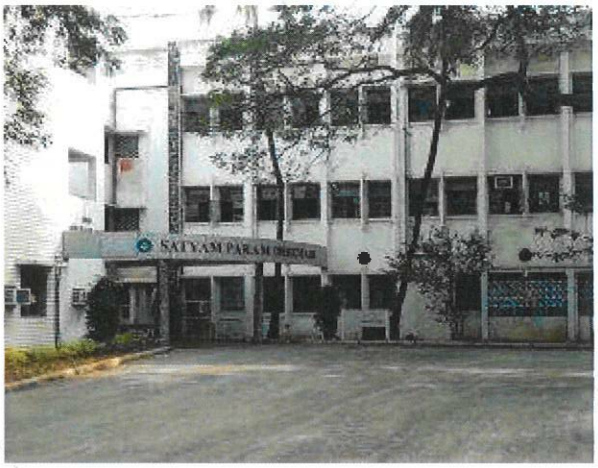
ENERGY AUDIT REPORT



DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE
(Autonomous)

Arumbakkam,

Chennai, Tamilnadu

Prepared by

GREENPRO BUILDMART

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ACKNOWLEDGEMENT

Greenpro Buildmart Team wishes to thank all the Teaching & Non teaching Staffs of DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE, Chennai for the kind cooperation and assistance extended to our team during the course of the audit.

We would like thank Principal **Dr S.Santhosh Baboo** for giving us the opportunity. And also would like to extend our thanks to Mr M Govindarajan – Electrical Engineer of the reputed campus.

From

GREENPRO BUILDMART

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CERTIFICATE OF ENERGY AUDIT

This is to certify that DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE, Arumbakkam, Chennai has conducted an Energy Audit in February 2021 for the year of 2020-2021 for understanding the current energy consumption pattern and to identify all possibilities of energy saving opportunity to mitigate greenhouse gas emissions & to reduce the carbon footprint for environmental protection.

GREENPRO BUILDMART * CHENNAI

Kanipandi G

Certified Energy Auditor EA – 19135

Date: 25-02-2021

Bureau of Energy Efficiency, Govt of India

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1. Summary

Energy Audit of DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE, Chennai was carried out by Greenpro Buildmart during February 2021.

The approach taken in this facility included different tools such as preparation of questionnaire, physical inspection of the campus, observation, measurement and review of the documentation, interviewing key persons and associated systems & equipment, including the Electrical, AC systems, Water supply systems and operational & maintenance procedures. Operational Data were also collected from the past records. The study covered the following areas to summarize the present status of energy management in the campus:

- Distribution Panel
- Packaged AC systems/Split AC/Window unit/Rooftop units
- Solar PV system
- STP system
- Lightings

The report compiles a list of actual measurements, observations & possible actions to conserve and efficiently use the electrical energy.

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2. Institution Details

Dwaraka Doss Goverdhan Doss Vaishnav College, a linguistic minority institution established in 1964 by Rajasthanis and Guajaratis settled in Chennai for the cause of higher education. The college with a sole purpose of imparting knowledge and value based education saw its grand day on 30th June 1964 with one course in B.Sc. Mathematics with Shri. Totadri Iyengar (teacher of Dr. APJ Abdul Kalam) as its first Principal.

Dwaraka Doss Goverdhan Doss Vaishnav College has been a haven for generations of enthusiastic learners through 5 decades and more. College was founded on the principles of Vaishnavism, with the sole purpose of imparting value based quality education and empowering youth. The college has seen a phenomenal growth in terms of its infrastructure , its constantly restructured and revamped curriculum to cater the specific needs of the students community. Outstanding performance of students in academics and extension activities has enabled the college to emerge as one of the premier institutions of higher learning.

The curriculum is reviewed and updated periodically, in keeping with the changes in the diverse disciplines of arts, commerce, science and technology. An interdisciplinary, multi disciplinary approach in designing the course work is adopted to ensure industry – academia collaboration. The college has entered into collaborations with many reputed institutions/organizations.

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2. Audit Details

An energy audit is an inspection survey and an analysis of energy flows for energy conservation in a building. It may include a process or system to reduce the amount of energy input into the system without negatively affecting the output.

