

ENERGY AUDIT REPORT

(2021-22)



Submitted To
The Principal
Cinnamara College
Jorhat, Assam

Submitted By



JKM Consultancy Service
Solution For Energy Audit

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Preface

Data collection for energy audit of the Cinnamara College, Jorhat was conceded by team for the period of March 2021 to February 2022

This audit was over sighted to inquire about convenience to progress the energy competence of the campus. All data collected from each classroom, laboratory, every room. The work is completed by considering how many tubes ,fan ,A.C, electronic instruments, etc. in each room. How much was participation of each component in total electricity consumption.

We really appreciate the effort put by college management for creating awareness of Energy Audit, use renewable energy such as solar energy and their significance use for efficient energy saving and our nature among the all of us. We really appreciate Management of the college for encouraging us by providing this wonderful opportunity to do the energy audit. Through this, we have been cleared the vision of Institution towards the Green campus and save our green nature. We really appreciate to develop good quality weather station in house of the college.



MainBuilding

Acknowledgement

We are sincerely thankful to the Cinnamara College, Jorhat management for giving us the opportunity to conduct energy audit in the college campus.

We are also grateful to Dr. Anjan Saikia, principal of Cinnamara College Jorhat whose valuable comment / feedback, during various reviews have helped us to bring the report in the present format.

We express our sincere gratitude to IQAC coordinator and all other concerned officials for their support and guidance during the conduct of the exercise

Energy Audit Certificate

This is to certify that an Energy Audit for Cinnamara college, Jorhat, Assam has been conducted from March-21 to February-22 to assess energy costs, availability and reliability of supply of energy, energy conservations technologies and ways to reduce energy consumption.

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21/08/2022

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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
HSDG	High speed diesel Generator
PF	Power Factor
SEC	Specific Energy Consumption
TR	Tons of Refrigeration
UOM	Unit of Measurement
APDCL	Assam Power Distribution Company Limited

Introduction to Energy Audit

- **General:**

Cinnamara College , Jorhat , Assam entrusted the work of conducting a detailed Energy Audit of campus with the main objectives are as bellows:

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

- **Scope of Work, Methodology and Approach:**

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.

- **Energy Audit:**

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.

There are three phases of energy audit

1. Pre audit phase
2. Audit phase
3. Post audit phase

Above phase include following stages

1. **Data collection-** In preliminary data collection phase, exhaustive data collection was performed using different tools such as observation , survey communicating with responsible persons and measurements.

Following steps were taken for data collection:

- a. The team went to each department , centers, library, canteen etc.
- b. Data about the general information was collected by observation and interview.
- c. The power consumption of appliances was recorded by taking an average value in some cases

2. **Data analysis** – Detailed analysis of data collected include: calculation of energy consumption , analysis of latest electricity bill of campus .

3. **Recommendation** - On the basis of results of data analysis and observations , some steps

For reducing power and water consumption were recommended. Proper treatments for waste were also suggested. Used of fossil fuels has to be reduced for the sake of community health The above target areas particular to the college was evaluated through questionnaire circulate

among the students for data collection. Five categories of questionnaires' were distributed. The format of this are given below

