INNOVATIVE ENERGY CONSERVATION SOLUTIONS

An ISO 9001:2015 Certified Organisation,

Certificate No:- 1205Q169822

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DATE

February 24, 2023

PLACE OF WORK: CHANDIGARH

No: CERT/2023/09

Energy, Environment & Green Audit Certificate

Is Issued To

GOVERNMENT HOME SCIENCE COLLEGE SECTOR 10, CHANDIGARH

for successful completion of Energy, Environment & Green Audit of the College for the Period FY 2022-23, conducted by M/s **Innovative Energy Conservation Solutions**. This Energy, Environment & Green Audit included Sectoral Audits in the reports i.e., Water, Energy, Waste cum Material, Air Quality & Noise, Bio-diversity, outdoor environment, Health & well-being, Activities and Institutional management aspect cover.

The College is certified to have done exceptionally well to conserve energy, environment and ensuring sustainable development for the assessment period.

Duration of Audit: Feb-2022 to Jan-2023

Date of Issue: 24/02/2023

PANKAJ DHOTE

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Date: 2023.02.24 17:27:16 +05'30'

Innovative Energy Conservation Solutions

Innovative Energy Conservation Solutions Proprietor

Innovative Energy Conservation Solutions

An ISO 9001:2015 Certified Organisation,

Certificate No:- 1205Q169822

Thank You

www.iecsolutions.in

Pankaj Dhote

Energy Audit

Report of

Government Home Science College, Sector-10, Chandigarh

Prepared & Submitted by

INNOVATIVE ENERGY CONSERVATION SOLUTIONS
ISO 9001:2015 (Certificate No: 1205Q169822)

Audit Details

Report Title	= Energy Audit Report
Client Name	= Government Home Science College, Chandigarh
Location of the Plant	= Sector 10-D, Chandigarh. Pincode-160011
Name of the Auditor	**Mr. Vijay Kumar Gupta** Chartered Engineer/ Professional/Lead Auditor/Competent Person/Energy Auditor Serial No- 351338 **Mr. Pankaj Dhote** Energy Audit Number: CEA :28926 M. Tech in Energy & Environmental Study **Mr. Nikhil Thakur** B. Tech Electrical

ACKNOWLEDGEMENT

Innovative energy conservation solutions (IECS) places on record its sincere thanks **to Government Home Science College Sector-10, Chandigarh** for entrusting the task of conducting “Energy Audit Study” during Jan-2023.

We hereby express our sincere thanks to **Professor Mrs. Sudha Katyal (Principal)** and their team, from **Government Home Science College Sector-10, Chandigarh** for their proactive support and courtesy extended to the IECS team during field study. We also thank other officials from **Government Home Science College Sector-10, Chandigarh** for their cooperation and support provided during data collection. We are also grateful to all those we interacted with during the audit who gave us some operational insights.

We hereby submit the Energy Audit Report for your reference.

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Executive Summary

Energy Audit is the key to a systematic approach for decision-making in the area of energy management as it attempts to evaluate the energy usage pattern in an establishment. Also, it serves to identify all the energy streams in an establishment, so that potential areas wherein energy savings are practically feasible are identified.

It was with this objective that Innovative Energy Conservation Solutions (IECS) was entrusted by Government Home Science College, Chandigarh, the energy audit of the Institute.

The study primarily covers the I) Present energy scenario of the building, ii) Detailed analysis of the data obtained through field visits, trial measurements by portable gadgets, discussions with concerned personnel etc., iii) Recommendations for energy savings options in all possible areas with cost benefit analysis.

General Building Details & Energy Consumption

Sr. No.	Particulars	Value
1	Connected Load (kW)	194 kW
2	Installed Solar Capacity	190 kWp Tentative Units Generation (190 x 1500 kWh) 285000 kWh (Annual)
3	Electricity Consumption, purchased from Utilities / Grid (kWh) – Jan 2022- Nov 2022	151473 kWh- Import 58128 kWh- Export
4	Electricity Consumption, through Solar (kWh) - Jan 2022- Nov 2022	175281 kWh- institute Consumption (Calculated Approx.)
5	Annual Cost of Electricity, purchased from Utilities/ Grid (Rs.) -	Rs 3.46/kWh
6	Working hours	General Lighting (7 hrs./day, 245 days a year)