The main objectives of carrying out Energy Audit are:

- To understand the current energy consumption pattern
- To identify all opportunities to reduce energy consumption
- To find out any waste energy utilization or cogeneration solution
- To identify any energy/heat loss due to error or repair
- To reduce green house gas & carbon footprint
- To identify potential investment with shorter payback

Our audit team underwent physical on-campus inspection, measurement and checked the related records. Interaction with the various campus stakeholders and the data generated by our team's findings and recommendations is given hereby. It will help the Institute achieve the long-term goal of environmental sustainability when implementing the suggestions.

Our Audit team includes:

- Mr G Kanipandi – Certified Energy Auditor (EA 19135)
- Mr Anand Sachithanantham (MTech- Energy Conservation & Management)
- Mr Sathya Sai (Industrial Process Expert)

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3. Campus Energy Scenario

Source

The electricity is drawn from the Tamilnadu Electricity Board TNEB and Diesel Generators are used as backup system to the energy demand of the campus. Additionally campus has installed 110kW solar power generation system on rooftops.

- Contract demand : **700 kVA**
- Diesel Generators : **4 * 500 kVA set**

Half Yearly Energy Consumption:

Month-Year	Units kWh
Jul-20	41097
Aug-20	42782
Sep-20	27856
Oct-20	24256
Nov-20	21072
Dec-20	30584
Total	187647

The overall half yearly energy consumption this current academic year is 187,647 kWh/annum. The greenhouse gas emissions equivalent for electricity is **168 tons of CO2.**

Other Sources:

- Diesel generator - 1870 kWh
- Solar PV system - 27330 kWh

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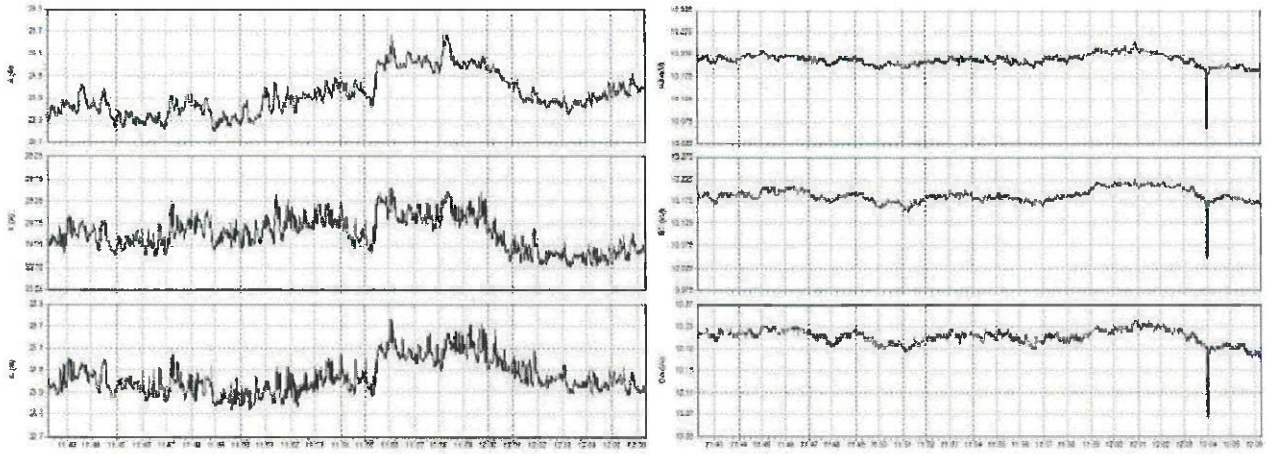
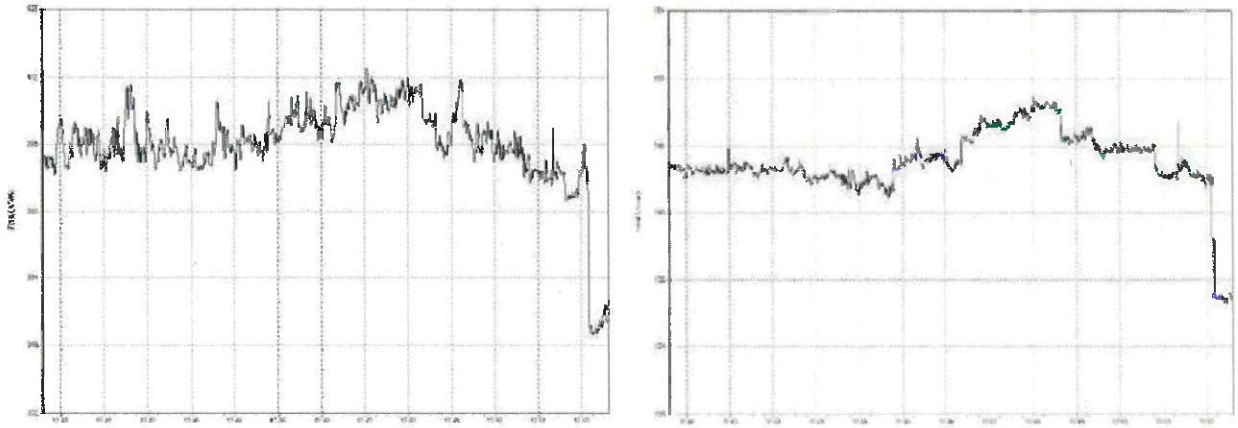
4. System Assessment

