



॥ ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ॥ - शिक्षणमहर्षी डॉ. बापुजी साखुंबे

**SHRI SWAMI VIVEKANAND SHIKSHAN SANSTHA,
KOLHAPUR**



Shri Swami Vivekanand Shikshan Sanstha, Kolhapur

Sanchlit.

**PADMABHUSHAN DR. VASANTRAODADA PATIL
MAHAVIDYALAYA, TASGAON**

ENERGY AUDIT REPORT

Academic Year 2018-19



By

DS ENERGY CONSULTANCY & SERVICES, SANGLI

ACKNOWLEDGEMENT:

Energy Audit Assessment Team thanks the management of Shri Swami Vivekanad Shikshan Sanstha Kolhapur Sanchit, Padmabhushan Dr. Vasantryadada Patil Mahavidyalaya, Tasgaon for assigning this important work of Energy Audit to DS Energy Consultancy and services, Sangli. We appreciate the cooperation to our Team for completion of study.

Our special thanks are to Principle of college Dr. Milind Hujare, Head of IQAC Dr. S.S. Patil, all head of the departments, teaching and non- teaching staff for giving us necessary inputs to carry out this very vital exercise of Energy Audit.

We are also thankful to other staff and office members who were actively involved while collecting the data and conducting field measurements.

DISCLAIMER

Energy Audit Team has prepared this report for Shri Swami Vivekanad Shikshan Sanstha Kolhapur Sanchit, Padmabhushan Dr. Vasantraodada Patil Mahavidyalaya, Tasgaon based on input data submitted by the representatives of College complemented with the best judgment capacity of the expert team.

While all reasonable care has been taken in its preparation, details contained in this report have been compiled in good faith based on information gathered.

It is further informed that the calculations are arrived flowing best estimates and no representation, warranty or undertaking, express or implied is made and no responsibility is accepted by Audit team in this report or for any direct or consequential loss arising from any use of the information, statements or forecasts in the report.

Prepared by:

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M.Tech(Energy Technology), B.E.(Mech)

Bureau of Energy Efficiency certified Energy Auditor

No: EA 31840

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SUMMARY

The objective of the audit was to study the energy consumption pattern of the facility, identify the areas where potential for energy/cost saving exists and prepare proposals for energy/cost saving along with investment and payback periods.

The salient observations and recommendations are given below.

1. Padmabhushan Dr. Vasantryadada Patil Mahavidyalaya, Tasgaon uses energy in the following forms:
 - a) Electricity from MSEDCL
 - b) High Speed Diesel (HSD)
 - c) Solar wind Hybrid Energy Source
2. Electrical energy is used for various applications, like Computers, Lighting, Air-Conditioning, Fans, Other Lab Equipment
The average energy consumption is around 3862.25 kWh/Month.
3. The Specific Energy Consumption (SEC) is the ratio of energy required per square meter. In this case the SEC is evaluated as electrical units consumed per square meter of area. It is calculated as under: For Electricity: 1.04 kWh/Sq m
4. It has found that there is wide scope for energy saving and pollution free campus development. Recommendations with cost benefit analysis have given in detail in report.
5. Total potential for energy saving within all campus is approximately **Rs. 0.60+Lakh** per annum.

ABBREVIATIONS

AHU	- Air handling unit
APFC	- Automatic Power Factor Controller
DG	-Diesel generator
ECP	-Energy Conservation Proposal
GCV	-Gross Calorific Value
HVAC	- Heating, Ventilation and Air Conditioning
HSD	-High speed diesel
kCal	-Kilo-calories
FO	-Furnace oil
PF	-Power Factor
SEC	- Specific Energy Consumption
TR	-Tons of Refrigeration
UOM	- Unit of Measurement
MAHADISCO	-Maharashtra State Electricity Distribution Company

INTRODUCTION OF ENERGY AUDIT

An energy audit is a process to study of a building or industry to know the energy consumption of the building and identify methods to reduce the energy consumption for energy savings. In Commercial Building, the present electrical consumption is about 8-10 percent of the total electricity. To meet the international level comfort and facilities the electrical demand is increasingly by 11-12 % annually. This is a challenge for every industry to ensure that energy growth in commercial building does not become unmanageable but also give and presents an opportunity to influence and identifies energy management issues in various commercial buildings and facilities. As the natural resources are limited and energy uses are increasingly very sharply so it is very necessary to save natural resources by reducing energy consumption which can be achieved by using energy efficient equipment's and also by awareness of peoples about energy conservation .Energy audit in industrial and commercial, is the process to identifying opportunities to reduce carbon footprints and energy conservation.

1.1 GENERAL

Padmabhushan Dr. Vasantraodada Patil Mahavidyakaya, Tasgaon entrusted the work of conducting a Detailed Energy Audit of campus at Tasgaon with the main objectives as below:

- To study the present pattern of energy consumption
- To identify potential areas for energy optimization
- To recommend energy conservation proposals with cost benefit analysis.


