ENERGY AUDIT REPORT

DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE (Autonomous)

Arumbakkam,

Chennai, Tamilnadu

Prepared by

GREENPRO BUILDMART

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.

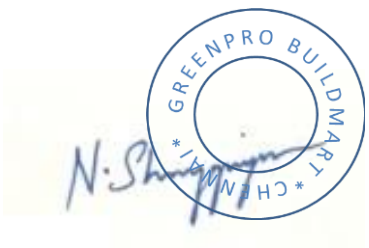
We would like thank Principal **Dr S.Santhosh Baboo** for giving us the opportunity. And also would like to extend our thanks to Mr M Govindarajan – Electrical Engineer of the reputed campus.

From

GREENPRO BUILDMART

CERTIFICATE OF ENERGY AUDIT

This is to certify that DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE, Arumbakkam, Chennai has conducted an Energy Audit in March 2022 for the year of 2021-2022 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.



Shanmugapriyan Natarajan

Certified Energy Auditor EA – 14692

Date: 12-03-2022

Bureau of Energy Efficiency, Govt of India

1. Summary

Energy Audit of DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE, Chennai was carried out by Greenpro Buildmart during March 2022.

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.

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.

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.

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 Shanmugapriyan Natarajan– Certified Energy Auditor (EA 14692)
- Mr Anand Sachithanantham – Certified Energy Manager | Lead ISO Auditor

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**

Campus receives 11kv HT connection from TNEB and the college has installed two nos. distribution transformers of 1000 kVA, 11kv/433v, ONAN with OLTC, Make: Voltamp and one nos. transformer of 500 kVA, 11kV/433V, Make: CREL*.

Yearly Energy Consumption:

Month-Year	Units kWh
Mar-21	75320
Apr-21	34568
May-21	26696
Jun-21	30848
Jul-21	39704
Aug-21	53216

Month-Year	Units kWh
Sep-21	62368
Oct-21	73320
Nov-21	49312
Dec-21	88632
Jan-22	37832
Feb-22	49152
Total	620968

The overall annual energy consumption for this current academic year is 620968 kWh/annum. The greenhouse gas emissions equivalent for electricity is **528 tons of CO2**. (0.85 kg CO2 emission / kwh)

Other Sources:

- Diesel generator - 4200 kWh
- Solar PV system - *kWh

*Note: * - During pandemic, the Roof top solar PV system is disconnected, as net metering was not installed and no internal load.*

Renewable Energy

Energy use is clearly an important aspect of campus sustainability and thus requires no explanation for its inclusion in the assessment. However, many may not realize how much influence the higher education sector has in the larger energy market.

Major use of energy is in office, classrooms, canteen, hostels and laboratories for lighting, and laboratory work. AC consumption in offices, computer labs & classrooms are considerably high. The sanctioned demand from TNEB is 600 kVA and supplied through 2*1000kVA transformers and a DG system of 4*500kVA as backup. The Institute campus is generating around 400-500 units daily from 110kW Grid connected Solar PV panels installed in roof tops of various blocks.

Also the hot water for the hostel is supplied by solar water heater installed in the roof. And the food waste & vegetable scraps from mess & canteen is feed to biogas system to generate cooking gas for 3-4 hours.

Rectifications and energy saving measures implemented in the current year of assessment
1. It is observed that in many places Fluorescent lamps are being replaced with **LED lights**. 2. It is observed that old Air-conditioners are replaced with **new 5 star rated Split air-conditioners**. 3. Power factor has been improved to a great extent and we observed that with out APFC, **PF of 0.96-0.97** is achieved during our audit. 4. It is observed that **Motion sensor** is provided for Board Room/ meeting room. 5. The college has been installing new air conditioners every year to cater the additional requirement and it is noted that the installed air conditioners are mostly 5 star rated air conditioners. Further, if any new additional Air-conditioners or replacement of Air-conditioners, it is suggested to go for 5 star rated air conditioners.