Pre audit phase

Survey form for data collection

1. List ways that you use energy in your college .(Electricity , Electric stove , Kettle, Microwave , LPG , Petrol , Diesel and others).
2. Electricity bill amount for the last five year
3. Amount paid for LPG cylinders for last one year
4. Weight of firewood used per month and amount of money spent ? Also mention the amount spend for petrol/diesel/others for generators?
5. Are there any energy saving methods employed in your college? If yes ,please specify . If no ,suggest some.
6. How much money does your college spend on energy such as electricity , gas , etc. In a month .(Record monthly for the year 2016).
7. How many CFL bulbs has your college installed ? Mention use (Hours used/ Daily for how many days in a month)
8. Energy used by each bulb per month? (For example- 60 watt bulb x 4 hour x No of bulbs= kwh).
9. How many LED bulbs are used in your college ? Mention the use (Hours used / day for how many days in a month)
10. Energy used by each bulb per month?(kwh) .
11. How many incandescent(tungsten)bulbs have your college installed?
12. Mentions used (Hours used/day for how many days in a month)
13. Energy used by each bulb per month?(kwh).
14. How many fans are installed in your college ? Mention use(Hours used /day for how many days in a month)
15. Energy used by each fan per month ? (kwh)
16. How many air conditioners are installed in your college? Mention use(Hours used /day for how many days in a month)
17. Energy used by each air conditioners per month?(kwh)
18. How many electrical equipment including weighing balance are installed in your college?
19. Mention the use (Hours used /day for how many days in a month)
20. Energy used by electrical equipments per month?(kwh)
21. How many computers are there in your college? Mention the use (Hours used /day for how many days in a month)
22. Energy used by each computer per month?(kwh)
23. How many photocopiers are installed by your college ?Mention use(Hours used /day for how many days in a month)
24. How many cooling apparatus per month are installed in your college ? Mention use(Hours used /day for how many days in a month)
25. Energy used by cooling apparatus per month?(kwh) Mention use(Hours used /day for how many

days in a month)

26. Energy used by each photocopier per month?(kwh) Mention use(Hours used /day for how many days in a month)how many inverters your college installed ? Mention use (Hours used /day for how many days in a month)

27. Energy used by each inverter per month?(kwh)

28. How many electrical equipment are used in different labs of your college? Mention use(Hours used /day for how many days in a month)

29. Energy used by each equipment per month?(kwh)

30. How many heaters are used in the canteen of your college? Mention use (Hours used /day for how many days in a month)

31. Energy used by each heater per month (kwh)

32. Number of street lights in your college?

33. Energy used by each street light per month?(kwh)

34. Any other item that uses energy(Please write the energy used per month) Mention use(Hours used /day for how many days in a month)

35. Are any alternative energy sources /Known conventional energy sources employed / installed in your college?(Photovoltaic cell for solar energy, windmill ,energy efficient stoves etc.,)Specify.

36. Do you run “switch off” drills at college?

37. Are your computers and other equipment put on power saving mode?

38. Does your machinery(TV, AC, Computer , weighing balance , printers, etc.)run on standby mode most of the time? If yes , how many hours?

39. What are the energy conservation methods adopted by your college?

40. How many boards displayed for saving energy awareness?

41. How much ash is collected after burning firewood per day in the canteen?

42. Write a note on the methods/ practice / adaptation by which you can reduce the energy used in college campus in future.

2. Audit Phase

In Cinnamara college , energy auditing was done with the help of team teaching staff and students. The energy audit began with the teams walking through all the different facilities at the college, determining the different types of appliances and utilities (lights, taps, toilets, fridges, etc.) as well as measuring usage per item (watts indicated on appliances) and identifying the relevant consumption patterns (such as how often an applicant is used) and there impacts. The staff and learners were interviewed to get details of usage, frequency or general characteristics of certain appliances.

Data collection

Data collection was done in the sector such as sources of energy and energy consumption pattern, college records and documents were verified several times to clarify the data received through survey and discussions. Although whole process was completed from 2021 march to February , 2022 , previous energy patterns were also observed.

Site Tour

Site inspection was done along with students and staff.

Review of Documents and Records

Documents such as electricity bill registers of electricity fuel consumption were collected.

Energy Consumption Profile

Source of Energy:

a. **Electricity from Assam Power Distribution Company Limited**

b. **High Speed Diesel Generator (HSDG):**

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

There is one number of DG set which is dedicated to supply power to entire campus.