Case Study in Campus:

We are taking this opportunity to express our heartily gratitude to Padmabhushan Dr. Vasantraodada Patil Mahavidyakaya, Tasgaon for giving opportunity for carrying Energy Audit in campus We once again put up our appreciation for full cooperation & valuable guidance for perfect auditing of the Campus to technical as well as commercial persons for providing all the required information & data as well as for providing

cooperation with all the departments & extend his best help in our work. We have tried our level best for the work of Energy Audit up to their satisfaction.

The major activities carried out during the audit are as follow:

- Collection of College's records regarding Electricity Power Bills, Power Distribution Diagram, Specifications of major power handling equipment – such as Fans, lighting and pumps.
- Analysis of above calculations, isolating the areas vulnerable to energy consumption not related to production.
- Recommendation of various methods of rectification.
- Making case study of projected saving by following our recommendations; and estimating potential investment & payback period.

 **Steps in Energy Auditing** The energy audit may range from a simple walk - through survey at one extreme to one that may span several phases: -

- 1) The first step is to identify the areas where energy is wasted and reduced energy without affecting the outputs of various functions.
- 2) The second step is to implement energy efficient appliances in place of normal appliances which reduce energy use by proper operations and maintenance. For this reason, it is necessary to reduce the number of operating machines and operating hours according to the demands of the load, and fully optimize equipment operations.

Energy audit depends on following factors: -

- Building equipment operation
- Lighting systems.
- Power systems.
- Building envelope
- Air-conditioning and ventilation equipment systems.
- Miscellaneous services.

The first two steps can be implemented without changing buildings and existing appliances.

3) The third step would require investment for remodeling, rebuilding, or introducing further control upgrades to the building.

4) The fourth step is to carry out large-scale energy reducing measures when existing facilities have past their useful life, or require extensive repairs or replacement because of obsolescence. In this case higher energy savings may be achieved. For these last two stages, the audit may be more extensive in order to identify more ECOs for evaluation, but at an increased need for heavier capital expenditure to realize these opportunities.

INTRODUCTION OF COLLEGE

Sr No.	Particulars	Details
1	Name of the Institutes	Shri Swami Vivekanad Shikshan Sanstha Kolhapur Sanchit, Padmabhushan Dr. Vasanttraodada Patil Mahavidyalaya, Tasgaon
2	Address	Sangli- Tasgaon Road, Tasgaon PIN CODE- 416312 Contact No.
3	Year of Establishment	1962
4	Courses offered	a) Bachelor of Science b) Bachelor of commerce c) Bachelor of Arts d) Masters in Science e) Masters in commerce f) Masters in Arts g) Bachelor of Computer Application
5	Affiliation	NAAC (B++ Grade ,2.76) UGC-approved an recognized college affiliated by the Shivaji University

Green Audit assement team	Dessignation
Prof.Mrs. D.S.Patil	Certified Energy Auditor
Dr. Milind Hujare	Principal
Dr. S.S. Patil	IQAC coordinator

Sr. No	Departments	No. of last year students	teaching staff
1	Marathi	19	3
2	Hindi	17	3
3	English	32	5
4	History	42	3
5	Economics	62	4
6	Sociology	38	2
7	Political Science	39	2
8	Geography	59	5
9	BCA	18	2
10	Physics	20	9
11	Chemistry	142	15
12	Mathematics	29	3
13	Statistics	54	10
15	Zoology	23	
16	Botany	19	
17	Computer Science	21	
18	Commerce	147	5

Total No. students: 3433

Total Teaching staff: 114

Total Non- Teaching staff: 38

Physical Structure

Total College campus Area	11 acre
Build up Area	40000 Sq.ft or 3716 Sq.m
Projected Area	16000 Sq.ft or 1486 Sq.m

SCOPE OF WORK AND APPROACH

SCOPE:

Scope of work and methodology were as per the proposal. While undertaking data collection, field trials and their analysis, due care was always taken to avoid abnormal situations so as to generate normal/representative pattern of energy consumption at the facility.

Approach to Energy Audit:

We focused our attention on energy management and optimization of energy efficiency of the systems, sub systems and equipment. The key to such performance evaluation lies in the sound knowledge of performance of equipment and system as a whole. The objective of Energy Audit is to balance the total energy inputs with its use and to identify the energy conservation opportunities in the stream.

Energy Audit also gives focused attention to energy cost and cost involved in achieving higher performance with technical and financial analysis. The best alternative is selected on financial analysis basis.

ENERGY AUDIT METHODOLOGY

Energy Audit Study is divided into following three steps

A] Historical Data Analysis

The historical data analysis involves establishment of energy consumption pattern to establish base line data on energy consumption and its variation with change in production volumes.

B] Actual measurement and data analysis

This step involves actual site measurement and field trials using various portable measurement instruments. It also involves input to output analysis to establish actual operating equipment efficiency and finding out losses in the system.

C] Identification and evaluation of Energy Conservation Opportunities

This step involves evaluation of energy conservation opportunities identified during the energy audit. It gives potential of energy saving and investment required to implement the proposed modifications with payback period. All recommendations for reducing losses in the system are backed with its cost benefit analysis.