Power Quality Study

Power Quality analysis have been carried out in necessary systems and measured parameters like current, kW, kVA, kVAR, THD-I, THD-V & Power factor for identifying any deviations from normal conditions.

- Trend chart of 11 kV VCB Panel (Input side)





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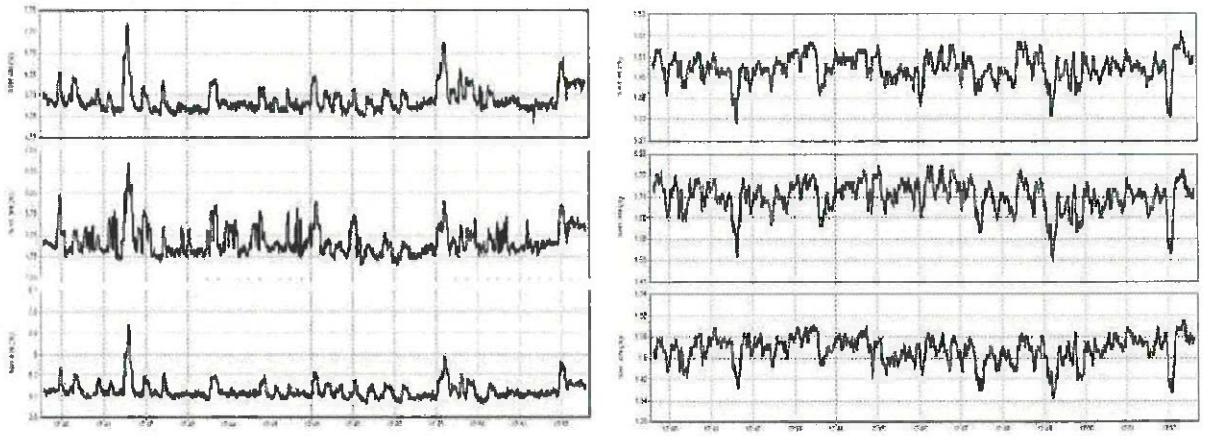
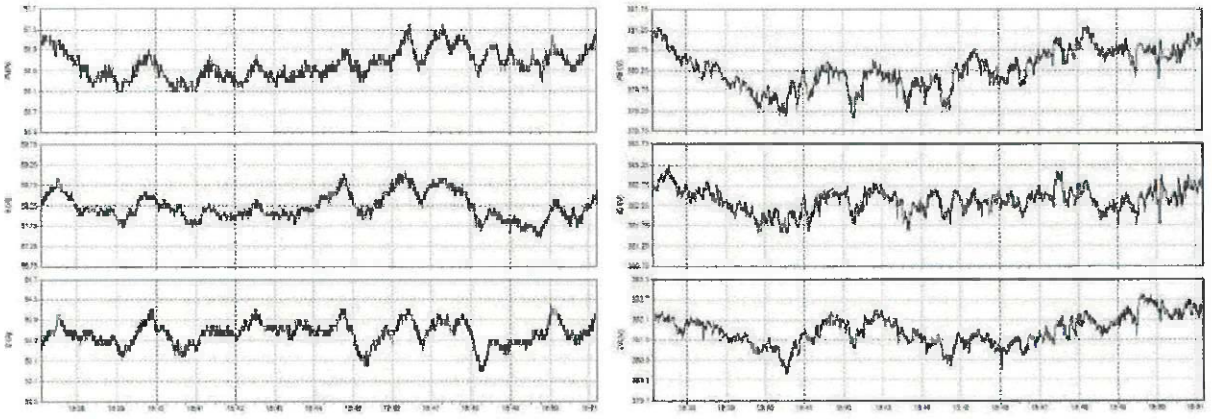
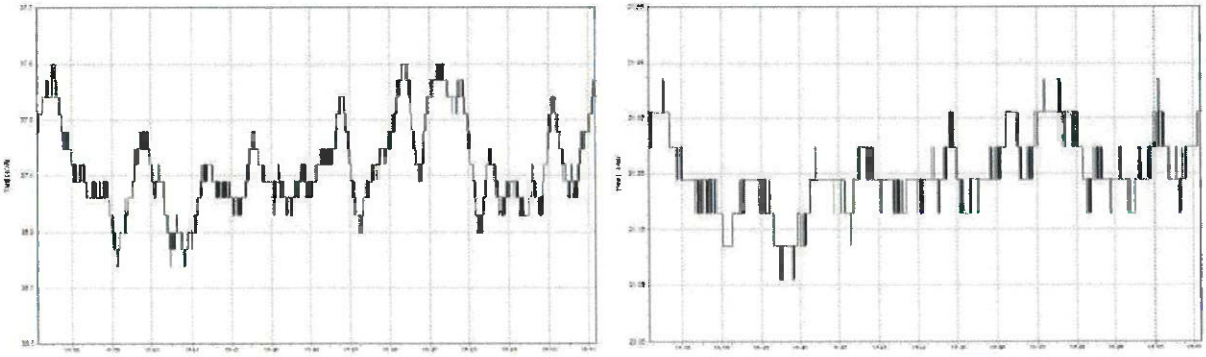
4. System Assessment

