2022
2023

ENERGY AUDIT REPORT

ENERGY AUDIT REPORT

Prepared for

K.K.WAGH Arts, Commerce,Science & Computer Science College,Chandori,Niphad

2022-2023

GREEN ENCON SOLUTION GES

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ABBREVIATIONS

ABBREVIATIONS	EXPANSIONS
APFC	Automatic Power Factor Controller
BEE	Bureau of Energy Efficiency
DG	Diesel Generator
EE	Energy Efficiency
MD	Maximum Demand
MT	Metric Ton
MTOE	Metric Ton of Oil Equivalent
No.	Number
PF	Power Factor
SEC	Specific Energy Consumption
A	Ampere
AC	Alternating Current
Avg.	Average
KW	Kilowatts
KWh	Kilowatt hours
GES	GreenEnCon Solution

DISCLAIMER

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PREFACE

K.K.WAGH ARTS, COMMERCE, SCIENCE & COMPUTER SCIENCE COLLEGE, CHANDORI is the acknowledged leader in education field. Today K.K.WAGH ARTS, COMMERCE, SCIENCE & COMPUTER SCIENCE COLLEGE, CHANDORI has established a strong presence in the education field. This audit was conducted to seek opportunities to improve the energy efficiency of the campus as well as promote the green energy practices in college campus. Reduction of energy consumption while maintaining or improving human comfort, health and safety were of primary concern. Beyond simply identifying the energy consumption pattern, this audit sought to identify the most energy efficient appliances. Moreover, some daily practices relating common appliances have been provided which may help reducing the energy consumption. The report accounts for the energy consumption patterns of the academic area, central facilities based on actual survey and detailed analysis during the audit. The work encompasses the area wise consumption traced using suitable equipments. The report compiles a list of possible actions to conserve and efficiently access the available scarce resources and their saving potential was also identified. We look forward towards optimization that the authorities, students and staff would follow the recommendations in the best possible way. The report is based on certain generalizations and approximations wherever necessary. The views expressed may not reflect the general opinion. They merely represent the opinion of the team guided by the interviews of consumers.

ACKNOWLEDGEMENTS

GES places on record its sincere thanks to K.K.WAGH ARTS, COMMERCE, SCIENCE & COMPUTER SCIENCE COLLEGE, CHANDORI for vesting confidence in GES to carry out the Green Energy Audit. A Green energy audit study is a joint venture exercise of consultant and institute to account and contain energy usage without sacrificing the purpose of energy use. The contribution of K.K.WAGH ARTS, COMMERCE, SCIENCE & COMPUTER SCIENCE COLLEGE, CHANDORI team is equally important in this venture. Team of technical experts from M/s GreenEnCon Solution, Nasik appreciates the keen interest shown by the management of K.K.WAGH ARTS, COMMERCE, SCIENCE & COMPUTER SCIENCE COLLEGE, CHANDORI, Nasik for their kind co-operation , furnishing required data and hospitality offered during our visits.

Our special thanks to,

- **Chairman- Mr. SAMEER BALASAHEB WAGH**
- **Principal – Dr. R.K. DATIR**

We are also thankful to other members of the institute for their diligent involvement and co-operation.

EXECUTIVE SUMMARY

Greenencon Solution has conducted a "Energy Audit" of K.K. WAGH ARTS, COMMERCE, SCIENCE & COMPUTER SCIENCE COLLEGE, CHANDORI for the academic year 2022-23. An energy audit is an analysis of a facility, indicating how and where that facility can reduce energy consumption and save energy costs. Its insight to energy efficiency and conservation can lead to significant savings on the utility bill. Energy is one of the major inputs for the economic development of any country. The fundamental goal of energy management is to produce goods and provide services with the least cost and least environmental effect. The energy audit is key to a systematic approach for decision making in the area of energy management. It attempt to balance the total energy inputs with its use, and serve to identify all the energy streams in a facility.

Questionnaires prepared to conduct the Energy audit were based on the guidelines, rules, acts and formats set by Government of India, Ministry of Environment and Forest and Bureau of Energy Efficiency. For audit purpose and suitability analysis of data the study area is grouped as administrative buildings, Seminar Hall, Laboratories, class rooms, Common rooms, Sick room, Computer centre & Language Lab. The audit was carried for electricity and energy.

1. PREAMBLE

K. K. Wagh Arts, Commerce ,Science & Computer Science College Chandori, Nashik include all Courses in the same Building affiliated with Savitribai Phule Pune University.

K. K. Wagh Arts, Commerce ,Science & Computer Science College Chandori, Nashik started in 2004 with a current intake of 750 for the Arts, Commerce, Science & Computer Science course. Over the years, K. K. Wagh Arts, Commerce ,Science & Computer Science College Chandori, Nashik has grown in leaps and bounds providing a stimulating learning environment in Nasik by providing a sprawling campus and state-of-the-art infrastructure. K. K. Wagh Arts, Commerce, Science & Computer Science College Chandori, Nashik has students from many different areas across the state pursuing their education in Arts, Commerce, Science & Computer Science streams. This Institute is strategically located in the heart of the city and has a campus providing enlightening and inspiring, academic ambience. K. K. Wagh Arts, Commerce, Science & Computer Science College Chandori, Nashik is spearheaded by well-qualified, experienced, and dedicated staff.

1.1 ABOUT GREEN AUDIT

Energy auditing is the process of identifying and determining whether institutions practices are eco-friendly and sustainable. Traditionally, we are good and efficient users of natural resources. But over the period of time excess use of resources like energy, water, chemicals are become habitual for everyone especially, in common areas. Now, it is necessary to check whether our processes are consuming more than required resources? Whether we are handling waste carefully? Energy audit regulates all such practices and gives an efficient way of natural resource utilization. In the era of climate change and resource depletion it is necessary to verify the processes and convert it in to Energy and clean one. Energy audit provides an approach for it. It also increases overall consciousness among the people working in institution towards an environment.

1.2 OBJECTIVES

The objective of Energy Audit is to promote the idea of Energy Conservation in the Campus of K. K. Wagh Arts, Commerce, Science & Computer Science College Chandori, Nashik. The purpose of the energy audit is to identify, quantify, describe and prioritize cost saving measures relating to energy use in the Departments and Institute Central Facilities.