Preliminary Survey

In this Preliminary survey, the auditor may need to know the building envelope and its energy consumption. The data of a building can be obtained from: -

- Building Architectural blueprints.
- Building Air-conditioning blueprints.
- Building Electrical lighting and power drawings.
- Electrical bills and operation logs for the year preceding the audit.
- Air-conditioning manuals and system data.
- ECOs for evaluation, but at an increased need for heavier capital expenditure to realize these opportunities.

Walk-Through: -

The walk-through process can be start after familiarized with the building, if the building blueprints and other electrical appliance information available describes the building and its operation accurately. In the walk-through audit, the building envelope can be study by a walk around the building. In the model analysis, the building must be divided into zones for analysis. The building survey would include that the air-conditioning system is as indicated on plans. In the building envelope, the type and condition of the windows, effectiveness of window seals will be noted. In the building, typical lighting and power requirements, occupancy and space usage are also noted. This information regarding building could be compared against the recommendations in the relevant Codes of Practices. The survey of mechanical rooms and plant room can give system and plant data. Name plate information could be compared against those in the building's documents, and pumps and chillers room can be visit for estimating the load on the system.

Operator's Input The auditor may discuss with the building maintenance staff further on the operating schedules and seek clarification on any unusual pattern in the trend of the utility bills. Unusual patterns such as sudden increase or decrease in utility bills could be caused by changes in occupancy in the building, or change in use by existing tenants. It is not uncommon for tenants to expand their computing operations that may increase the energy use significantly

A] HISTORICAL DATA ANALYSIS

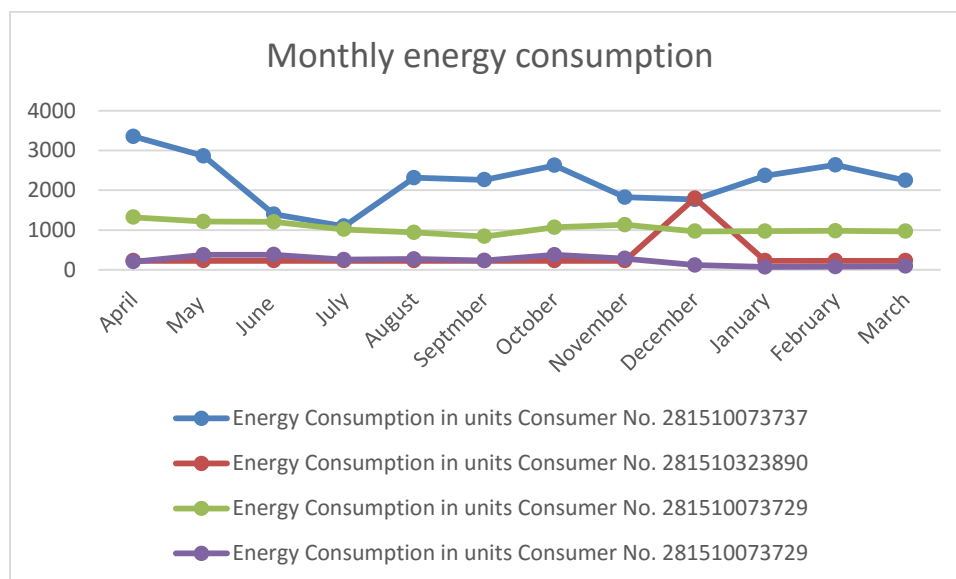
Record of monthly energy consumption of individual meter in Kwh (units) and repective Energy bill in Rupees is given below

		Consumer No. 281510073737		Consumer No. 281510323890	
		Meter No.		Meter No. 04103997868	
Sr. No	Month	Energy consumption units kWh	Bill in Rs	Energy consumption units kWh	Bill in Rs
1	April	3353	35740	225	2730
2	May	2862	31050	225	2810
3	June	1397	31240	225	2710
4	July	1097	11730	225	2790
5	August	2314	35840	225	5530
6	September	2262	11160	225	-140
7	October	2626	27300	225	2530
8	November	1824	19420	225	2780
9	December	1768	18060	1800	2570
10	January	2367	25060	225	2690
11	February	2639	28310	225	2730
12	March	2247	23260	225	2650

		Consumer No. 281510073729		Consumer No. 281510073729			
		Meter No. 09849981633		Meter No. 09849981633			
Sr. No	Month	Energy consumption units or kWh	Bill in Rs	Energy consumption units or kWh	Bill in Rs	Total Energy consumption units or kWh	Total Bill in Rs
1	April	1321	13920	201	2390	5100	54780
2	May	1211	12980	375	4900	4673	51740
3	June	1203	11480	379	4740	3204	50170
4	July	1016	10840	254	3190	2592	28550
5	August	938	20510	270	6490	3747	68370
6	September	836	-2450	230	-490	3553	8080
7	October	1066	8350	374	4180	4291	42360
8	November	1131	11890	281	3540	3461	37630
9	December	967	9770	117	1510	4652	31910
10	January	969	10160	67	1120	3628	39030
11	February	979	10310	75	1160	3918	42510
12	March	966	9890	90	1270	3528	37070