Sr. No.	Particulars	Value
		Air Conditioning (7 hrs./day, 150 days a year)
		Fans (7 hrs./day, 210 days a year)
7	Working days/week (e.g., 5/6/7 days per week)	06 days per week
8	Installed capacity of Air Conditioning System (TR)	Total no of AC Installed =57
9	Installed lighting load including Lights (kW) Total 3078	110. 808 kW
10	Installed load of Fans (kW)	59.92 kW
11	Installed Load of Air conditioners	108.15 kW
12	Exhaust Fan Total – 35	19.25 kW
13	Street Light Total – 70	8.4 kW
14	Water Coolers	4.65 kW
15	Water Dispensers	2.5 kW
16	Computer Total – 235	47 kW

Total Energy Consumed in MTOE per annum

Period Jan-2022 to Nov- 2022

Source of Energy	Consumption	Calorific Value	Equivalent kCal	Equivalent MTOE
	kWh/annum	kCal/ kWh		
Total Purchased Power	151473	860	130266780	13.02
Total Power Generated through solar	175281	860	150741660	15.07
Total				**28.09**

Cumulative Energy Saving Opportunities

Particulars	Annual Savings				Estimated Investment
	kWh	ToE	tCO2	Rs in Lakh	(Rs in Lakh)
Replace Existing Ceiling Fans with low wattage Ceiling Fans on Failure Replacement Basis	57253	4.92	46.9	1.98	18.75
Replace Existing old Conventional Lamps with LED Low wattage Lamps on Failure Replacement Basis	11276	0.97	9.2	0.39	0.58
Replace Existing 3 Star ACs with Inverter Technology 5 Star ACs on Failure Replacement Basis	32445	2.79	26.6	1.12	22.8
Replace the Existing Raw Pumps with new Energy Efficient Pumps	5120	0.44	4.2	0.18	0.25
Total	**106094**	**9.12**	**86.9**	**3.67**	**42.38**

Except Pumps replacement project all other projects are to be implemented on phase manner and on failure replacement basis. Otherwise, payback period will be high

CHAPTER:1 INTRODUCTION

1.1 THE PROJECT

According to energy Conservation Act, 2001, Energy Audit is the verification, monitoring, and analysis of the use of energy including submission of a technical report containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce energy consumption.

Energy Audit is the key to a systematic approach for decision-making in the area of energy management as it attempts to evaluate the energy usage pattern in an establishment. Also, it serves to identify all the energy streams in an establishment, so that potential areas wherein energy savings are practically feasible are identified.

It was with this objective that Innovative Energy Conservation Solutions (IECS) was entrusted by Government Home Science College, Chandigarh, the energy audit of the Institute.

1.2 GENERAL DETAILS

Particulars		Details
Name & Address of Institute	:	Government Home Science College, Chandigarh,
Contact	:	Mrs.. Mona Soin (Nodal Officer) Mob: 9464121752
Annual Purchased Power Consumption (Period: Jan 2022- Nov 2022)	:	151473 kWh- Import Consumption 226872 kWh- Institute Consumption (Calculated Approx.) 58128 kWh- Export to Grid
Basic Purchased Power Rate	:	Units Consumption — Unit rate in Rs/kWh 0-150 kWh per month — 2.50

Particulars		Details
		151-400 kWh per month 4.25 Above 400 kWh per month 4.65
Overall Purchased Power Rate including Fixed Demand and other Charges	:	Rs 3.46 per kWh (averaged out for the assessment period)