The work eligible for Energy Audit Study should be directed towards Identification of areas of energy wastage and estimation of energy saving potential in Departments and Institute Central Facilities Suggesting cost-effective measures to improve the efficiency of energy use. Estimation of implementation costs and payback periods for each recommended action. Documenting results & vital information generated through these activities. Identification of possible usages of co-generation, renewable sources of energy (say Solar Energy) and recommendations for implementation, wherever possible, with cost benefit analysis.

1.3 GOALS OF GREEN & ENERGY AUDIT

K. K. Wagh Arts, Commerce, Science & Computer Science College Chandori has conducted a green audit with specific goals as:

1. Identification and documentation of green practices.
2. Identify strength and weakness in green practices.
3. Conduct a survey to know the ground reality about green practices.
4. Analyze and suggest solution for problems identified from survey.
5. Assess facility of different types of waste management.
6. Increase environmental awareness throughout campus.
7. Identify and assess environmental risk.
8. Motivates staff for optimized sustainable use of available resources.
9. The long-term goal of the environmental audit program is to collect baseline data of environmental parameters and resolve environmental issue before they become problem.

1.4 SCOPE OF WORK

- To study electrical energy metering, Green practices, monitoring and control system existing at site and to recommend a suitable system for future monitoring.
- To study monthly power factor, maximum demand, working hours, load factor etc. for the reference period along with monthly electricity Consumption and establish scope for MD control through load optimization of load factor and through detailed load management study.
- To recommend a specific rationalization/ optimization program based on measurement of DB power factors, existing capacitor system and its maintenance, automatic / manual controls required etc.
- To study water distribution system for improving efficiency of water use. The water used at bathrooms, toilets, laboratory, kitchen, garden, shower and other uses as well as leakages and over flow of water from overhead tanks is also been evaluated.
- To undertake detailed lighting study on all Buildings with the help of Lux meter to identify lux level for each application.
- Based on the above to evaluate the possibility of replacing inefficient light with Energy efficient lighting system.

2. METHODOLOGY

The methodology adopted for this audit was a three-step process comprising of:

1. Data Collection– In preliminary data collection phase, exhaustive data collection was performed using different tools such as observation, interviewing key persons, and measurements.

2. Data Analysis- Detailed analysis of data collected was done using Elektra. The database generated by Elektra was used for producing graphical representations.

3. Recommendation– On the basis of results of data analysis and observations, some steps for reducing power consumption without affecting the comfort and satisfaction were recommended along with their cost analysis.

2.1 Data Collection

The first module is related to the general information of the concerned department, which broadly includes name of the department, month and year, total number of students and employees, visitors of the department, average working days and office timings etc. The next module is related to the present consumption of resources like

water, energy, or the handling of solid and hazardous waste. Maintaining records of the handling of solid and hazardous waste is much important in green audit.

For suggesting any corrective measures to reduce power consumption, it is first necessary to know the power consumption pattern in detail. For this, the exhaustive data collection exercise was performed at all the departments, academic centers, and other supporting entities such as library, institute hospital, computer center etc.

Following steps were taken for data collection:

- The team went to each department, center, etc.
- Information about the general electrical appliances was collected by observation and interviewing.
- The power consumption of appliances was measured using power analyzer in some cases (such as fans) while in other cases, rated power was used (CFL for example).
- The details of usage of the appliances were collected by interviewing key persons e.g. Warden (in case of hostels), caretaker (in case of departments) etc.
- Light intensity was measured using lux meters at the places where light intensity was either very low or very high.
- In case of Air Conditioning, insulation was checked by visual inspection.

2.2 Data Analysis

In data analysis, the data collected is processed to draw significant conclusions to pinpoint loopholes and identify the areas to focus upon. Analysis of the power consumption observations obtained was used to obtain the power consumption pattern and also to get the information about the points where electric power is wasted. Analysis of the water consumption observations obtained was used to obtain the water consumption pattern and also identify the losses. This helped to identify the areas with maximum water and energy saving potential

2.3 Recommendations

Energy as well as cost analysis of different areas were performed and recommendations were made based on the capital cost recovery time.

Following were the steps involved in this process:

- The capital cost involved in replacing an appliance and/or process was estimated.
- The energy saving by the move was calculated in terms of price of energy per year.
- These two costs were compared to calculate the capital cost recovery time which is defined as the total time by which the saving in energy bill balances the capital cost involved.
- If capital cost recovery time is less than the product life, the move can be supported.
- Some other recommendations were also made which are based on lighting intensity, AC insulation, water leakage, solid waste etc.

3. ABOUT THE UNIT

The college was established in the year 2004, this institute is started in rural area & the 16-year journey has been a story of hard work, sincere effort toward quality enhancement, quantitative growth & expansion.

During this short span the number of students has increased considerably & characteristically almost 70% of the students have been girl students. Visa-vis there's been growth in infrastructure - a large campus with Gymkhana, Smart Classroom, a large Playground, Computer Lab, well equipped Departments, Language Lab, Commerce Lab and Psychology Lab and experienced qualified faculty.

4. ENERGY AUDIT

An energy audit is an analysis of a facility, indicating how and where that facility can reduce energy consumption and save energy costs. Its insight to energy efficiency and conservation can lead to significant savings on the utility bill. Energy is one of the major inputs for the economic development of any country. The fundamental goal of energy management is to produce goods and provide services with the least cost and least environmental effect. The energy audit is key to a systematic approach for decision making in the area of energy management. It attempts to balance the total energy inputs with its use, and serve to identify all the energy streams in a facility.

4.1. ELECTRICITY AUDIT

Energy resources utilized by all the departments, support services and the administrative Buildings of K. K. Wagh Arts, Commerce, Science & Computer Science College Chandori campus include electricity. Major use of the energy is at office, class room and laboratories, for lighting and laboratories instruments. K. K. Wagh Arts, Commerce, Science & Computer Science College Chandori has total sanctioned load of 200KW with 1 commercial Electricity meter. Electricity is supplied to the KKWACS&CS campus by Maharashtra State Electricity Board.