- Trend chart of EB Incomer



- Trend chart of Big Auditorium (Packaged Units 2*17TR)





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4. System Assessment

Packaged Air Conditioning Units

In majority of buildings, air conditioning system would be the major energy consuming system than other systems and monitoring them would possibly help in reducing the energy demand and operational cost.

Air conditioned spaces in the campus includes

- Auditorium
- Computer labs
- MBA class rooms
- Seminar halls
- Administrative spaces

Voltas & Bluestar packaged systems are used for conditioning the required spaces.

Equipment used for performance evaluation are:

- Power Analyzer
- Anemometer
- Clamp meter
- Sling Psychrometer
- IR Thermometer
- Thermal Imaging Camera

As part of audit, entire equipment list cannot be measured and hence certain key equipment are selected on sample basis for analysis.

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4. System Assessment

Packaged Air Conditioning Units – Equipment Chosen

In majority of buildings, air conditioning system would be the major energy consuming system than other systems and monitoring them would possibly help in reducing the energy demand and operational cost.

analysis.

Description	Installed Capacity	Indoor Unit Details	Outdoor Unit Details
Auditorium - Left	34 TR	2*17 TR	4*8.5 TR
Auditorium - Right	34 TR	2*17 TR	4*8.5 TR
BBA Lab	11 TR	2*5.5 TR	2*5.5 TR
MCA Lab	44 TR	4*11 TR	8*5.5 TR
Ganga block Lab	11 TR	1*11 TR	2*5.5 TR

Measurements

Location	Capacity TR	V	A	kW	PF	kVA
Big Auditorium L	34 TR	388	45.5	25.99	0.85	30.58
Big Auditorium R	34 TR	385	39.5	22.65	0.86	26.34
MCA Lab	44 TR	370	70.6	38.91	0.86	45.24
BBA Lab	11 TR	380	18.1	10.24	0.86	11.91
Lab - Ganga Block	11 TR	375	19.2	10.72	0.86	12.47

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4. System Assessment

Packaged Air Conditioning Units – Capacity Measurement

Description	Auditorium Left	Auditorium Right	BBA Lab	MCA Lab	Ganga Block Lab
Air Flow (m^3/hr)	8660	8540	3210	11690	3190
Supply Air DBT (°C)	23.5	24.3	23.4	20.7	19.2
Supply Air WBT (°C)	17	18	17	15	14
Enthalpy (kJ/kg)	47.66	50.73	47.66	41.9	39.18
Return Air DBT (°C)	26.3	26.3	27.5	24	24.6
Return Air WBT (°C)	21	21	22	19	19
Enthalpy (kJ/kg)	60.74	60.74	64.34	53.96	53.94
Calculated TR	8.96	6.76	4.24	11.15	3.72
kW	25.99	22.65	10.24	38.91	10.72
kW/TR	2.90	3.35	2.42	3.49	2.88
COP	1.21	1.05	1.45	1.01	1.22
EER	4.14	3.58	4.96	3.44	4.17

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5. System Upgradation Proposal with Payback options

On assessing the current HVAC system in the campus, a system upgrading proposal is put forth with payback analysis. To analyze the payback calculation, we need to arrive at the current operating cost with actual measurements & calculations done. For calculation purpose, average price per kWh considered as INR 9.75 and 200 working days with 6 hours operating time.