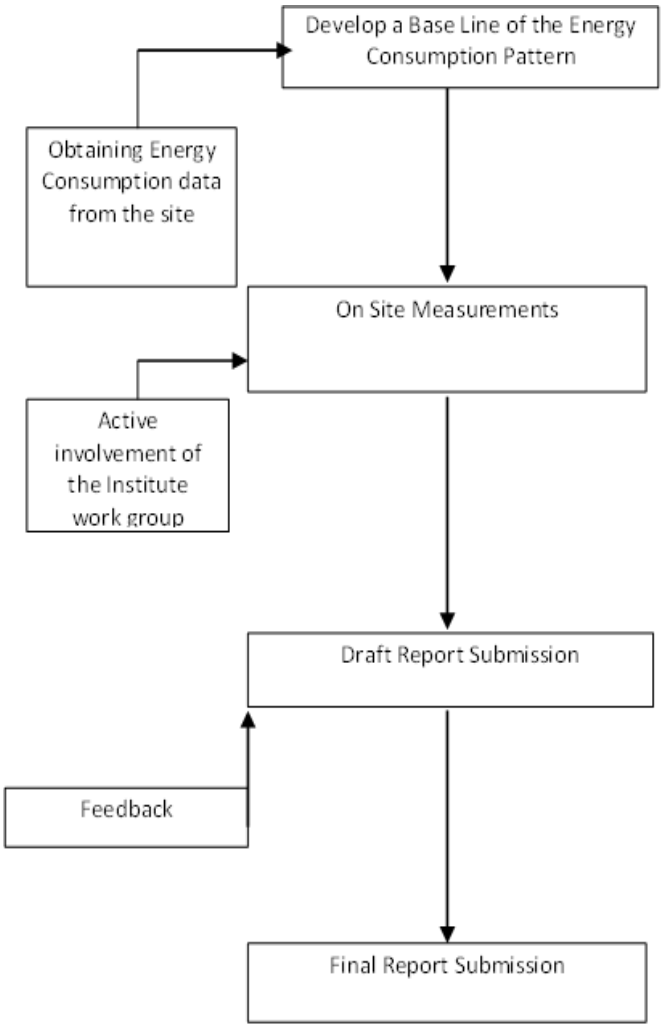
1.3 DELIVERABLES IN THE DETAIL PROJECT REPORT

- Methodology adopted for the study
- Present energy scenario of the building
- Detailed analysis of the data obtained through field visits, trial measurements by portable gadgets, discussions with concerned personnel etc.
- Recommendations for energy savings options in all possible areas with cost benefit analysis.
- Technical specifications for any retrofit options

1.4 METHODOLOGY

Methodology adopted for achieving the desired objectives viz: Assessment of the Current operational status and Energy savings include the following:

- Discussions with the concerned officials for identification of major **areas of focus** and other related systems.
- A team of engineers visited the Institute premises and had discussions with the concerned officials/ supervisors to collect data/ information on the operations and energy distribution in the building. The data was analyzed to arrive at a **base line energy consumption pattern**.
- **Measurements and monitoring** with the help of appropriate instruments including continuous and/ or time-lapse recording, as appropriate and visual observations were made to identify the energy usage pattern and losses in the system.
- Computation and **in-depth analysis** of the collected data, including utilization of computerized analysis and other techniques as appropriate were done to draw inferences and to evolve suitable energy conservation plan/s for improvements/ reduction in specific energy consumption.



- Draft Report submission on the findings of the audit.
- Final report submission after incorporating the observations/ comments made by the Institute.

CHAPTER:2 ABOUT THE COLLEGE

Government Home Science College is recognized as one of the premier institutions of higher learning and research in the country. Since its inception in 1961, the college is committed to the sustenance and promotion of an environment, favorable to the growth and development of an academic excellence, satisfying contemporary women's professional and specialized needs. Aligning with the objectives of the various developmental schemes initiated by the Government of India such as "Skill India'', "Atmanirbhar Bharat" 'Indian Skill Development Service' (ISDS) as well as 'Pradhan Mantri Kaushal Vikas Yojana (PMKVY) to nurture the academic institutes as incubation centers for the professional training of the students, the vision and mission of the college is to equip the students with market-relevant skill training. The rationale is to bridge the gap between skills required by the industry and the skills students acquire during their academic training in the institute.

Over the years, the college has built up great credibility and gained recognition as a premier institute. National Institution Ranking Framework (NIRF) has evaluated the college on the basis of Teaching Learning and Resources (TLR), Research and Professional Practice (RP), Graduation Outcome (GO), Outreach and Inclusivity (OI), and Perception. The College topped amongst city colleges in NIRF Ranking fourth time in a row at the National Level. It has been successful in attaining its position in the top 100 institutes of India consecutively for the last three years. This year, the college took a massive jump and figured among the top 50 institutes of India. It has significantly improved its ranking from 78th in 2021 to 46th spot in 2022 in India Rankings 2022 by NIRF, MoE, Government of India 2022.