Table 1: Total Load Consumption of the Unit

Location	SR. NO	Block	Flourescent Tube	Fan	Exaust Fan	LCD Projector	LED
Building A – GF	1	A-101 Store Room		1			5
Building A - GF	2	A-102 Zoology Botany Lab					5
Building A - GF	3	A-103 ICT Class Room		2			5
Building A - GF	4	A-10 T&P Cell		2			3
Building A – GF	5	A-105 Incubation Center		2			3
Building A - GF	6	A-106 Class Room		2			5
Building A – GF	7	A-107 NSS and BSD Department		2			5
Building A- GF	8	A-108 Class Room		3			5
Building A – GF	9	Porch					7
Building A - 1F	10	A-201 Class Room		4			5
Building A - 1F	11	A-202 Class Room		4			5
Building A - 1F	12	A-203 ICT Class Room		3		1	4
Building A - 1F	13	A-204 Vice Principal Office		3			5
Building A - 1F	14	A-205 Exam Section		4			4
Building A - 1F	15	A-206 Class Room		4			5
Building A - 1F	16	A-207 ICT Class Room		4		1	5
Building A - 1F	17	A-208 Commerce & Economics Dept.		5			5
Building A - 1F	18	Porch					7
Building A- 2F	19	A-301 Geography lab		4			5
Building A 2F	20	A-302 Class Room		4			5
Building A - 2F	21	A-303 ICT Class Room		4		1	5
Building A — 2F	22	A-304 CAP Room	1	3			5
Building A — 2F	23	A-305 Marathi & English Department		2			3
Building A —	24	A-306 ICT Class Room		4			5

2F							
Building A 2 F	25	A-307 Class Room		4			5
Building A — 27	26	A-308 Class Room		4			5
Building A - 2F	27	Porch					7
Building A — 3F	28	A-401 Computer Lab • 1		5			5
Building A — 3F	29	A-402Computer lab 2		5		1	5
Building A — 3F	30	A-403 ICT Class Room		4			5
Building A — 3F	31	A-404 Computer Science		2			2
Building A — 3F	32	A405 Ladies Common Room		2			3
Building A — 3F	33	A-406 Electronic Lab		4			5
Building A — 3F	34	A407 ICT Class Room		5		1	5
Building A — 3F	35	A-408 ICT Class Room		4		1	5
Building A — 3F	36	Porch					7
Building B- GF	37	B- 101 Principal Office		4		1	6
Building B- GF	38	8-102 Waiting Room		1			1
Building B- GF	39	B-103 Admin. Office		5			6
Building B- GF	40	8-104 QAC Department	1	1			
Building B- GF	41	8-105 Class Room	4	5			
Building B – GF	42	B-106 Reading Room	4	5			
Building B- GF	43	B-107Da Care Center		1			1
Building 8 GF	44	B-108-StoreRoom					
Building B- GF	45	B-109 Geno Lavato					2
Building B- GF	46	8-110 Language Lab		1			1
Building B- GF	47	8-111 Store Room		1			2
Building B- GF	48	B-112 Library	6	6			
Building B- GF	49	8-113 Physics & Mathematics Lab		4			6
Building B- GF	50	B114 Physics & Chemistry		5	1		8

Building B-GF	51	B115 Ladies Lavatory					2
Building B – GF	52	B-116 Girls Common Room		1			1
Building B – GF	53	B-117 First Aid Room		1			1
Building B-GF	54	8-118 Chemistry Lab	5	4	2		
Building B-GF	55	B-119 ICT Class Room		3		1	5
Building B – GF	56	B-120 Dept. Of, Chemistry		1			1
Building B G F	57	Porch					21
Total			**21**	**154**	**3**	**8**	**239**

Location	SR. NO	Block	Computers	Printer	Scanner	Photocopier
Building A – GF	1	A-101 Store Room				
Building A - GF	2	A-102 Zoology Botany Lab				
Building A - GF	3	A-103 ICT Class Room				
Building A - GF	4	A-IO T&P Cell				
Building A – GF	5	A-105 Incubation Center				
Building A - GF	6	A-106 Class Room				
Building A – GF	7	A-107 NSS and BSD Department				
Building A-GF	8	A-108 Class Room				
Building A - GF	9	Porch				
Building A - 1F	10	A-201 Class Room				
Building A - 1F	11	A-202 Class Room				
Building A - 1F	12	A-203 ICT Class Room				
Building A - 1F	13	A-204 Vice Principal Office				
Building A - 1F	14	A-205 Exam Section	2			1
Building A - 1F	15	A-206 Class Room				
Building A - 1F	16	A-207 ICT Class Room				

Building A - 1F	17	A-208 Commerce & Economics Dept.	8	2		
Building A - 1F	18	Porch				
Building A- 2F	19	A-301 Geography lab	1			
Building A 2F	20	A-302 Class Room				
Building A - 2F	21	A-303 ICT Class Room				
Building A — 2F	22	A-304 CAP Room	1			1
Building A — 2F	23	A-305 Marathi & English Department		1		
Building A — 2F	24	A-306 ICT Class Room				
Building A 2 F	25	A-307 Class Room				
Building A — 2F	26	A-308 Class Room				
Building A - 2F	27	Porch				
Building A — 3F	28	A-401 Computer Lab 1	23			
Building A — 3F	29	A-402Computer lab 2	24			
Building A — 3F	30	A-403 ICT Class Room				
Building A — 3F	31	A-404 Computer Science	1	1		
Building A — 3F	32	A405 Ladies Common Room				
Building A — 3F	33	A-406 Electronic Lab	17	2		
Building A — 3F	34	A407 ICT Class Room	1			
Building A — 3F	35	A-408 ICT Class Room				
Building A — 3F	36	Porch				
Building B- GF	37	B- 101 Principal Office	1	1		
Building B- GF	38	B-102 Waiting Room				
Building B- GF	39	B-103 Admin. Office	4	3	3	1
Building B- GF	40	B-104 QAC Department	2	1		
Building B- GF	41	B-105 Class Room				
Building B - GF	42	B-106 Reading Room				