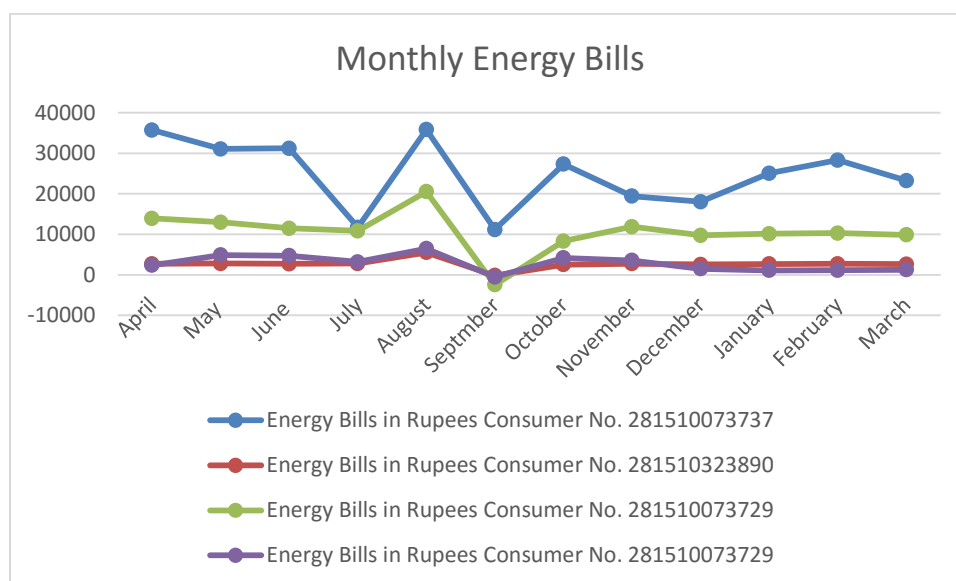
A] Energy Consumption in units or kWh

Month	Consumer No. 281510073737	Consumer No. 281510323890	Consumer No. 281510073729	Consumer No. 281510073729
April	3353	225	1321	201
May	2862	225	1211	375
June	1397	225	1203	379
July	1097	225	1016	254
August	2314	225	938	270
September	2262	225	836	230
October	2626	225	1066	374
November	1824	225	1131	281
December	1768	1800	967	117
January	2367	225	969	67
February	2639	225	979	75
March	2247	225	966	90



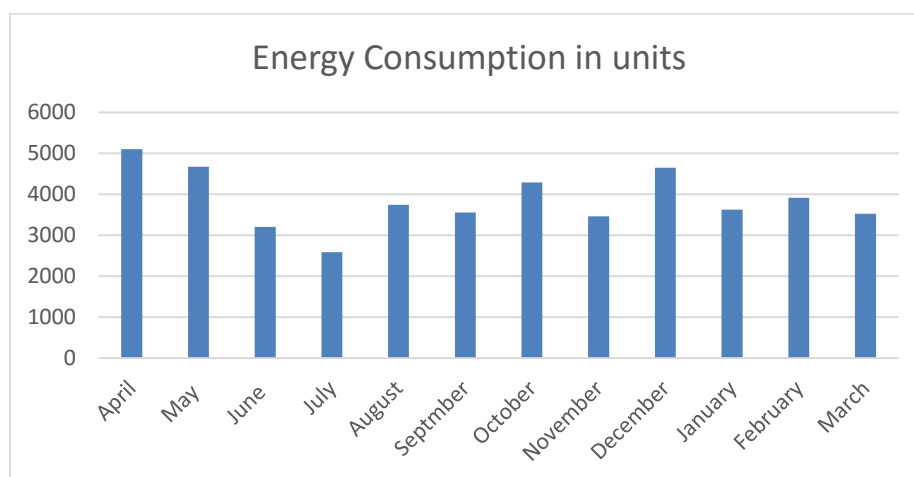
B] Energy Bills in Rupees

Month	Consumer No. 281510073737	Consumer No. 281510323890	Consumer No. 281510073729	Consumer No. 281510073729
April	35740	2730	13920	2390
May	31050	2810	12980	4900
June	31240	2710	11480	4740
July	11730	2790	10840	3190
August	35840	5530	20510	6490
September	11160	-140	-2450	-490
October	27300	2530	8350	4180
November	19420	2780	11890	3540
December	18060	2570	9770	1510
January	25060	2690	10160	1120
February	28310	2730	10310	1160
March	23260	2650	9890	1270



**Total Annual Energy
Consumption in Units**

Month	Energy Consumption in units
April	5100
May	4673
June	3204
July	2592
August	3747
Septmber	3553
October	4291
November	3461
December	4652
January	3628
February	3918
March	3528
Avg	3862.25



SOURCE OF ENERGY:

Padmabhushan Dr. Vasantryadada Patil Mahavidyakaya, Tasgaon uses Energy in following forms:

A] Electricity from MSEDCL

Padmabhushan Dr. Vasantryadada Patil Mahavidyakaya, Tasgaon receives Electricity from MSEBE

B] High Speed Diesel (HSD)

HSD is used as a fuel for Diesel Generator which is run whenever power supply from MSEDCL is not available.