LED Batten Installed in Corridor

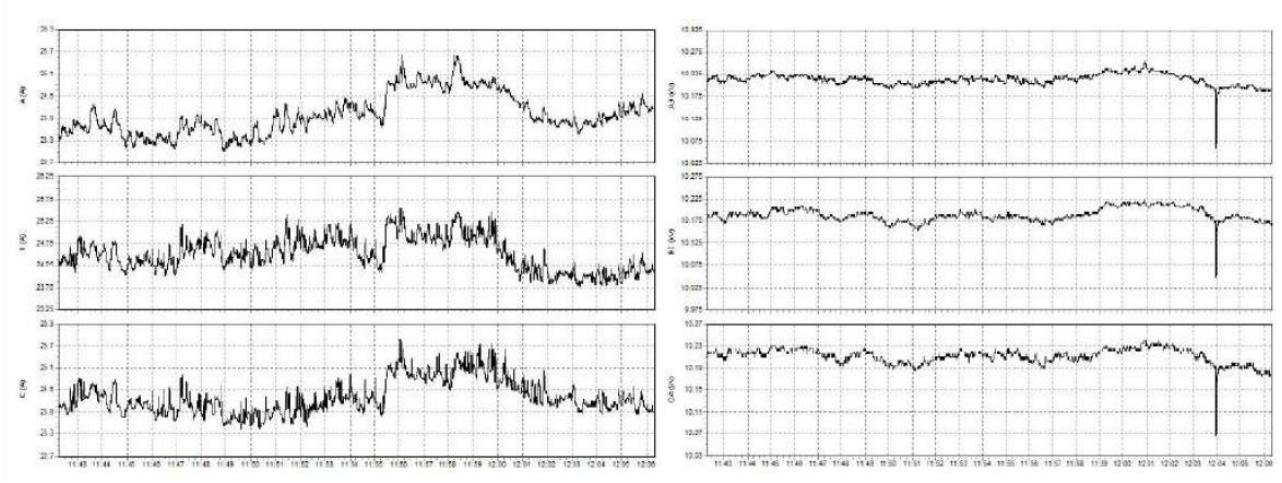
Newly purchased 5star Split AC

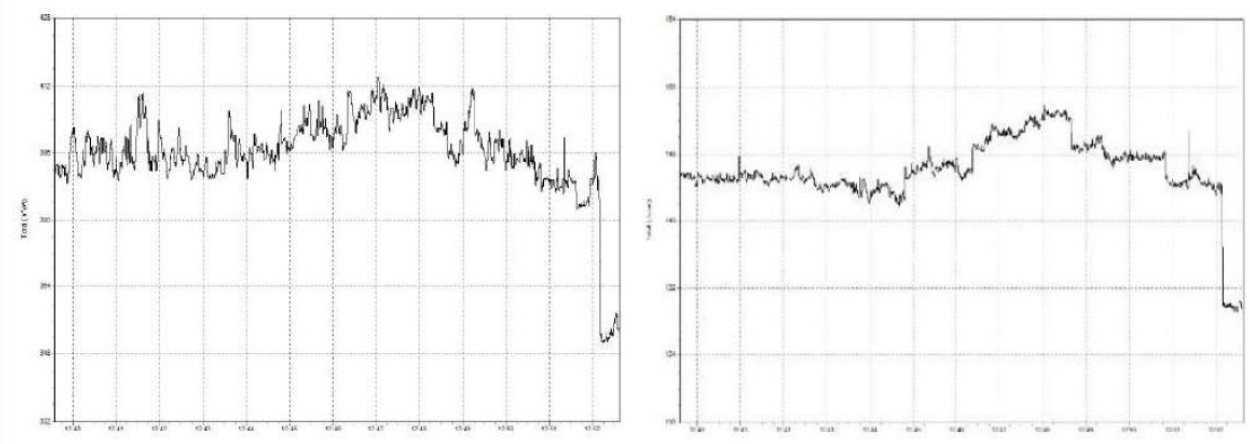
4. System Assessment

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.