Building B-GF	43	B-107Da Care Center				
Building 8 GF	44	B-108-StoreRoom				
Building B-GF	45	B-109 Geno Lavato				
Building B-GF	46	8-110 Language Lab	11			
Building B-GF	47	8-111 Store Room				
Building B-GF	48	B-112 Library	6	1		
Building B-GF	49	8-113 Physics & Mathematics Lab	5			
Building B-GF	50	B114 Physics & Chemistry				
Building B-GF	51	B115 Ladies Lavatory				
Building B – GF	52	B-116 Girls Common Room				
Building B – GF	53	B-117 First Aid Room				
Building B-GF	54	8-118 Chemistry Lab				
Building B-GF	55	B-119 ICT Class Room				
Building B – GF	56	B-120 Dept. Of, Chemistry	1	1		
Building B G F	57	Porch				
Total			108	13	3	3

Location	SR. NO	Block	LAB Equipments	Refrigerator	Water Cooler	induction Cooker
Building A – GF	1	A-101 Store Room				
Building A - GF	2	A-102 Zoology Botany Lab				
Building A - GF	3	A-103 ICT Class Room				
Building A - GF	4	A-IO T&P Cell				
Building A - GF	5	A-105 Incubation Center				
Building A - GF	6	A-106 Class Room				
Building A - GF	7	A-107 NSS and BSD Department				
Building A- GF	8	A-108 Class Room				
Building A - GF	9	Porch			1	
Building A- 1F	10	A-201 Class Room				
Building A- 1F	11	A-202 Class room				
Building A- 1F	12	A-203 ICT Class Room				
Building A- 1F	13	A-204 Vice Principal Office		1		
Building A- 1F	14	A-205 Exam Section				
Building A- 1F	15	A-206 Class Room				
Building A- 1F	16	A-207 ICT Class Room				
Building A- 1F	17	A-208 Commerce & Economics Dept.				
Building A- 1F	18	Porch				
Building A- 2F	19	A-301 Geography lab				
Building A 2F	20	A-302 Class Room				
Building A - 2F	21	A-303 ICT Class Room				
Building A — 2F	22	A-304 CAP Room				
Building A — 2F	23	A-305 Marathi & English Department				
Building A — 2F	24	A-306 ICT Class Room				
Building A 2	25	A-307 Class Room				

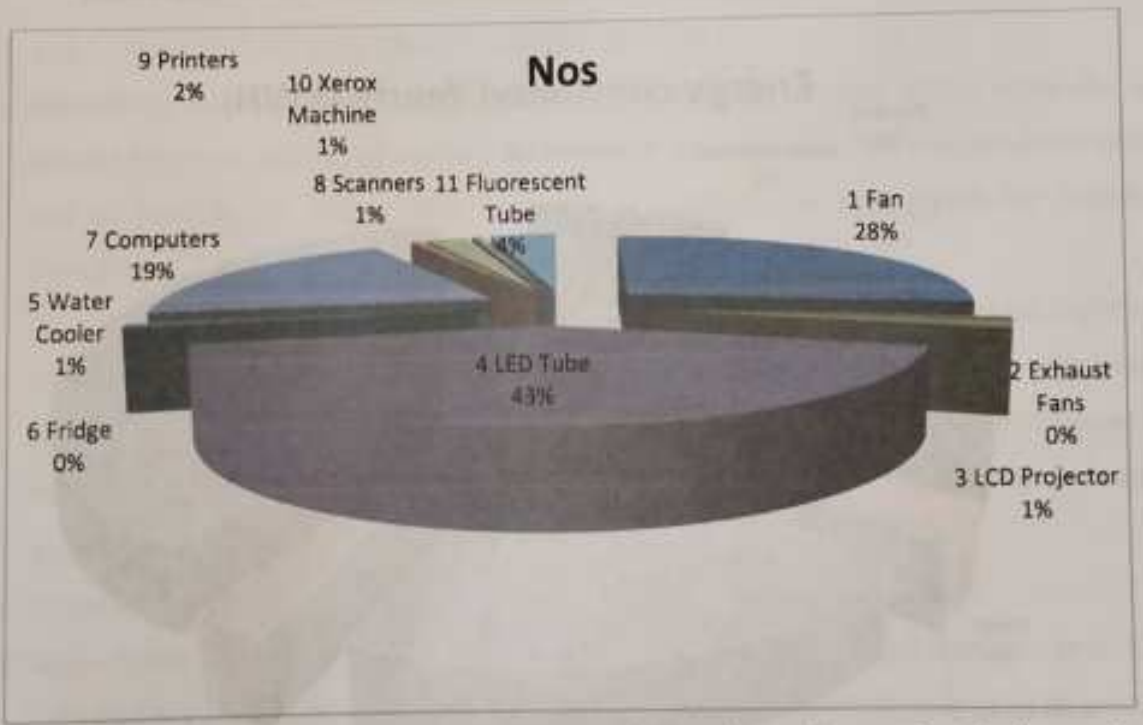
F						
Building A — 2F	26	A-308 Class Room				
Building A - 2F	27	Porch			1	
Building A — 3F	28	A-401 Computer Lab 1				
Building A — 3F	29	A-402Computer lab 2				
Building A — 3F	30	A-403 ICT Class Room				
Building A — 3F	31	A-404 Computer Science				
Building A — 3F	32	A405 Ladies Common Room				
Building A — 3F	33	A-406 Electronic Lab	6			
Building A — 3F	34	A407 ICT Class Room				
Building A — 3F	35	A-408 ICT Class Room				
Building A — 3F	36	Porch			1	
Building B-GF	37	B- 101 Principal Office				
Building B-GF	38	B-102 Waiting Room				
Building B-GF	39	B-103 Admin. Office				
Building B-GF	40	B-104 QAC Department				
Building B-GF	41	B-105 Class Room				
Building B – GF	42	B-106 Reading Room				
Building B-GF	43	B-107Da Care Center				
Building B GF	44	B-108-StoreRoom				
Building B-GF	45	B-109 Geno Lavato				
Building B-GF	46	B-110 Language Lab				
Building B-GF	47	B-111 Store Room				
Building B-GF	48	B-112 Library				
Building B-GF	49	B-113 Physics & Mathematics Lab	6			
Building B-GF	50	B114 Physics & Chemistry				
Building B-GF	51	B115 Ladies Lavatory				

Building B – GF	52	B-116 Girls Common Room				
Building B – GF	53	B-117 First Aid Room				
Building B- GF	54	B-118 Chemistry Lab				
Building B- GF	55	B-119 ICT Class Room				
Building B – GF	56	B-120 Dept. Of, Chemistry				
Building B G F	57	Porch				
Total			**12**	**1**	**3**	**0**