Location	Design TR	Running Capacity TR	kW/TR	Power drawn kW	Total Energy Consumption/ Year kWh	Total Electricity Cost/Year INR
Big Auditorium L	34 TR	8.96	2.9	25.99	31188	3,04,083
Big Auditorium R	34 TR	6.76	3.35	22.65	27180	2,65,005
MCA Lab	44 TR	11.15	3.49	38.91	46692	4,55,247
BBA Lab	11 TR	4.24	2.42	10.24	12288	1,19,808
Lab - Ganga Block	11 TR	3.72	2.88	10.72	12864	1,25,424
					130212	12,69,567

Energy Efficient Package Unit with 1.3 kW/TR

Location	Design TR	Running Capacity TR	kW/TR	Power drawn kW	Total Energy Consumption/ Year kWh	Total Electricity Cost/Year INR
Big Auditorium L	34 TR	8.96	1.3	11.65	13977.6	1,36,282
Big Auditorium R	34 TR	6.76	1.3	8.79	10545.6	1,02,820
MCA Lab	44 TR	11.15	1.3	14.50	17394	1,69,592
BBA Lab	11 TR	4.24	1.3	5.51	6614.4	64,490
Lab - Ganga Block	11 TR	3.72	1.3	4.84	5803.2	56,581
					54334.8	5,29,764

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5. System Upgradation Proposal with Payback options

Energy Efficient VRF (Full load - 1.2 kW/TR and Part load – 0.85 kW/TR)

Location	Design TR	Running Capacity TR	kW/TR	Power drawn kW	Total Energy Consumption/Year kWh	Total Electricity Cost/Year INR
Big Auditorium L	34 TR	8.96	0.85	7.62	9139.2	89,107
Big Auditorium R	34 TR	6.76	0.85	5.75	6895.2	67,228
MCA Lab	44 TR	11.15	0.85	9.48	11373	1,10,887
BBA Lab	11 TR	4.24	0.85	3.60	4324.8	42,167
Lab - Ganga Block	11 TR	3.72	0.85	3.16	3794.4	36,995
					35526.6	3,46,384

From the above analysis, it is evident that lower the specific kW/TR, the operating cost of the HVAC systems are reduced up to 50%-75%.

System	Annual kWh	Annual Cost INR	Annual Cost Difference	Cost Reduction %
Existing system	130212	12,69,567		
Efficient Packaged unit	54334.8	5,29,764	7,39,803	58%
Efficient VRF (@Part Load)	35526.6	3,46,384	9,23,183	73%

System	Annual Cost Difference	Per TR cost	Total Budget for 134 TR	Payback in Years
Efficient Packaged unit	739803	35,000	46,90,000	6.34
Efficient VRF (@Part Load)	923183	50,000	67,00,000	7.26

The capital cost can be reduced with proper sizing of HVAC system and efficient ducting methods.

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5. System Upgradation Proposal with Payback options

Upgradation suggestions:

- Site, typology, occupancy schedule & climate conditions have to studied during design of system
- Look out for some passive heat ingress reduction strategies
- Conditioned space load calculation with appropriate diversity factor has to be done
- Proper HVAC system with flexibility to cater cooling/heating demand, climate variation, occupancy & maintenance
- The distance between indoor & outdoor unit shall not be more than 90 meters incase of Package & VRV system
- If there is high fluctuations in the occupancy of the space, VRV system can cater the cooling load with better efficiency & payback

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6. Energy Saving Recommendations

6.1 Maintenance of Packaged HVAC system

Observation:

- Some outdoor units needs maintenance and some unwanted items are placed inside the conditioned space which may contaminate the air quality
- Maintenance sheets available are not filled.