The following are the major consumers of electricity in the facility

- Computers
- Lighting
- Air-Conditioning
- Fans
- Other Lab Equipment

C] Hybrid (Solar with wind miles) energy generation device

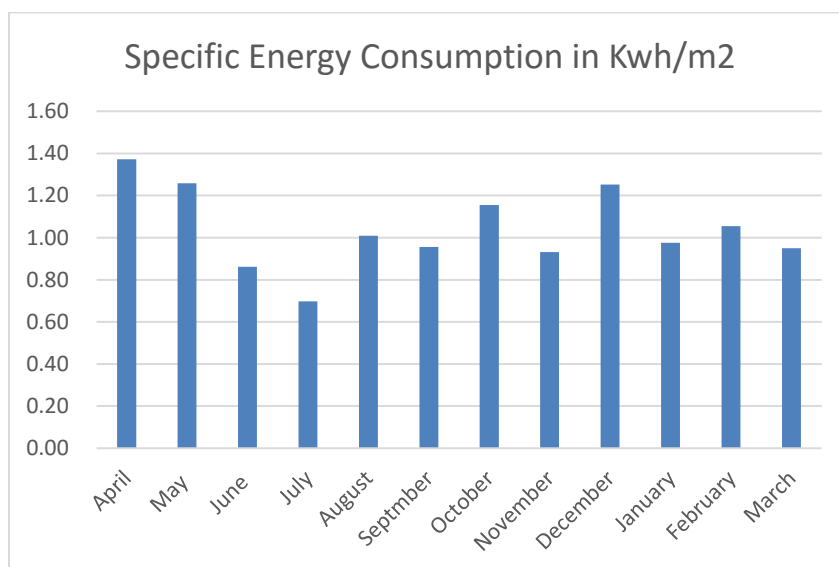
The hybrid energy generation devices contain a solar panel and wind turbine. The hybrid energy generation device has rated power 2 KW.

SPECIFIC ENERGY CONSUMPTION (SEC)

Specific Energy Consumption (SEC) is defined as energy usage per Square meter of area. it is calculated total electrical kWh/total area of the campus. By calculating SEC, we can crudely target the factors of energy efficiency or inefficiency. SEC for last twelve months was calculated and is as shown in the chart below.

Total College campus Area	11 acre
Build up Area	40000 Sq.ft or 3716 Sq.m
Projected Area	16000 Sq.ft or 1486 Sq.m
Specific Energy Consumption	Units/Sq.m

Month	Specific Energy Consumption in Kwh/m2	Energy Consumption in units
April	1.37	5100
May	1.26	4673
June	0.86	3204
July	0.70	2592
August	1.01	3747
September	0.96	3553
October	1.15	4291
November	0.93	3461
December	1.25	4652
January	0.98	3628
February	1.05	3918
March	0.95	3528



B] STUDY OF ACTUAL MEASUREMENT AND ITS ANALYSIS

I) ACTUAL MEASUREMENT OF EXISITING EQUIPMENTS:

All required data is collected by Energy Audit Team. In this data, different classifications are done and made survey of the college. In this survey, in every room, how much fans, tubes, fans, computer, instrument AC, etc. will these is measured. According to survey following data is collected

A] All Electricity consuming equipment and respective energy consumption in kW

Energy Consumption				
	Equipment	Quantity	Actual load in Watt	Total consumption in Watt
Department of Mathematics	Fan	2	78	156
	Tube light	3	40	120
	computers	16	520	8320
	printer	2	200	400
Department of Computer Science	Fans	4	78	312
	Tube light	6	40	240
	Air conditioners (1.5 Tonne)	1	5500	5500
	computers	38	520	19760
	Printer	1	200	200
Department of Physics	Fans	9	78	702
	Tube light	9	40	360
	computers	4	520	2080
	Printer	2	200	400
	LED Projector	1	200	200
Department of Botany	Fans	7	78	546
	tube light	5	40	200
	wall Fan	1	100	100

	Refrigerator	1	180	180
	computers	1	520	520
	printer	1	200	200
Zoology Department	Fan	9	78	702
	Tube light	10	40	400
	wall Fan	1	100	100
	Projector	1	200	200
	Oven I	2	1000	2000
	Oven II	1	2000	2000
	outdoor light	2	40	80
	computers	2	520	1040
	Printer	1	200	200
Statistics Department	Fan	12	78	936
	Tube light	9	40	360
	wall Fan	3	100	300
	outdoor light LED	2	10	20
	computers	39	520	20280
	Air conditioners (2 Tonne)	1	7050	7050
chemistry Department	Fan	15	78	1170
	Tube light	26	40	1040
	computers	12	520	6240
	wall Fan	1	100	100
	TV LED	1	100	100
	oven	2	1500	3000
	Refrigerator (253 units per year saving	1	180	180
	Air conditioners(1.5 Tonne)	1	5275	5275
Class rooms (No.22)	Fans	1	78	78
	Tube light	1	40	40
Library	Fan	18	78	1404
	18 tube light	1	18	18
	Tube light	20	40	800
	CFL (18W)	1	18	18