4.2. EQUIPMENT WISE ANALYSIS OF CAMPUS:

Table 2: Equipment wise Load of Campus

SR.No	Equipment	Nos	Total Wattage (Kw)
1	Fan	154	10.78
2	Exhaust Fans	3	0.12
3	LCD Projector	8	1.6
4	LED Tube	239	4.78
5	Water Cooler	3	0.15
6	Fridge	1	0.3
7	Computers	108	10.8
8	Scanners	3	0.15
9	Printers	13	0.65
10	Xerox Machine	3	0.3
11	Fluorescent Tube	21	0.84



Equipment wise analysis has been performed in order to identify the equipment, within same application area, which consume more power as compared to others. During equipment wise analysis of the overall campus, the equipment with power consumption less than 1% of total power consumption of the campus were ignored so as

to make the analysis results simple and easy to observe. Following chart summarizes the results of equipment wise analysis of power consumption of K. K. Wagh Arts, Commerce, Science & Computer Science College Chandori campus:

SR. No	Equipment	Energy consumed Yearly (KWH)
1	Fan	2856.7
2	Exhaust Fans	15.9
3	LCD Projector	424
4	LED Tube	2280.06
5	Water Cooler	159
6	Fridge	795
7	Computers	1431
8	Scanners	79.5
9	Printers	344.5
10	Xerox Machine	238.5
11	Fluorescent Tub	1113
	TOTAL	**9737.16**

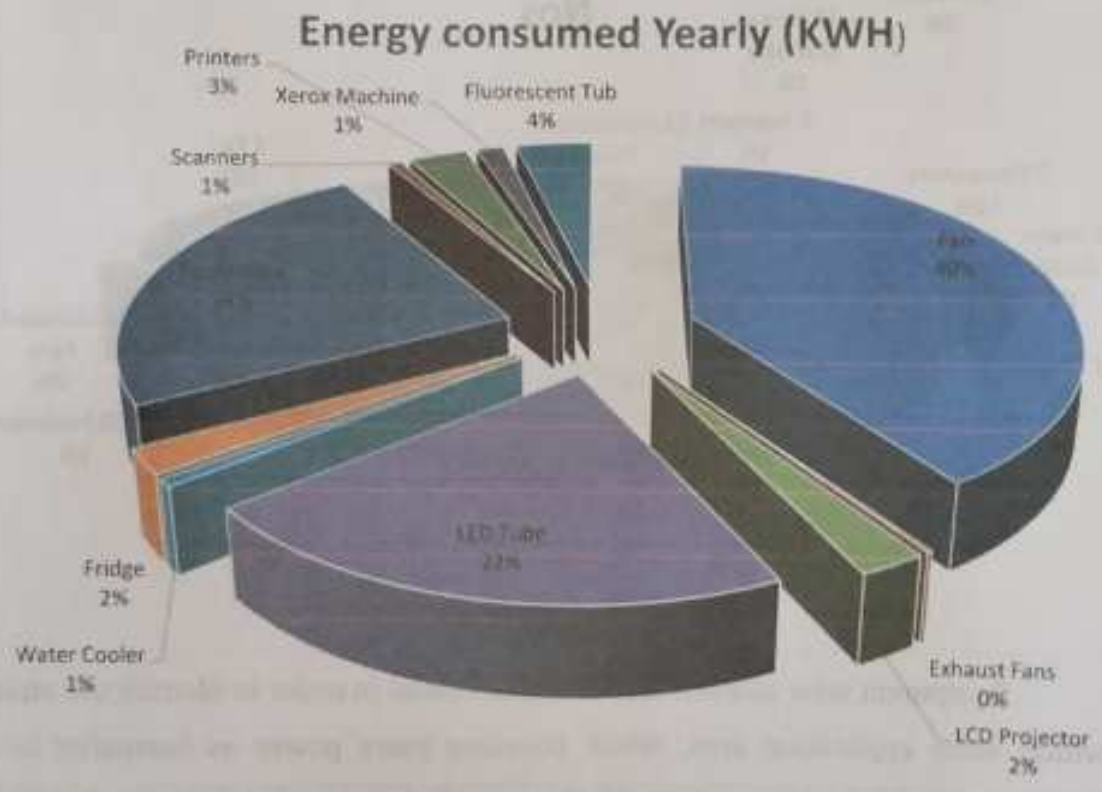


Fig.2.: Equipment wise energy consumed yearly chart

Computer consumes 15 % while LCD Projector consumes 4% of total power consumed. For lighting, dominant appliance is the relatively efficient LED lamps have 23 % share. Fans have 29 % share while Xerox Machine has 2% share in total power consumption. Fridge has 8 % share. Water cooler has 2% share of total power consumption.

4.3. LEVEL OF AWARENESS

- The level of awareness for energy conservation in top and middle management is excellent. It is felt necessary to make serious efforts to percolate the same up to the operating staff level and students.
- It is very important to record and monitor energy consumption department wise. Such recording and monitoring of energy consumption help in continuous performance monitoring of the equipment and attending to deviations, if any.
- The electrical personal regularly monitor and record current and power consumption of major equipment to assess their operating performance.

4.4. DETAILED TECHNICAL FEASIBILITY ASSESSMENT OF THE UNIT

4.4.1. ANALYSIS OF ELECTRICITY CONSUMPTION

Identifying where energy is used is useful because it identifies which areas the audit should focus on and raises awareness of energy use and cost. The results of the analysis can be used in the review of management structures and procedures for controlling energy use.

Analysis of energy use can be done by installing sub meters in different plant locations to pinpoint actual energy usage per area. This is a good source data for allocating energy use. The plant manager can also list all equipment used and the corresponding operating hours. With this information, spreadsheet can be created and charts useful for analysis may be generated.

Important Points to Consider When Collecting Load Data:

a. Usage– The usage of the equipments in terms of hours per day and days per year can be collected from key persons in s, departments etc. It is important to ensure the accuracy of this data because much of the potential for energy savings lies on wise allocation of the equipment's operating hours.

b. Actual power consumed– Actual power consumption is measured by Wattmeter or Power analyzer.

c. Supplementary Information – Some other supplementary information are also collected such as state of insulation in case of ACs or availability of natural light etc.

