	**50 W**
Proposed LED light	28 W
Difference in Wattage	32W
No: of working hours/day	10
No: of working days per year (Average)	300
Number of Lights operating for Annual factor	0.8
No: of replaceable light	90
Annual energy saving of kWh for (10*300*92*.0.9*32/1000	7776kWh
Cost per kWh (Average Rs /kWh)	Rs.5.2
Annual Financial Savings (8 x 17,739)	**Rs** 40435
Cost of LED light	Rs 990
Investment for LED (90*990)	**Rs 89100**
Simple Payback period	**27 Months**

TABLE 28: ENERGY SAVINGS PROPOSAL – REPLACEMENT OF FLUORESCENT TUBES WITH LED LAMPS

ENERGY SAVING PROPOSAL-4

REPLACEMENT OF T-8 WITH LED LIGHTS AT LIBRARAY, CLASS ROOMS, LAB

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

Calculations:

Existing Fluorescent lights (T-8 with Copper chock)	**50W**
Proposed LED light	18 W
Difference in Wattage	32 W
No: of working hours/day	06
No: of working days per year (Average)	250
No: of working hours per annum (250*6)	1500

Number of Lights operating for 1500 Hrs/Annum	180
kWH Saving per Annum (1500*180*32/1000	**8640**
Cost per kWH (Average Rs /kWH)	Rs 5.2
Annual Financial Savings (5.2 x 8640)	**Rs 44928**
Cost of LED light	Rs990
Investment for LED (150*990)	**Rs 178200**
Simple Payback period	**48 Months**

TABLE 29: ENERGY SAVINGS PROPOSAL – REPLACEMENT OF FLUORESCENT TUBES WITH LED LAMPS

Notes:

- Replacement and maintenance cost of luminaries is not considered in the above calculation.
- The maintenance cost of luminaries is drastically reduced because the life span of LED lights is 3 times more than normal luminaries.

Reasoning for change of lamps

Type of lamp	Typical life in Hours	Cost per lamp	No: of lamps required during LED life time(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	6000	800	0	0	0	0

TABLE 30: LED LIGHT CHANGING REASONS

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 color 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.

Specification for purchasing LED

• COLOR	-	Cool white
• Watts	=	5, 8 and 18
• Lumen	=	400, 500 and1200 lm
• Dimmable	=	Yes
• Life span	=	25000 hrs.
• Power factor	=	> 0.92
• Lighting efficiency	=	85%
• CRI –	=	>75
• Work frequency	=	50/60Hz
• Constant circuit error	=	-< 2%
• Micro wave /Noise -	=	-<240mV
• Short circuit protection	=	OK
• Operation temperature	=	20- 65^{0}C
• Lighting source	=	SMD3528Episar
• Efficiency	=	100 lm/w
• Beam angle	=	120 degree
• THD V and THD i	=	As per IEEE standard 519 or CEA standard

ENERGY SAVING PROPOSAL-5

REPLACEMENT OF CEILING FANS WITH BLDC FANS AT OFFICE, DEPARTMENTS AND CONVENT

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 of time, 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.

Calculations:

Existing Ceiling Fans	**70 W**
Proposed BLDC Fans	30 W
Difference in Wattage	45 W
Avg No: of working hours/day	10
No: of working days per year (Average)	300
No: of working hours per annum (300*10)	3000
Number of Fans operating for 7300 Hrs/Annum	217
Usage factor of fan	0.8
kWh Saving per Annum(0.8*124*45*3000/1000)	**13392**
Cost per kWh (Average Rs /kWh)	**Rs**5.2
Annual Financial Savings (8 x 55,444)	**Rs** 69638
Cost of BLDC Fans	Rs 3000
Investment for BLDC Fans (124*3000)	**Rs 372000**
Simple Payback period	**64Months**

TABLE 31: REPLACEMENT OF CEILING FANS WITH BLDC FANS

ENERGY SAVING PROPOSAL-6

INSTALLATION OF 25 KW GRID CONNECTED SYSTEM

TheSunisaninexhaustible,reliableandnon-pollutingsourceofpower.Sincetheinceptionoflifeonearth,theonlyenergythatwasavailablecamefromthesun.Thetimeisnowapproachingwhenhumankindwillagaindependuponthesunasdominantenergysource.Weareawarethatfossilfuelsarenotgoingtolastforever.Agrowingworldwideconcernforconservationofenergyhasreignitedourinterestinecologicallysustainablematerials,processes and sources ofenergy.

Ofthenumerousrenewablesourcesofenergyknowntohumankind,SolarPhotoVoltaicorSPVisone that has the potential to supply power for our future needs: Solar radiationis the largest renewable energy source

- The solar energy is more evenly distributed in the world than wind or bio-mass.

- It is well proven and demonstratedtechnology
- It promises to be most cost effective renewable power at high volumes.

ThesolarenergypotentialinIndiaisimmenseduetoitsconvenientlocationneartheEquator.Indiareceivesnearly3000hoursofsunshineeveryyear,whichisequivalentto5000trillionkWh of energy.

Solar Grid Tie modesystem of **25 kW** systeminstallation details are given in the section:

Calculations:

Particulars	Unit	
Proposed system	kW	25
Average Units per day	kWh	100
No: of sunny days	days	300
Average Units per year	kWh	30000
Average utility electricity cost	Rs	5.2
Annual financial savings (Rs 30000*5.2)	**Rs**	**156000**
Investment (Subsidized & in Grid tied mode)	**Rs**	**17,50,000**
Simple payback period	**Years**	**11**

TABLE 32: SOLAR GRID TIE MODE SYSTEM

Suggestion

CHANGE OF EXISTING AIR CONDITIONERS WITH 5 STAR AIR CONDITIONERS

Presently air conditioners are selected according to the star rating of air conditioners
And it is on the base of EER (Energy Efficiency ratio) means cooling capacity in Watts divided by power consumption in watts
Cooling capacity of I TR = 3514watts
Star 1- 2.3, Star 2=2.5, Star 3= 2.7, Star 4= 2.9, and Star 5=3.1 are the EER ratios as approved by BEE for standard labelling

- The maintenance of AC Units are found to be improved. This will reduce the power consumption by the reduction in running time of air conditioners from the present level.

By 20%.

ANNEXURE-2

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	:	Kilo gram
KVA	:	Kilo Volt Ampere
KVAH	:	Kilo volt Ampere Hour
KVAR	:	Kilo volt ampere
KW	:	Kilo Watts
KWH	:	Kilo watt 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 supplyVFD : Variable frequency drive

INSTRUMENTS USED

SL.NO	EQUIPMENT DESCRIPTION	MAKE & MODEL
1	Power energy & harmonic Analyser	Fluke 1730 Krykard ALM 35
2	Lux Meter	
3	Air quality meter	Testo
4	Thermal Imager	FLIR

TABLE 33: INSTRUMENTS USED

REFERENCES

1. BEE energy audit books
2. CEA regulations of grid connectivity-2007
3. IEEE Std. 519-1992.