The salient technical specifications are as follows:

Company	JAYCEE
Model no	JPS/3151R
Machine no	322ES
KVA	15
Voltage	415v
Current	87amp
Power factor	0.8



Diesel Generator

Following are the major consumes of electricity in the facility

- **COMPUTERS**
- **LIGHTING**
- **FANS**
- **OTHER LAB EQUIPMENT**
- **PRINTERS**
- **XERO MACHINES**
- **CCTV**
- **UPS**
- **LCD PROJECTOR**
- **ROUTER SYSTEM**
- **PUMPING MOTORS**

Historical Data Analysis

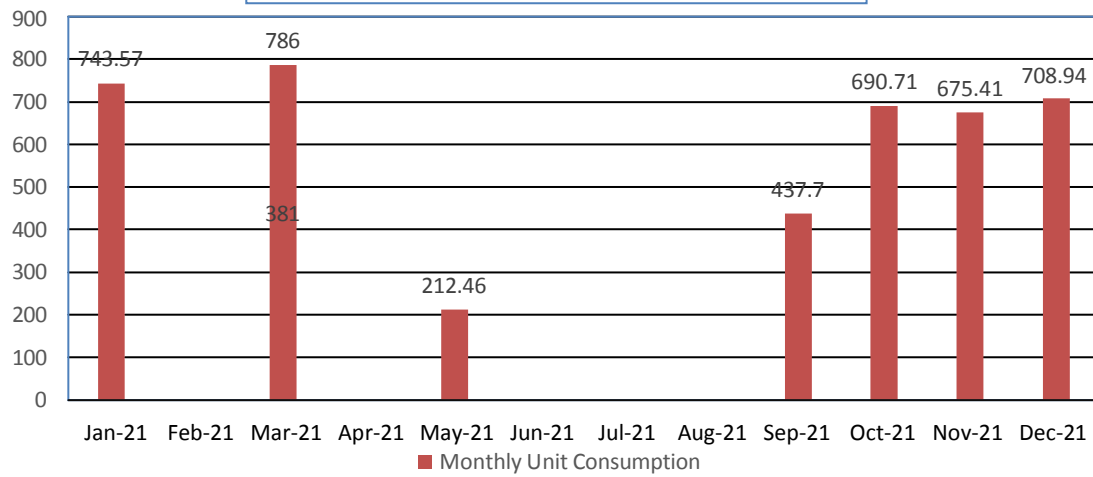
Study of Variation of Monthly Units consumption & Power Factor:

In this Chapter, we study the details of the 12 months Electricity Bills.

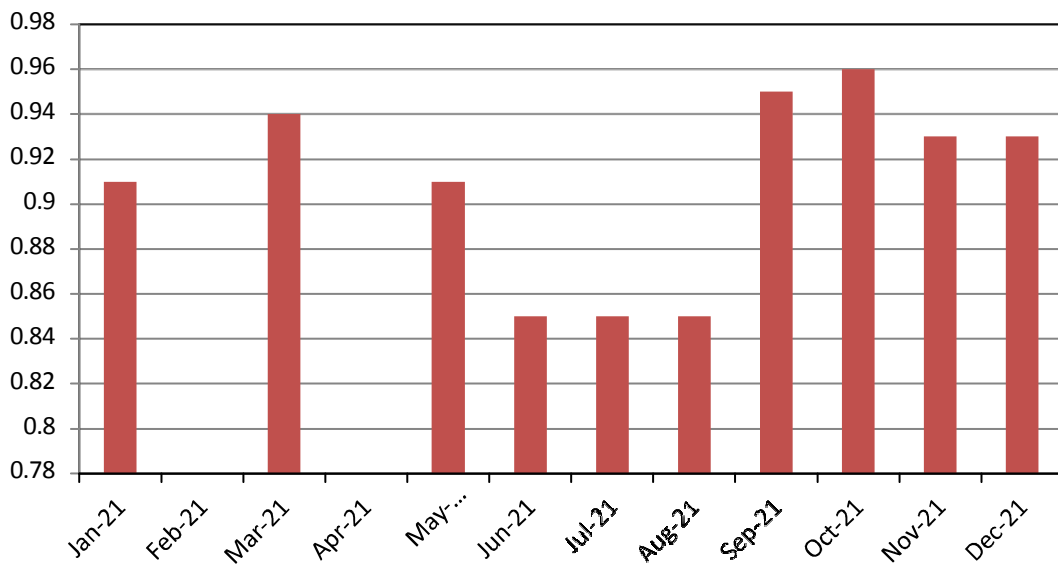
TableNo4.1Variation in Units Consumption& Power Factor (PF)