4.4.2. IDENTIFIED ENERGY CONSERVATION MEASURES IN THE UNIT

Based on the analysis of the power consumption data, certain steps have been recommended for improving energy efficiency of the campus. Complete cost analysis of implementation of recommended measures has been performed wherever necessary. Also, a number of general measures for energy efficiency have been listed. Described below are some important recommendations for better energy efficiency:

4.4.2.1. Replacing Conventional Ballast[Choke] FTLs with LED TL

Fig. 3. : Conventional Ballast FTL

Dominant light source at most places in the campus is traditional 40W FTLs with conventional Ballast[Choke] which consumes 20W in addition to the 40W. As per our data collection, the campus has in total 21 conventional Ballast[Choke] FTLs and 239 nos. of LED TL[Choke] FTLs. If these conventional Ballast[Choke]s are replaced by LED TL[Choke], 15-20W power can be saved per FTL. Cost Analysis of Replacing Conventional Ballast[Choke] FTL with LED TL[Choke] FTL.

Table 3: Energy Conservation in lighting system

A: Title of Recommendation	**1. Replacement of Conventional ballast with Electronic ballast**
B: Description of Existing System and its operation	The Existing system consist of 21 Fluorescent Tubes with conventional Ballast. The Max. working Hrs. are considered to be 6 Hrs. Total load of the lighting system is 5.62 KW. The total annual Energy consumption of the lighting system is 8935 KWH
C: Description of Proposed system and its operation	All the Conventional Ballast (21 Nos) are replaced with LED TL. Besides it arrange the Fluorescent TL with proper design as per the working area.
D: Energy Saving Calculations	
1. No of Ballast to be replaced	21
2. Avg power of conventional Ballast	40
3. Avg. power of Electronic Ballast	20
4. Power saved per FTL	(40-20)=20 W
5. Total Power saving	(21*20)/1000= 0.42 KW
6. Avg. use of FTL / year	(270*6)= 1620 Hrs
7. Total Energy saved / year	(0.42*270*6)= 680 KWH
E: Cost Benefits	
1. Savings in Rs./ Year	**(680*17)= Rs.11560/-**
2. Investment	Rs. 4,500/-
3. Payback period in Years	(4500/ 11560) =0.39Yrs

Hence, the capital cost recovery time for replacing all conventional Ballast[Choke] FTLs of the campus is around 0.39 years.

4.4.2.2. Revamping of Existing lighting system:

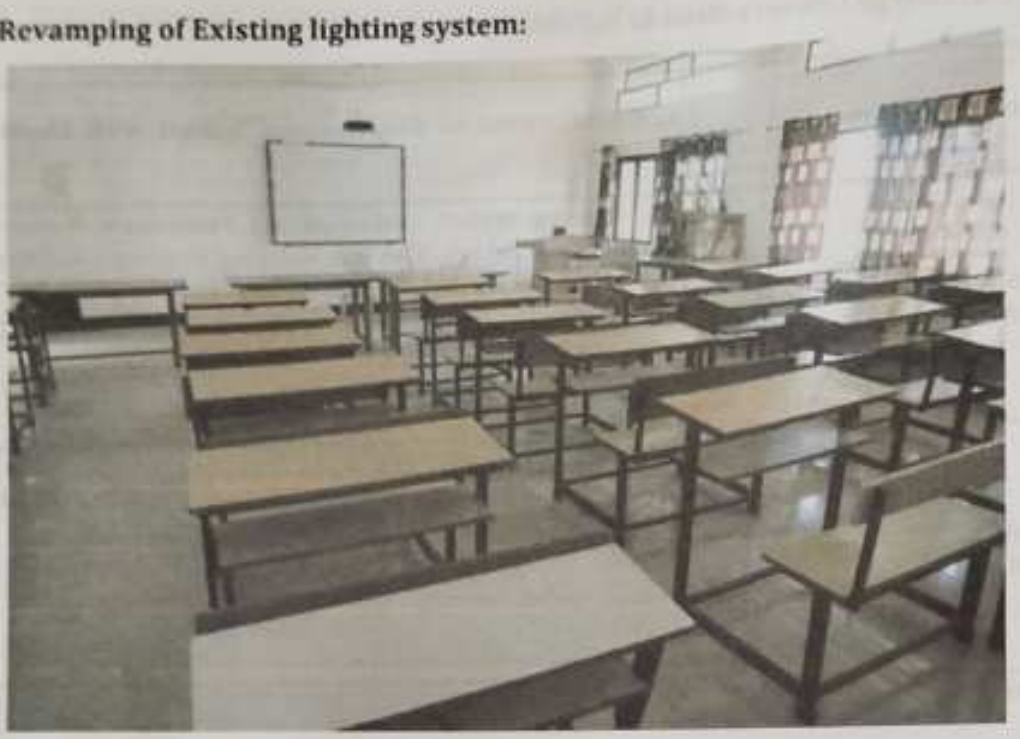


Fig. 4. : Existing Lighting System

Most of the Buildings in K. K. Wagh Arts, Commerce, Science & Computer Science College Chandori campus are very old and so are the lighting system. According to the data collected, there are a total of 260 TL. Most of the lighting systems are not according to standards. A saving of 1650 units can be obtained by Revamping of existing lighting system.

Cost Analysis of **Revamping of Existing lighting system:**

- Total units consumed by existing lighting system = 8935 kWh
- Average units saved by revamping = 1650 kWh
- Saving in Rs. Per year = 1650*17 = Rs.28,050 /-
- Average Cost of Revamping = Rs. 10,900/-
- Capital Cost Recovery time = (10,900)/(18,480) = 0.39 yrs

Hence, the capital cost recovery time for **Revamping of Existing lighting system** of the campus is around 0.39 years.

4.4.2.3 Use of Motion Sensors in Corridors and Toilets:

Corridors and toilets have large potential of saving energy by use of automation tools. Motion sensors can be used there to automatically switch on the light when there is any movement and switch off the light when there is no movement. This can greatly reduce the total load in corridors and toilets.