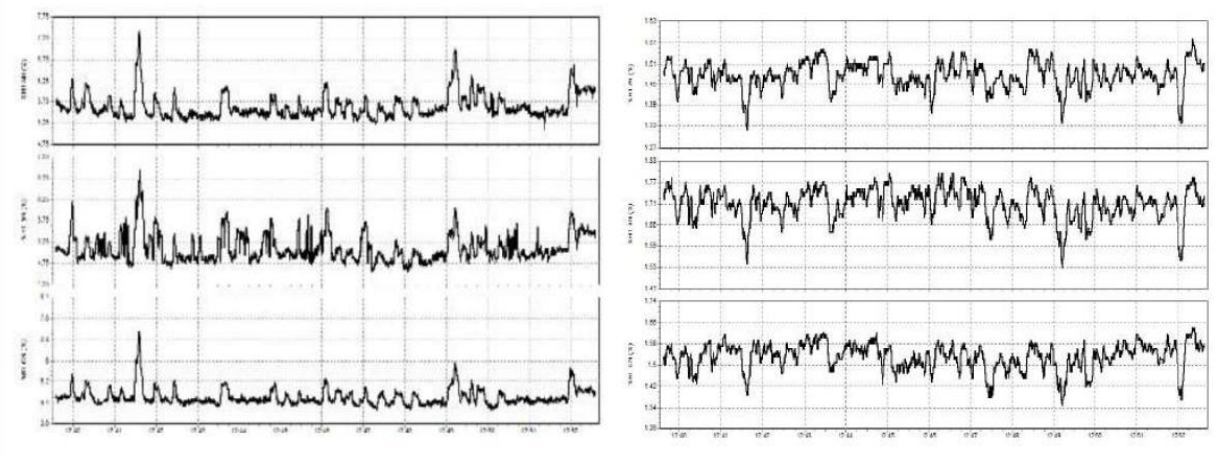
- Trend chart of 11 kV VCB Panel (Input side)