Sl. No.	Month	No. of units in in Kwh	Power Factor
1.	March-21	786	0.94
2.	April-21	Na	Na
3.	May-21	212.46	0.91
4.	Jun21	NA	NA
5.	July-21	NA	NA
6.	August -21	NA	NA
7.	September-21	437.7	0.95
8.	October-21	690.71	0.96
9.	November-21	675.41	0.93
10.	December-22	708.94	0.93
11.	January-22	743.57	0.91
12.	February-22	NA	NA
13	March-22	686.39	0.93

Monthly Unit Consumption



Month wise Power Factor



Conclusion: Variation of PF

The Power Factor to reduce the utility power bill. Most utility bills are influenced by KVAR usage. A good Power Factor provides a better voltage. Reducing the pressure on electrical distribution network. Reducing cable heating, cable over loading and cable losses. Reducing over loadings of control gears and switch-gears etc.

Whenever the average power factor over a billing cycle or a month, whichever is lower, of a higher tension consumer is below 90%, Penal charges shall be levied to the consumer at the rate of 2 % (two %) of the amount of monthly energy bill (excluding of Demand Charges, FOCA, Electricity Duty and Regulatory Liability Charge etc.)

For power factor of 0.99, the effective incentive will amount to 5% (five percent) reduction in the energy bill and for unity power factor; the effective incentive will amount to 7% (seven percent) reduction in the energy bill

General Observations based on Electricity Bill:

1. The average electricity cost is Rs. 7.2 considering the last twelve months.
2. Average monthly Power Factor is maintained near **P.F. 0.93**
3. Load Factor need to be improved to maximum value.

Electrical Supply Details

Study of electrical demand

There is only one meter installed in the premises the details are as under:

Meter no: A3002933

SL. NO	Basic Building Data	Value
1	Connected Load	48kW
	Contract Demand	56.47KVA
2	Installed capacity of DG set	15KVA(1Nos)
3	Annual electricity consumption (March2021-February2022)	4941
4	Working hours (Academic and administrative building)	8hrs (9am to 5pm)
5	Working days/week	6 Days

Actual measurement and its analysis

Room	Sl. No.	Name of the equipment	Power Rating (Watt)	Qty.	Used Per Day (hr)	Power Consumption Per day (watt)
Office Room	1	Fan	80	7	6hrs	480
	2	Tube light	20	2	2hrs	160
	3	Desktop	100	2	2hrs	400
	4	Printer	100	2	1hrs	100
	5	Led light	10	2	1hrs	20
Principal Room	1	Inverter		1	1hr	
	2	Fan	70	2	6hrs	1260
	3	Tube light	20	4	1hr	100
	4	Desktop Set	100	1	2hrs	200
	5	LED BULB	10	1	1hrs	10
Vice principal room	1	LED	10	1	1hr	10
	2	Fan	70	1	6hr	420
IQAC ROOM	1	LED tube	20	2	1hr	40
	2	Fan	70	1	6hr	420
	3	Desktop Set	100	1	4hr	400
	4	Printer	100	1	1hr	100
Department of Assamese	1	Led light tube	20	4	1hr	80
	2	Fan	70	6	6hr	2520
	3	LED bulb	100	1	3hrs	300
Department of Education	1	LED tube	20	7	1hr	140
	2	Fan	70	12	6hr	5040
New Building 1&2	1	LED tube	20	3	3hrs	180
	2	LED bulb	10	2	3hrs	60
	3	Fan	70	12	6hrs	5040