Recommendations:

- Proper care should be taken for equipment maintenance schedules & record the same for assessment
- Easy access to the indoor & outdoor units help for better maintenance & in case of emergencies
- Conditioned spaces should not be used as storage space for unused items

6.2 Proper insulation of Refrigerant pipes

Observation:

- Refrigerant pipe insulations are worn out due to climate & age. This insulation directly reflect in the cooling of the system & poses fire hazard in case of leakage
- Incase of refrigerant leakage, air conditioning of the space will be affected & additional repair cost higher than insulation can be incurred

Recommendations:

- Proper insulation is required at the earliest
- This insulation might cost around 30,000 INR and can provide savings of up to 2-4%

6. Energy Saving Recommendations

6.3 Power Factor Improvement

Observation:

- Power factor on the VCB panel varies within 0.93-0.95
- Though there are 3 APFCR panels installed, all are operated manually
- Also PF on the HVAC equipment indicate around 0.85

Recommendations:

- PF has to be improved & maintained at 0.99
- Detailed checking of APFCR on health of capacitor & to be calibrated/tested
- APFCR has to be kept in Auto mode

Benefits:

- Reduced Maximum demand (kVA) & distribution losses
- Reduced MD charges due to reduced kVA
- Better voltage at the equipment end which helps for improved performance
- At least 3% of savings can be expected

6.4 Solar Panel Testing

Observation:

- With help of thermal imaging camera, it is found that few PV panels are defective & some with partial defects

Recommendations:

- Detailed thermal study has to be done for entire system to find out the issues & rectify or replace the same
- At least 5% of more power generation can be expected

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6. Energy Saving Recommendations

6.5 BEE Star Rated Equipment & LED lightings

Observation:

- Some class rooms have 2 star Window AC are operated
- Still T5 & CFL lights are used in some places
- Some lights are non functional

Recommendations:

- 5 star rated Window/Split AC shall be used
- LED battens shall be replaced old lights & defective ones
- High efficient BLDC fans are available and those are silent & economical

6.6 Student Awareness

Observation:

- Campus has Environment Committee to create awareness for environmental protection

Recommendations:

- Awareness campaigns, sign boards & posters especially for Energy saving shall be organized
- Such awareness to students can help them practice for better utilization of the electricity on both the campus & home
- At least 1% of savings can be expected with proper switching off of unused appliances

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Other Observations/Ideas that can be implemented

1. There seems to be frequent tripping in HT VCB breaker as the HT current reaches set limit. This can be addressed by additional demand request or by PF improvement to 0.99
2. The total Transformer & DG capacity are under utilized as the MD ranges from 320 to 480 kVA. Either the management can dispose of the extra capacity if there arise a chance or plan for utilization of all equipment on a round about.
3. It is observed that SSB installed near Big Auditorium & BBA computer lab are not safe to operate. It needs to be retrofitted or replaced.
4. Fire pumps are not fully operational as corresponding valve are closed & pressure is below limit. These needs to be sorted out.
5. Block wise and Usage wise (STP, AC, Lighting, etc.) Energy meter can be installed to monitor the actual performance of each usage/block to identify any problems in future.
6. It is observed that adequate lightning arrestors are not available in the campus and it is considered to be of high risk inflicting personnel & property damage.
7. Occupancy/Daylight/Timer Sensor operational lights for interior & exterior lights can be used for better artificial light utilization.
8. Personalised or localized light switches or control can be used for applicable space for reducing common lighting control for whole space.
9. Automatic OHT water level controller can be installed for reducing water & pump energy wastage.

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7. Conclusion

Proposal	Estimated Corresponding Savings %	Estimated Savings potential kWh	Estimated Cost Savings INR
Upgrading - Efficient Packaged Unit	58%	75877.2	7,39,803
Upgrading - Efficient VRV (@part load)	73%	94685.4	9,23,183
Insulation of Refrigerant pipes	2-4%	2604.24	25,391
Equipment Maintenance	1-3%	1302.12	12,696
Power factor Improvement	1-3%	3752.94	36,591
Student Awareness	1-3%	500	4,875
Solar Panel thermography	1-5%	1366.5	13,323
BEE star rated appliance (LED & BLDC)	1-3%	7505.88	73,182
Total		111717.08	10,89,242

End notes:

- A potential savings of about 11 lakh INR per annum in electricity energy consumption cost are included in the report for the campus.
- The mentioned energy savings can reduce carbon emissions of about 100 tons CO2 per annum.

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