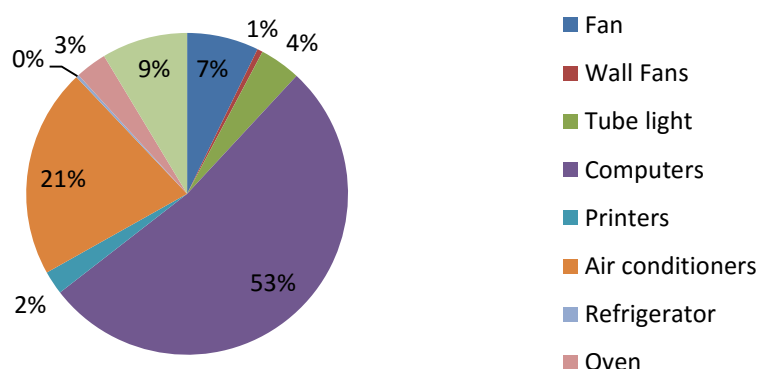
	outdoor light	2	40	80
	Printer	1	200	200
	computers	7	520	3640
Staff room for Arts and Commerce	Fan	4	78	312
	Tube light	4	40	160
	computers	1	520	520
Office	Fan	8	78	624
	Tube light	9	40	360
	wall Fan	1	100	100
	Xerox machine	1	500	500
	computers	7	200	1400
	Printer	6	200	1200
Principle Office	Fan	5	78	390
	Tube light	1	40	40
	LED light	17	10	170
	CFL (18W)	1	18	18
	Air conditioners	2	7050	14100
	LED TV	2	100	200
	computers	1	520	520
	Printer	1	200	200
Hostel	Fan	21	78	1638
	Tube light	21	40	840
	Bulb	8	15	120
	Light Bulb	3	5	15
	Motor	1	746	746
	Water purifier	1	100	100
Jimkhana	Fan	2	78	156
	Tube light	7	40	280
	street light	2	25	50
	bulb CFL (18 W)	1	18	18
Total		124324		

Total Energy Consumption: 124324 Watt or 124.324 kW

B] Major electricity consuming equipment and respective total load

Equipments	Quantity	Actual load in Watt	Total Load in Watt
Fan	117	78	9126
Wall Fans	7	100	700
Tube light	131	40	5240
Computers	128	520	66560
Printers	15	200	3000
Air conditioners	2 (1.5 Tonne) + 3(2 Tonne)		26650
Refrigerator	2	180	360
Oven	2(1kW) + 1 (2kW)		4000
others			8688
Total			124324

Total Electrical load distributrion in college campus



II) RENEWABLE ENERGY SOURCE:

Hybrid (Solar with wind miles) energy generation system is available in college campus. The device has rated power 2KW.

Assuming total working hours -4 hours

Total kWh or units energy obtained from renewable source is 8 kWh

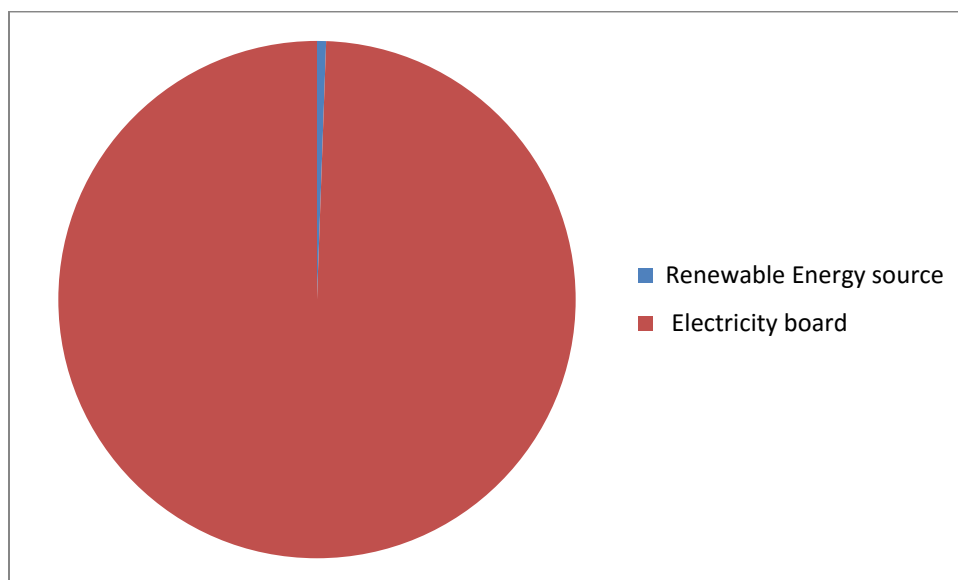
Equipment working on renewable energy

Sr. No	Equipment	Quantity	Actual consumption by equipment	Total Energy consumption in kWh or units
1.	Computer	1	520 W	520W x 4 = 2080Wh 2.08kWh
2.	Printer	1	200 W	200W x 4 = 800Wh 0.8 kWh
3.	Tube light	2	40 W	80W x 4 = 320Wh 0.32 kWh
4.	Fan	2	78 W	156W x 4 = 624Wh 0.624 kWh
Total				5.736 kWh