Exam room	1	LED tube	20	1	3hrs	60
	2	Fan	70	2	6hrs	420
	3	Xerox	1200	1	1hr	1200
Distance Education Room	1	LED Tube	20	1	3hrs	60
	2	Fan	70	2	6hrs	420
	3	Electric cattle	1500	1	1hr	1500
KKHSOU Room	1	LED Tube	20	1	3hrs	60
	2	CFL bulb	10	1	3hrs	30
	3	Fan	70	3	6hrs	420
	4	Desktop computer	100	2	2hrs	400
	5	Printer	100	2	1hrs	200
	6	Inverter	900	1	2hrs	1800
	7	Electric Cattle		1	1hr	
	8	TV	59	1	1hr	59
Canteen	1	LED Tube	20	2	3hrs	120
	2	Fan	70	4	6hrs	1680
Common Room	1	Bulb	10	1	3hrs	30
	2	LED Tube	20	4	3hrs	120
	3	LED Bulb	10	2	3hrs	60
	4	Fan	70	6	6hrs	2520
	5	Water pump	750	1	2hr	1500
	6	Led TV	59	1	1hr	59
	7	CCTV camera	50	2	24hrs	1200

NTT office	1	CFL bulb	10	2	6hrs	120
	2	Fan	70	1	6hrs	420
Department Of Soc.	1	Fan	70	7	6hrs	2940
	2	LED tube	20	4	1hr	80
Department of History	1	Fan	70	4	6hrs	1680
	2	LED tube	20	1	1hr	20

	3	LED bulb	100	1	3 hrs	300
Department of economics	1	Fan	70	5	6hrs	2100
	2	LED tube	20	4	1hr	80
	3	CCtv	50	1	24hr	1200
Museum	1	Led tube	20	4	3hrs	240
	2	Halogen	14	6	3hrs	252
	3	Fan	70	1	6hrs	420
Department of geography	1	Fan	70	18	6hrs	7560
	2	LED	20	18	1hr	360
Library	1	Fan	70	12	6hrs	5040
	2	Desktop	100	3	3hr	300
	3	Xerox machine	1000	1	2hrs	2000
	4	Led tube	20	8	1hr	160
	5	Inverter	900	1	2hr	1800
	6	Led Bulb	3	10	1hrs	30
	7	CCTV	50	5	24hrs	6000
Varanda	1	Led bulb	10	4	6hrs	240
	2	Bulb	100	1	6hr	600
	3	Led tube	20	8	1hr	160
Dept. Of English	1	Fan	70	5	6hrs	2100
	2	LED tube	20	4	1hr	80
Dept. of Pol. Science	1	Fan	70	8	6hrs	3360
	2	LED tube	20	3	1hr	60

Remarks:

- It has been observed that in old and new building majority of electrical power consumption is through light load such as fan, FTL and power load such as refrigerator, ups, etc. unnecessary use of electrical equipment must be avoided.
- As per individual dept. level load consumption, we understand the scope for improvement of energy saving. Hence our electricity bill will be reduced by proper load management techniques along with optimum utilization of resources.

Observations and suggestions:

- It is found that FTL, Bulbs, CFLs is installed in the facility.
- It is recommended that some tube lights in this area be switched off when sufficient daylight is available.
- Presently there are no reflectors installed for tube lights.
- Every light or electric gadget left on when not needed is wasting energy and money and is causing pollution that is totally unnecessary.

- **Stand-by power can use up to 8% of a household's total electricity.**

For most homes a 10% reduction in electricity consumption can save \$200 a more a year off our electricity bill and nearly $\frac{3}{4}$ of a tone of CO² pollution. A 20% reduction on average consumption will save over \$400 and over 1.5 tons of CO².

Don't forget to power down these things when not in use:

- Lights
- Heaters and fans (or air-conditioning)
- Printers and scanners
- Battery and phone chargers
- Computers
- Gaming consoles
- TVs, DVD players
- Stereos
- Kitchen gadgets such as blenders, kettles, toast

Carbon Di-Oxide Emission

In this Chapter we compute the CO₂ emissions. 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:

Table 8.1: CO₂ Emission:

Sl.No.	Month	kWh	CO ₂ Emitted in MT
1	March-21	786	0.78
2	April-21	-	-
3	May-21	212.46	0.17
4	June-21	-	-
5	July-21	-	-
6	August-21	-	-
7	September-21r	437.7	0.35
8	October-21	690.71	0.55
9	November-21	708.94	0.57
10	December-21	-	-
11	January-22	743.57	0.59
12	February-22	686.39	0.55
	Total		Avg. Emission =0.51

Merits/Existing Features for Energy Savings.