COURSES OFFERED:

Degrees	Courses
B.Sc.	Home Science (Clothing & Textiles)
	Home Science (Foods & Nutrition)
	Home Science (Family Resource Management)
	Home Science (Composite)
	Home Science (Human Development)
	Fashion Designing (Self Finance Course)
M.Sc.	Clothing & Textiles
	Foods & Nutrition
	Human Development
PG Diploma	Nutrition & Dietetics
	Fashion Designing
	Child Guidence & Family Counselling

Google Map – Satellite View of Campus

Reporting Requirement

Table 1: Contact Details of the Organization and the Contact Persons

Organization	
Name of the Organization	Government Home Science College, Chandigarh,
Postal Address	Sector 10-D, Chandigarh. Pincode-160011
Name	**Designation**
Mrs. Ranjana Sharma	Associate Professor, In charge Environment Committee- Harita
Mrs. Mona Soin	Assistant Professor, Member, Harita
Mrs. Annu Deharwal	Assistant Professor, Member, Harita
Mrs. Pratibha Thapa	Assistant Professor, Member, Harita
Dr Shikha Garg	Assistant Professor, Member, Harita
Dr Reenu	Assistant Professor, Member, Harita
Ms Akshata Verma	Assistant Professor, Member, Harita
Mrs. Raman Bhalla	Superintendent
Mrs. Gurjinder Kaur	Care Taker

Table 2: General Building Details & Energy Consumption

SR. No.	Item	Value
1	Connected Load (kW)	194 kW
2	Installed Solar Capacity	190 kWp Tentative Units Generation (190 x 1500 kWh) 285000 kWh (Annual)

SR. No.	Item	Value
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5	Annual Cost of Electricity, purchased from Utilities/ Grid (Rs.) -	Rs 3.46/kWh
6	Working hours	General Lighting (7 hrs./day, 245 days a year)
		Air Conditioning (7 hrs./day, 150 days a year)
		Fans (7 hrs./day, 210 days a year)
7	Working days/week (e.g., 5/6/7 days per week)	06 days per week
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9	Installed lighting load including Lights (kW) Total 3078	110. 808 kW
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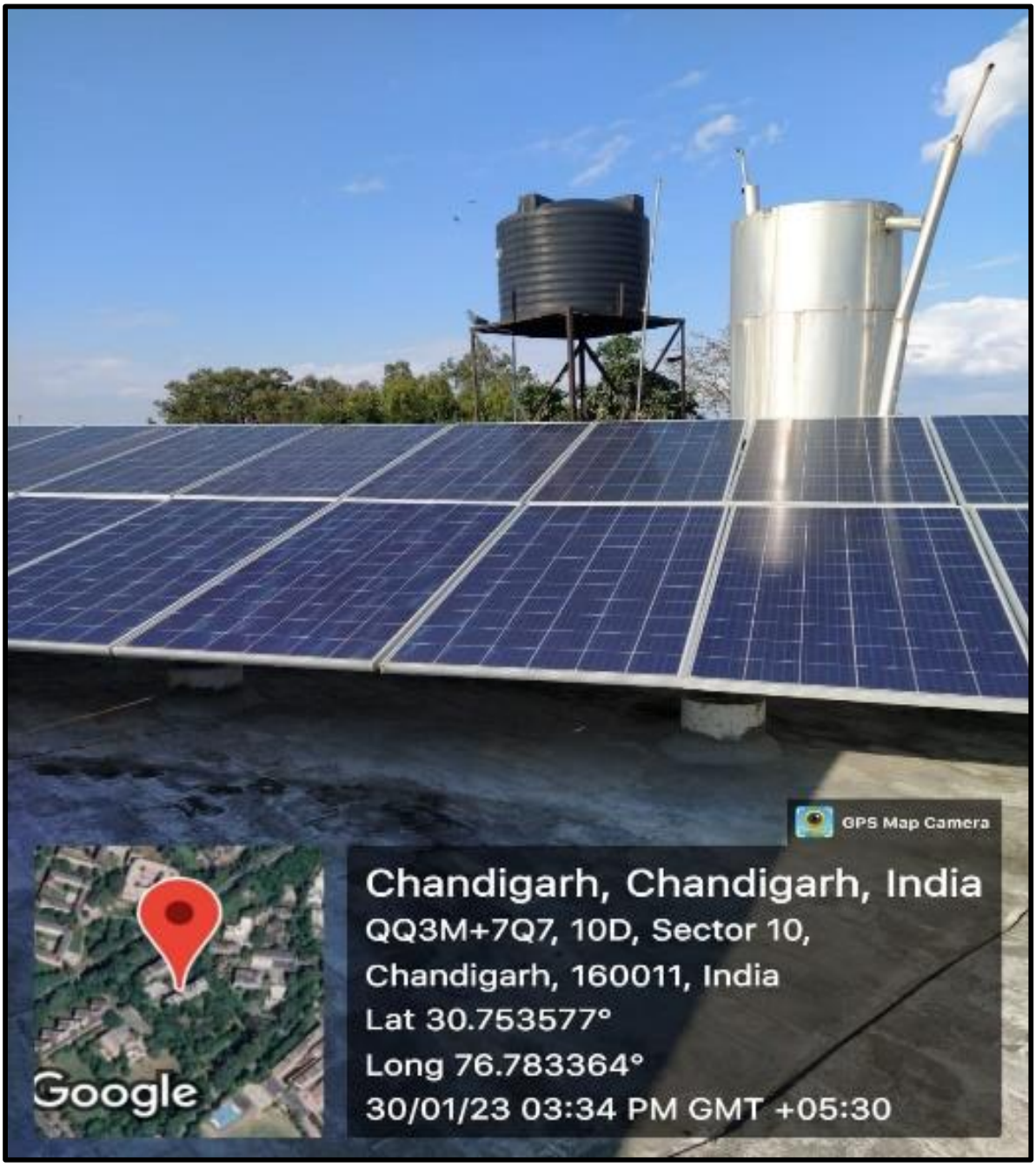
11	Installed Load of Air conditioners	108.15 kW
12	Exhaust Fan Total – 35	19.25 kW
13	Street Light Total – 70	8.4 kW
14	Water Coolers	4.65 kW
15	Water Dispensers	2.5 kW
16	Computer Total - 235	47 kW