Total daily energy consumption by Renewable Energy source = 3.824 kWh

Therefore monthly energy consumption by Renewable Energy source = 21.92 kWh

Monthly Average energy consumption by Electricity board = 3862.25 kWh

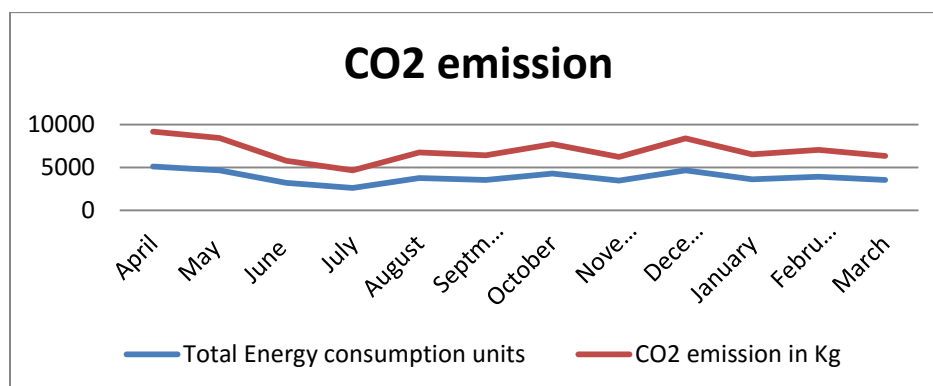


III) CARBON- DIOXIDE EMISSION

For consumption of 1 Unit (1 kWh) of Electricity, the CO₂ emitted is 0.8 Kg. OR the Emission is 0.8 Kg/kWh. In the following Table we present the total units consumed and CO₂ emitted as under:

Sr.No	month	Energy consumption (kWh)	CO ₂ emitted in kg
1	January	5100	4080
2	February	4673	3738.4
3	March	3204	2563.2
4	April	2592	2073.6
5	May	3747	2997.6
6	June	3553	2842.4
7	July	4291	3432.8
8	August	3461	2768.8
9	September	4652	3721.6
10	October	3628	2902.4
11	November	3918	3134.4
12	December	3528	2822.4
	Avg	3862.25	3089.8

Chart: Monthly CO₂ Variation



IV) RERQUIREMENT OF NAAC

A) Alternative Energy Initiative

Percentage of power requirement met by renewable energy sources

$$= (\text{Power requirement met by renewable energy sources} / \text{Total power requirement}) \times 100$$

We have,

Power requirement met by renewable energy sources -21.92 kWh

Monthly Average energy consumption by Electricity board - 3862.25 kWh

Total Power requirement: 21.92 + 3862.25 = 3884.17 kWh

Therefore,

$$= (21.92/3884.17) \times 100$$

$$= 0.56 \%$$

B) Percentage of lighting power requirement met through LED bulbs

Percentage of lighting power requirement met through LED bulbs

$$= (\text{Lighting power requirement met through LED bulbs} / \text{Total lighting power requirement}) \times 100$$

$$= (14.79/43.44) \times 100$$

$$= 34.06\%$$

C] IDENTIFICATION AND EVALUATION OF DATA

The electrical devices which are connected in college campus are not energy saving devices. These devices can be changed by electrical efficient appliances. The appliances are of high watt equipment so the electrical consumption is high in Tasgaon college campus. Now a day's low wattage appliances are used in building. They are helpful in saving electricity.

Table Energy Efficient Electrical Equipment

Sr.No	Equipment	Make	Rating	Specification	Cost INR
1	20 W LED Tube light	Wipro	18 W	LED	300*
2	Fan (1200 mm)	Usha	50 W	BEE 4 star	1255*
3	Fan (700mm)	Usha	43 W	BEE 4 star	1135*
4	Exhaust fan	Usha	50 W	BEE 4 star 486 m ³ /min	1650*
5	Tube light	Philips	36 W	Lumen	250*

*Price is based on market rates

- 1) Tubes and CFL are replaced by LEDs.
- 2) Replacing the CRT Monitors with LCD Monitors:
- 3) Replacing regular fans by BEE 4 star fans

ENERGY SAVING CALCULATION

1) Cost Analysis of LED light with Conventional tube light.

Total No. of conventional Tube Lights in Campus = 131

Conventional Tube Light average power = 40 W.

LED Tube Light average power = 20 W.

Difference in power saved per Tube Light = (40-20) W =20 W.

% saving After Replacement: $20W/40W \times 100 = 50\%$

Average Use of Tube Light per year (From Actual Measurement Data) =1935kWh

Energy saved per year = 50%*1935 kWh = 967.5 kWh.