Cost analysis of Installing Motion Sensors in a Typical Corridor:

- Average number of tube lights in a corridor = 49
- Average power of the tube lights = 20W
- Average number of motion sensors required = 10
- Average reduction in usage per day by motion sensor = 3 hrs
- Total energy saved in corridor per year = (10*20*2*365)/1000 = 146 kWh
- Saving in Rs. Per year = 146*17 = Rs. 2,482/-
- Cost of installation per motion sensor = Rs. 300
- Total cost of installing motion sensors in a corridor = 10*300 = Rs. 3,000/-
- Capital Cost Recovery Time = (3,000/2,482) = 1.21 yrs

Hence, the capital cost recovery time for installing motion sensors in corridors is 1.21 years.

Toilets are also having comparable capital cost recovery time. Hence, this is a highly recommended step to largely reduce the consumption in corridors and toilets.

4.4.2.4 Minimizing Repair Works in Fans:

During data collection, the repaired fans have been found to be consuming very high power as compared to the rated power. Fans repaired once and twice were consuming 16W and 43W more than the average consumption of new fans respectively. Thus, effort should be made to minimize the repairing of fans and also repair work should be supervised properly.

4.4.2.5. Use of Master Switch outside each Room:

Installation of a master switch outside a room can make it easy for a person to switch off all the appliances of a room in case someone forgets to switch off while leaving the room. This can help improving energy efficiency.

4.4.2.6 Replacing old conventional fans with New Technology BLDC Fans

A: Title of Recommendation	**1. Replacement of old conventional fans with New Technology BLDC Fans**
B: Description of Existing System and its operation	The Existing system consist of 154 Fans with conventional technology. The Max. working Hrs. are considered to be 6 Hrs. Total load of the Fan system is 10.78 KW. The total annual Energy consumption of the Fan system is 14284 KWH
C: Description of Proposed system and its operation	All the Conventional technology fans (154 Nos) are replaced with New Technology BLDC Fans.
D: Energy Saving Calculations	
1. No of Fans to be replaced	154
2. Avg. power consumption of Fan	70 W
3. Avg. power of BLDC Fan	30 W
4. Power saved per FTL	(70-30)=40 W
5. Total Power saving	(154*40)/1000= 6.16 KW
6. Avg. use of Fans / year	(270*6)= 1620 Hrs
7. Total Energy saved / year	(6.16*270*6)= 9980 KWH
E: Cost Benefits	
1. Savings in Rs./ Year	**(9980*17)= Rs.1,69,660/-**
2. Investment	Rs. 5,39,000/-
3. Payback period in Years	(539000/ 1,69,660) =3.17Yrs

As the Payback period is more i.e. 3.17 years, it is advisable that burnt or damaged fans can only be replaced with BLDC Fans

4.4.2.7. Reduce Contract Demand (CD) to 320 kVA from existing level of 400 kVA

Install MD Controller so as to restrict MD Level at less than 320 kVA

Table 4: Reduced Contract Demand

Solution Description –

The working is done with existing values applied with HT VIII B Tariff for Y 2022-23.

Month	CD	70% CD	MD [kVA]	BD [kVA]	BD - MD [kVA]	Demand Rate	Add. BD Charges	
Oct-22	250	162.5	23	163	140	454	63560	
Nov-22	250	162.5	25	163	138	454	62652	
Dec-22	250	162.5	31	163	132	454	59928	
Jan-23	250	162.5	25	163	138	454	62652	
Feb-23	250	162.5	19	163	144	454	65376	
Mar-23	250	162.5	30	163	133	454	60382	
Apr-23	250	162.5	25	175	150	499	74850	
May-23	250	162.5	21	175	154	499	76846	
Jun-23	250	162.5	22	175	153	499	76347	
Jul-23	250	162.5	21	175	154	499	76846	
Summation	NAP	NAP	NAP	NAP	NAP	NAP		
Minimum	250	162.5	19	163	132	454	6110	
Average	250	162.5	24.2			472.0		
Maximum	250	162.5	31	175	154	499	74850	

Month	New CD	70% of CD	New BD	New BD-MD	New Add. BD Charges	Saving in BD Charges
Oct-22	62	40	40	17	7854.2	55705.8
Nov-22	62	40	40	15	6946.2	55705.8
Dec-22	62	40	40	9	4222.2	55705.8
Jan-23	62	40	40	15	6946.2	55705.8
Feb-23	62	40	40	21	9670.2	55705.8
Mar-23	62	40	40	10	4676.2	55705.8
Apr-23	62	40	40	15	7634.7	67215.3
May-23	62	40	40	19	9630.7	67215.3
Jun-23	62	40	40	18	9131.7	67215.3
Jul-23	62	40	40	19	9630.7	67215.3
Summation	NAP	NAP	NAP	NAP	76343	603096
Minimum	62	40	143	112	0	9080
Average	62		143		6362	50258
Maximum	62	143	143	124	14982	23608

Saving - kWh/Year	Saving - Rs. Lacs/Year	Investment - Rs. Lacs	Simple Payback-Months
NAP	6.03	1.5	2.99

4.4.2.6 Improve the performance of APFC and maintain Unit PF (0.999 Lag) resulting into kVAh consumption almost equal to kWh

Table 5: Improve APFC panel

MONTH	KVAH	(KVAH-KWH)	Rs./KVAH	extra charges	present pf
Oct-22	4887	2155	8.96	19308.8	0.559
Nov-22	4298	1216	8.96	10895.36	0.717
Dec-22	5168	1251	8.96	11208.96	0.753
Jan-23	4341	1289	8.96	11549.44	0.703
Feb-23	3045	886	8.96	7938.56	0.709
Mar-23	3931	1101	8.96	9864.96	0.72
Apr-23	4105	1170	8.96	10483.2	0.715
May-23	3658	1156	10.4	12022.4	0.684
Jun-23	2692	240	10.4	2496	0.911
Jul-23	2918	286	10.4	2974.4	0.762
Aug-23	8896	708	14.93	10570.44	0.945
Summation	47939	11458	NAP	109312.52	NAP
Minimum	2692	240	8.96	2496	0.559
Average	3994.917	954.8333333		9109.376667	0.7434545
Maximum	8896	2155	14.93	19308.8	0.945