2.1 ENERGY CONSERVATION ACTIVITY TAKEN BY THE COLLEGE

We appreciate the College for their steps taken to reduce the energy consumption in proactive manner. In the last year there were many energies conservation point taken by the College.

- With support from CREST, college has installed grid-connected rooftop solar photovoltaic power plant of capacity 190 kWp on various buildings in the college since past 6 years.
  - 90 kWp rooftop SPV plant on the Academic building
  - 50 kWp rooftop SPV plant on B.Sc. hostel building (both old wing and new wing)
  - 30 kWp rooftop SPV plant on M.Sc. hostel building
  - 20 kWp rooftop SPV plant on Multimedia Research Block building



- The water geysers, lights and fans in both the hostel buildings run fully on solar power generated by the SPV plant on campus.

With support from Department of Science and Technology and Renewable Energy, Chandigarh Administration, college installed 13 solar lights in the college campus.

Table 3: Details of Installed Solar Lighting in the Campus:

S. No.	Area	No. of solar lights
1	Car Parking Area	01
2	B.Sc. hostel – in the park	03
3	B.Sc. hostel parking area	01
4	Principal's lodge- front and back	02
5	M.Sc. hostel – in the park	02
6	College main gate	01
7	Near college gate 2 – along roadside	01
8	Outside Principal office – in the park	01
9	Sports ground – near office building	01
	TOTAL	**13**

- College also took an initiative to replace old tube lights with energy efficient LED lights in:
  - Academic building, B.Sc. Hostel (both wings) and M.Sc. Hostel building, Auditorium, Chaitanya Laboratory Nursery School, Multimedia Research Block and Principal's residence.
  - It also replaced existing solar lights in campus area with 40-watt solar LED light fitting in the college.
  - Replaced existing 2x40 watt street light fitting with 45-watt LED fitting and 125 watt/HPMV fitting in campus area.

- Energy efficient re-wiring was also done throughout the campus to increase energy efficiency of its systems, reduce energy loss and improved safety of the building occupants and residents on campus.
- The college also has a facility of electric bike for internal commutation.
- Environment committee- Harita, conducted regular energy efficiency awareness programs like inter-college competitions for sensitizing staff and students on energy efficiency, renewable energy, energy monitoring, waste segregation and disposal, water conservation etc.
- An 'Energy Saving Brigade' comprising of students from different classes is constituted in the college in every session that works towards:
    - Spreading awareness about efficient resource conservation and utilization by the use of posters, conducting Nukkad Natak, required signage's, etc. wherever and whenever required.
    - Ensuring that the lights, fans, computers and other systems on campus are turned off, unplugged or kept in power saving mode when they are not in use.