Per year saving = 967.5 *8= Rs. 7740

LED tube light average cost = Rs. 300.

Total Cost of Replacing all Conventional tube lights = 131*300 = Rs.39300

Payback time = (39300/7740) = 5 yrs. Hence, the payback time for replacing all conventional tube lights of the campus with LEDs is around 5 year.

2) Replacing the CRT Monitors with LCD Monitors:

In the college campus computers with CRT monitors are 128 numbers and the power consumption of CRT monitor is 520 W which is very large. The power consumption of LCD monitor is 250 Watts so the difference between CRT monitors and LCD monitor is large but the LCD monitor are costlier than CRT monitors. This saving of 270W per monitor is very large. LCD monitor cost analysis with CRT monitors.

Total no. of computers with CRT monitors is = 128.

Power saving per monitor = 270W.

% saving after replacement = 270W/520W x 100 = 52%

Average Use of computers per year (From Actual Measurement Data) =24573kWh

Annual Power saving = 24573kWh x52%= 12778kWh.

Annual Saving in Rs. per year = 12778*8 = Rs. 102224

Cost for replacing Monitor = Rs.4500.

Total Cost of Replacing all monitors = 128*4500 = Rs.576000

Capital Cost Recovery time = $(576000)/(102224) = 5.5$ yrs. Hence, the payback period for replacing CRT monitors by LCD monitors is 5.5 years. Since the product life of LCD is much more than that, the move is economically beneficial.

3) Replacing regular fans by BEE 4 star fans

Total No. of conventional Fans in Campus = 117

Conventional Fan average power = 78 W.

BEE 4 star rated fan average power = 50 W.

Difference in power saved per Tube Light = $(78-50) \text{ W} = 28 \text{ W}$.

% Total Power saving = $28\text{W} / 78\text{W} \times 100 = 36\%$

Average Use of fans per year (From Actual Measurement Data) = 3370 kWh

Energy saved per year = $3370\text{W} \times 36\% = 1213 \text{ kWh}$.

Per year saving = $1213\text{W} \times 8 = \text{Rs.}9704$

BEE 4 star rated fan average cost = Rs. 1255

Total Cost of Replacing all Conventional tube lights = $117 \times 1255 = \text{Rs.} 146,835$

Payback time = $(146,835/9704) = 15$ yrs. Hence, the payback time for replacing all conventional fans of the campus with BEE 4 star rated fan is around 15 yrs year.

***Payback period is more than average life of equipment so not recommended.**

4) Providing Solar PV system for part load operations during day time

There are mainly Lighting and Computer loads. Since, there is no separate lighting feeder; it becomes necessary to separate out the lighting feeder for those lights where they are used 6 to 8 hours in a day.

A 5 kW Solar PV is proposed for the Lighting load application with minimum Storage batteries.

The power saved considering the 85% loading = 5 kW

Average Daily available hours = 6 h/day

Electricity Saved = $6 \times 5 = 30$ kWh/day

Yearly availability = 300 days/year

Yearly savings in electricity = $300 \times 30 = 9000$ kWh/year

Monitory Savings = $9000 \times 8 = \text{Rs. } 72000$ / year

Approximate cost of the solar system = Rs. 3.6 lac

Payback Period: $360000/72000 = 5$ Yrs.

Average life of project: 25 Yrs.

Net Saving: $20 \text{ yrs} \times 72000/\text{yrs.} = 1440000/-$

RECOMMENDATIONS

General Recommendations

- All Class Rooms and labs to have Display Messages regarding optimum use of electrical appliances in the room like lights, fans, computers and projectors.
- Most of the time, all the tube lights in a class room are kept ON, even though, there is sufficient light level near the window opening. In such cases, the light row near the window may be kept OFF.
- All projectors to be kept OFF or in idle mode if there will be no presentation slides.
- All computers to have power saving settings to turn off monitors and hard discs, say after 10 minutes/30 minutes.
- The comfort air conditioning temperature to be set between 24°C to 26°C.
- Lights in toilet area may be kept OFF during day time

Commercial Recommendations

- Installation of solar PV panel system of capacity 5kWh is highly recommended. The total saving through-out the project life is **Rs. 1440000/-**
- Replacement of CRT monitors with LED monitors will save **Rs. 102224/-** per year and payback period is 5 yrs. Its highly recommended as it will avoid digital eye strain on users.
- Replacement of Conventional tube lights with LED monitors will save **Rs. 7740/-**. Per year & payback period is 5 years

CONCLUSION :

Natural resources on earth are limited and consuming very sharply. It can be saved by employing energy efficiency and it is very necessary to prevent depletion of natural resources. The Electrical audit of college buildings shows that the load of electrical equipment's is significant and should be taken some necessary step for reducing energy conservation. Today energy conservation plays a very important role for energy conserving because energy consumption is increasing day by day but the natural resources are not increasing and also generation is not match with consumption People should aware about energy conservation and reduce energy consumption by adopting modern technologies.