Month	New Expected PF	New Expected kVAh	New (kVAh - kWh)	Saving in Extra kVAh	Saving in Rs.
Oct-22	0.999	2734.73	2.73	2152.27	19284.30
Nov-22	0.999	3085.09	3.09	1212.91	10867.72
Dec-22	0.999	3920.92	3.92	1247.08	11173.83
Jan-23	0.999	3055.06	3.06	1285.94	11522.07
Feb-23	0.999	2161.16	2.16	883.84	7919.20
Mar-23	0.999	2832.83	2.83	1098.17	9839.58
Apr-23	0.999	2937.94	2.94	1167.06	10456.88
May-23	0.999	2504.50	2.50	1153.50	11996.35
Jun-23	0.999	2454.45	2.45	237.55	2470.47
Jul-23	0.999	2634.63	2.63	283.37	2947.00
Aug-23	0.999	8196.20	8.20	699.80	10448.07
Summation	NAP	36517.52	36.52	11421.48	**108925.46**
Minimum	0.999	2161.16	2.16	237.55	2470.47
Average	0.999	3319.77	3.32	1038.32	9902.31
Maximum	0.999	8196.20	8.20	2152.27	19284.30

Saving - kWh/Year	Saving - Rs. Lacs/Year	Investment - Rs. Lacs	Simple Payback-Months
11421	1.08	1.2	10.8

4.7. SUMMARY OF ENERGY CONSERVATION OPTIONS & RECOMMENDATIONS:

Table64: Summary of Energy Conservation Measures

Sr. No	Energy Saving Recommendations	Annual Energy Savings(KWH)	Annual Cost Savings(Rs.)	Capital Investment(Rs.)	Simple Payback Period(Yrs.)
1	LED TL	680	Rs. 11,560	Rs. 4,500	0.39
2	Revamping	1650	Rs. 28,050	Rs. 10,900	0.39
3	Automation	146	Rs. 2,482	Rs. 3,000	1.21
4	BLDC Fans	9980	Rs.1,69,600	Rs.5,39,000.00	3.17
4	MD controller	-	Rs.6,03,000	Rs. 1,50,000	0.25
5	APFC	11421	Rs. 1,08,000	Rs.1,20,000	0.90
Total		**23,877**	**Rs. 9,22,692**	**Rs. 8,27,400**	**0.89**

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5.SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Summary:

Energy Audit is one of the important tools to check the balance of energy input and its judicial use. Energy auditing is the process of identifying and determining whether institutional practices are eco-friendly and sustainable. It is a process of regular identification, quantification, documenting, reporting and monitoring of energy consumption in a specified area. The main objective to carry out Energy audit is to check the energy conservation practices followed by institute and to conduct a well-defined audit report to understand whether the institute is on the track of sustainable development. After completing the audit procedure of college campus for energy conservation practices, there are following conclusions, recommendations which can be followed by college in future for keeping campus energy friendly.

5.2. Conclusion:

Considering the fact that the organization is a well-established, long time run establishment with good reputation, there is significant scope for conserving energy and make the campus as self-sustained in it. The energy conservation initiatives taken up by the institution are substantial. Energy efficient lighting schemes, awareness created among stakeholders and necessary power backups are being practiced by the institution. There are some best Practices followed on Energy Audit in the Organization like Transformers, Generators and UPS are protected properly with fencing and kept awareness boards on 'Dangers' and 'Warnings'. It is observed that the most of places, sign board of 'Switch ON' and 'Switch OFF' are kept towards saving energy measures to the stakeholders. Electrical wires, switch boxes and stabilizers are properly covered without any damage which will cause any problems to the staff and student members. Adaptation of sprinkler irrigation in the campus to minimize the energy potential are well appreciated. Few recommendations, in addition, can further improve the energy savings of the Organization. This may lead to the prosperous future in context of Energy Efficiency Campus and thus sustainable environment and community development to the stakeholders in coming years to come.

5.3. Recommendations:

- The energy audit included suggestions for energy cost reduction, preventive maintenance and quality control activities, all of which are critical for utility operation in the audit sites.
- Promoting ECON awareness and practice among the stakeholders may be conducted periodical through Association, Clubs, Forums and Chapters.
- Turn off electrical equipment when not in use
- Maintain appliances and replace old appliances in all laboratories.
- Use computers and electronic equipment in power saving mode.
- There are fans of older generation and non-energy efficient which can be phase out by replacing with new energy efficient fans.

5.4. Steps undertaken to amend the suggestions given in the previous Energy Audit Report

As per the previous Energy Audit report, the following steps were undertaken to amend the suggestions and recommendations. The last Energy Audit was conducted on 07.04.2022 by the M/s. ENSUS Consultancy services, Nashik.

Table 7- Steps undertaken to amend the suggestions given in the previous Energy Audit Report

Sr. No	Suggestions made during the previous Energy Audit Report	Steps taken to amend the suggestions of the previous Energy Audit Report
1	Switch over from HT category to LT category	In process & working with management
2	Replace FTL with LED TL	In process & replaced the damaged TL with new LED TL
4	Replace existing regular Fans with BLDC fans	Not yet installed
5	Operate all pumps in the night zone	Action taken

6.INSTRUMENT USED BY AUDIT TEAM

Table 8: Instruments used by Audit Team

SR.NO.	INSTRUMENT NAME	SPECIFICATIONS
1	Clamp-on Power meter	0-1200KW 0-600 V AC 0-600 V DC 0-400 A AC/DC
2	Power Analyzer	3 phase 4 wire Recording parameters- voltage current, frequency, Harmonics/ Inter harmonics up to 49th , THD of voltage, current with crest factor, Transients, voltage sag – swells, all power measurements, Inrush current, monitoring of events,etc.
3	Lux Meter	0-2,00,000 lux level
4	Infrared Thermometer	Non contact type Temp.= -30 to 550®C RH= 10 to 95 %

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ENERGY AUDIT

CERTIFICATE

This is to certify that **GREENENCON SOLUTION** has successfully completed Energy Audit at **K. K. Wagh Arts, Commerce, Science & Computer Science College** Chandori, Nashik. The work of Energy Audit is completed on 1st Feb., 2023 for year 2022-23.

Thanking you and assuring you for our best services.

Audit Report by,

Mr. Santosh D Jadhav
Energy Auditor(BEE cert.)
Regn. No.- EA-21802

Date: 01/02/2023
Place: Nashik

Santosh D. Jadhav
Energy Auditor
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For **GREENENCON SOLUTION**

Mr. Santosh D Jadhav

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