We congratulations institute management to take the upfront step for installing solar PV- System to protect the environment, reduced the greenhouse gases emission, improve sustainability.

CHAPTER:3 POWER SUPPLY SYSTEM AND ENERGY CONSUMPTION PATTERN

3.1 POWER SUPPLY SYSTEM

The Power Supply to the building is sourced from the Chandigarh Electricity Department at 0.433 kV under DS (domestic supply) category. Billing is done on kWh basis. There Were 8 nos of electrical Connections were present. Details and Power consumption is tabulated below

Table 4:Electrical Connection and Energy Consumption Details

Date in	Date Out	no. of days	Connected Load in kW	Energy Consumption in kWh	Energy Charges in Rs	Fixed Charges in Rs	Total Amount Paid in Rs	Amount Payable in Rs	Solar units Export in kWh
102104370173RE									
03-01-2022	03-03-2022	59	10.73	1658	6865	220	7990	0	0
03-03-2022	03-05-2022	61	10.73	4448	19838	220	21092	0	0
03-05-2022	03-07-2022	61	10.73	3716	16438	226	17098	0	0
03-07-2022	03-09-2022	62	10.73	3806	16928	330	18116	0	0
03-09-2022	03-11-2022	61	10.73	2738	11962	330	12967	0	0
Total		**304**	**10.73**	**16366**	**72031**	**1326**	**77263**		
102104370289RR									
03-01-2022	03-03-2022	59	0.2	310	793	20	0	-10053	0

Date in	Date Out	no. of days	Connected Load in kW	Energy Consumption in kWh	Energy Charges in Rs	Fixed Charges in Rs	Total Amount Paid in Rs	Amount Payable in Rs	Solar units Export in kWh
03-03-2022	03-05-2022	61	0.2	89	223	20	0	-10128	0
03-05-2022	03-07-2022	61	0.2	81	204	21	0	-9897	0
03-07-2022	03-09-2022	62	0.2	126	347	30	0	-9454	0
03-09-2022	03-11-2022	61	0.2	57	157	30	0	-9215	0
Total		**304**	**0.2**	**663**	**1724**	**121**	**0**		
102104370114SY									
03-01-2022	03-07-2022	181	8.62	944	2441	185	2626	-32931	0
03-07-2022	03-09-2022	62	8.62	202	556	270	0	-31963	0
03-09-2022	03-11-2022								
Total		**243**	**8.62**	**1146**	**2997**	**455**	**2626**		
102104370072RT									
30-01-2022	30-03-2022	59	91.2	12414	53658	1055	57960	0	693
30-03-2022	30-05-2022	61	91.2	13475	61214	1840	44539	0	129
30-05-2022	30-07-2022	61	91.2	12728	49714	2300	51149	0	1863
30-07-2022	30-09-2022	62	91.2	10575	40415	2760	45035	0	1718
30-09-2022	30-11-2022		91.2						

Date in	Date Out	no. of days	Connected Load in kW	Energy Consumption in kWh	Energy Charges in Rs	Fixed Charges in Rs	Total Amount Paid in Rs	Amount Payable in Rs	Solar units Export in kWh
Total		**243**	**91.2**	**49192**	**205001**	**7955**	**198683**		
102104370073SX									
30-01-2022	30-03-2022	59	44.43	269	0	0	0	-103486	142
30-03-2022	30-05-2022	61	44.43	241	603	900	0	-103699	0
30-05-2022	30-07-2022	61	44.43	1002	0	1125	0	-102741	28052
30-07-2022	30-09-2022	62	44.43	919	0	1350	0	-101391	4158
30-09-2022	30-11-2022	61	44.43	1571	0	1350	0	100041	2672
Total		**304**	**44.43**	**4002**	**603**	**4725**	**0**		
102104370291RR									
30-01-2022	30-03-2022	59	10.42	4315	2072	220	0	-40303	2556
30-03-2022	30-05-2022	61	10.42	4820	10138	220	0	-36366	2458
30-05-2022	30-07-2022	61	10.42	6961	17508	275	0	-18058	3022
30-07-2022	30-09-2022	62	10.42	4644	4201	330	0	-13303	3575
30-09-2022	30-11-2022	61	10.42	4995	12087	330	0	-838	2230
Total		**304**	**10.42**	**25735**	**46006**	**1375**	**0**		