1. Staff vigilance
2. Computers are connected in LAN.
3. Printers are shared in LAN.
4. Screen savers facility implemented for every computer.
5. AC's used are of three STARS.
6. Refrigerators are of three STARS.
7. Incandescent Bulbs are nowhere used.
8. They are replaced by CFL tubes with electronic choke.
9. Maximum use of natural light.
10. Cross Ventilation is provided in laboratory &
class rooms, which reduced number of fans.
11. Most of the practical's are scheduled in noon time when Billing Rate in normal.
12. Walls are painted with off white colour to have sufficient brightness.
13. LED flash light is used in Seminar hall.

Energy conservation Proposals

Providing Energy Saver Circuit to the Air Conditioners:

The **energy saver circuits for the air conditioners, intelligently reduces the operating hours** of the compressors either by timing or temperature difference logic without affecting the human comfort. This can save around 15% to 30% of the electricity depending on the weather conditions and temperature settings.

Replacing Fluorescent Tube Lights (FTL)with LED Tube Lights

The 100 FTLs can be replaced with the LED tube lights 16 W. These changes can be made at the places where the life is higher .Usually minimum of 3 years warranty is given and approximate burning hours is 40 000.(15yearsconsidering8hours per day running)

Following calculations are done for 8 hours working:

- Power consumption by 36w FTL with conventional choke = 40 W/ Tube Light
- Equivalent LED tube light = 16 W/ Tube Light
- Savings in power = 24 W/ Tube Light
- Operating hours = 8 h/day x 300 = 2400 h/year
- Tube Light Yearly savings = 2400 x 24 W = 57.6 kWh/year/Tube Light
- Average Cost of electricity = Rs.7.20/ kWh
- Saving = 57.6 kWh x 7.2= Rs.414.72 / year/ Tube light
- Approximate investment on single LED Tube lights = Rs. 200
- Number of Tube Lights to be replaced = 100

Summary:

- ✓ **Total Yearly Saving = 100x 414.72 = Rs. 41472/year**
- ✓ **Total Investment = 100x Rs. 200 = Rs.20000/-**

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. Save electricity. **Display the stickers of save electricity**, save nature everywhere in the campus. So that all stakeholders encouraged to save the electricity.
- 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.
- Lights in toilet area may be kept OFF during daytime

USE AUTOMATIC POWER FACTOR CORRECTION (APFC) Panel FOR PF improvement.

- Need to focus on existing solar plant which is generating power below the rated power
- Need to replace FTL by smart LED Tube
- Need to replace ordinary bulb by LED bulb.
- Need to replace ordinary CRT monitor by LED.
- Need to replace ordinary refrigerator by BEE power saver refrigerator if possible.
- Out of total electricity bill paid, 53 percentage are actual energy utilized charges and remaining expense belongs to additional taxes on energy consumption

Executive Recommendations:

1. **There has to be Institute level student community that keeps track of the energy consumption Parameters of the various departments, class rooms, halls, areas, meters, etc.**
2. **Energy auditing inside the campus has to be done on a regular basis and report should be made public to generate awareness.**
3. **Need to Create energy efficiency/ renewable energy awareness among the college campus i.e. solar, wind, Biogas energy. College should take initiative to arrange seminars, lectures, paper presentation competition among students and staff for general awareness.**

2.3 Post audit phase

Follow up and action plans

Energy audits form a part of an on-going process. Innovative energy saving initiatives has to be designed and implemented every year to make the college environmentally sustainable.

Photographs Museum





Diesel Generartor



Transformer



College View