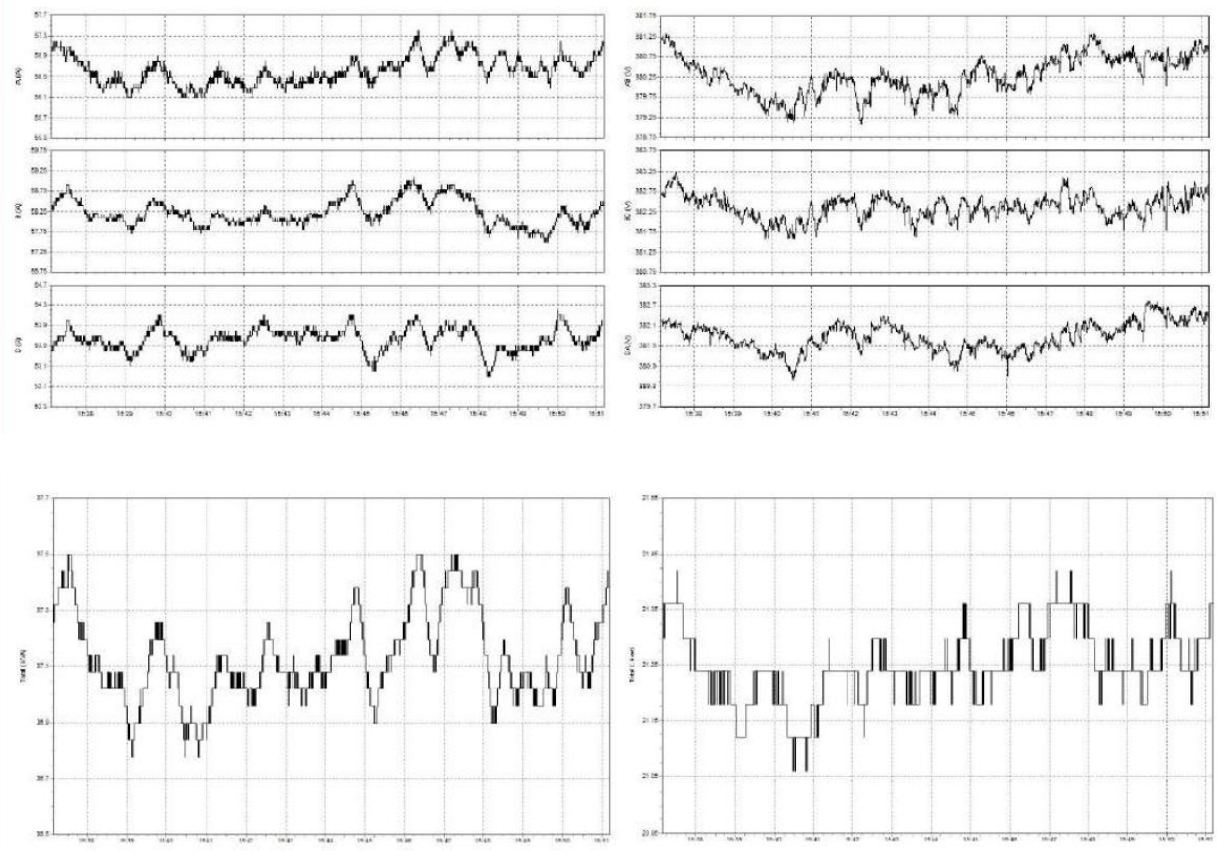


4. System Assessment

- Trend chart of EB Incomer



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



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.

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

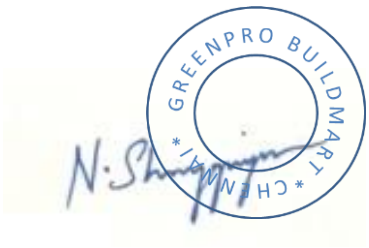
Measurements

Location	Capacity TR	V	A	kW	PF	kVA
Auditorium - Left	34 TR	388	45.5	25.99	0.85	30.58
Auditorium - Right	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

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



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
Auditorium Left	34 TR	8.96	2.9	25.99	31188	3,04,083
Auditorium Right	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
Auditorium Left	34 TR	8.96	1.3	11.65	13977.6	1,36,282
Auditorium Right	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

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
Auditorium Left	34 TR	8.96	0.85	7.62	9139.2	89,107
Auditorium Right	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.

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

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
- Specific energy monitoring option to study the energy pattern.

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 0.96-0.98
- Though there are 3 APFCR panels installed, all are operated manually

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

6. Energy Saving Recommendations

6.5 BEE Star Rated Equipment & LED lightings

Observation:

- Some class rooms have 2 star Window ACs & replacement with 5 Star Split AC are under progress
- T5 & CFL lights in some places are under replacement with LED lights

Recommendations:

- Remaining window AC shall be replaced with 5 star rated Split AC
- LED battens shall be replaced instead of 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

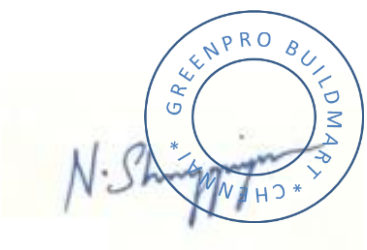
Other Observations/Ideas that can be implemented
1. The total Transformer & DG capacity are under utilized as the **MD ranges from 320 to 480 kVA**. Either the management can dispose of the extra capacity if there arise a chance or plan for utilization of all equipment on a round about. 2. Existing VRV system shall be either replaced or specifically monitored to study energy consumption pattern. 3. 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. 4. 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. 5. Occupancy/Daylight/Timer Sensor operational lights for interior & exterior lights can be used for better artificial light utilization. Timer control for Exterior lighting, Motion sensor for toilets & Daylight sensor for corridors shall be installed. 6. Personalised or localized light switches or control can be used for applicable space for reducing common lighting control for whole space. 7. Automatic OHT water level controller can be installed for reducing water & pump energy wastage. 8. It is observed that many solar panels are found with hotspot and hence the defective panels are being replaced by new solar modules.

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%	6209.68	60,544
Student Awareness	1-3%	500	4,875
Solar Panel thermography	1-5%	1366.5	13,323
BEE star rated appliance (LED & BLDC)	1-3%	12419.36	1,21,089
Total		119087.3	11,61,101

End notes:

- A potential savings of about 11.6 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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