Date in	Date Out	no. of days	Connected Load in kW	Energy Consumption in kWh	Energy Charges in Rs	Fixed Charges in Rs	Total Amount Paid in Rs	Amount Payable in Rs	Solar units Export in kWh
1021043702 92RU									
30-01-2022	30-03-2022	59	32.26	5814	26190	660	28071	0	0
30-03-2022	30-05-2022	61	10.42	8568	38996	660	50544	0	0
30-05-2022	30-07-2022	61	10.42	12535	57308	825	60583	0	37
30-07-2022	30-09-2022	62	10.42	6669	17174	990	18974	0	2810
30-09-2022	30-11-2022	61	10.42	6212	18755	990	19807	0	2013
Total		**304**	**14.788**	**39798**	**158423**	**4125**	**177979**	**0**	
1021043700 73RW									
03-03-2022	AVERAGE	61	13.64	14571	66914	287	67858	0	0
01-05-2022	03-09-2022	125	13.64	0	0	420	352	0	0
03-09-2022	03-11-2022	61	13.64	0	0	420	352	0	0
		247	**13.64**	**14571**	**66914**	**707**	**68210**	0	0
			194	**151473**	**130266780**		**524761**	**-533785**	**58128**

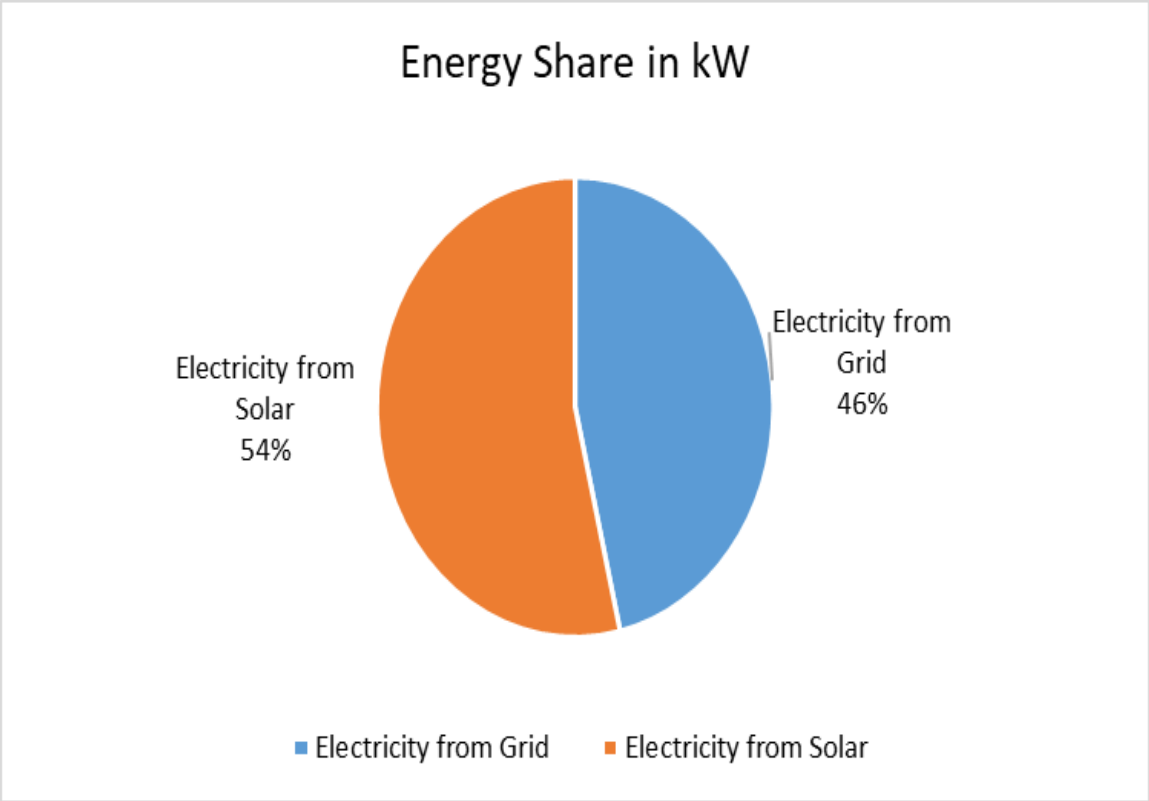
From Electricity Bills analysis, we can summaries that the solar power plant generated electricity which is used in college with surplus export to grid. Thus, college have negative electricity bill.

Total Energy Consumption Share from Grid and Solar PV is tabulated below

Table 5:Energy consumption share from Grid and PV Panels

Energy Share		
Particulars	**Values in kWh**	**Percentage**
Electricity from Grid	151473	46%
Electricity from Solar	175281	54%
Total	**326754**	**100%**

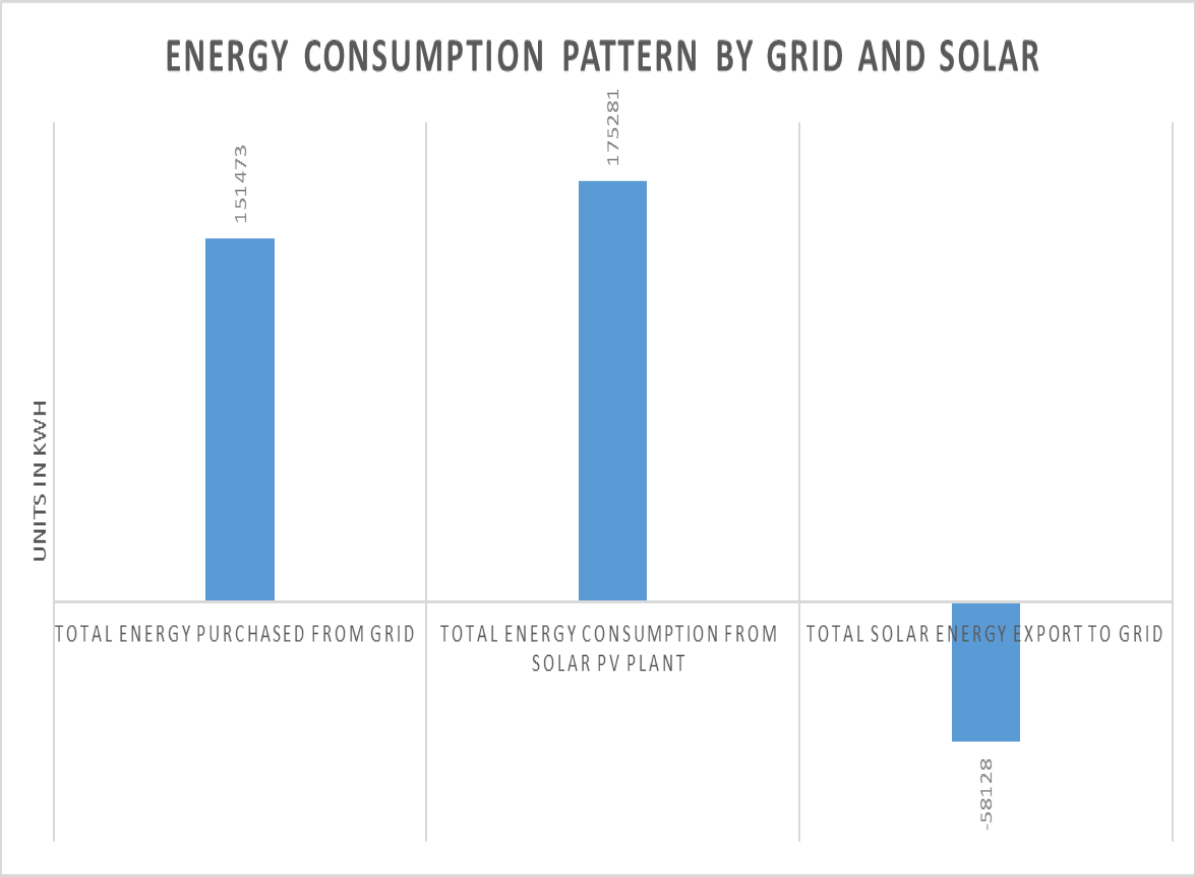
The graph showing the share of energy consumption from grid and solar PV. As we can see from following graph that major contributor for meeting the requirement of collage is solar PV which is nearly 54 %.



Total Energy generation & consumption pattern

Period Jan-2022 to Nov- 2022

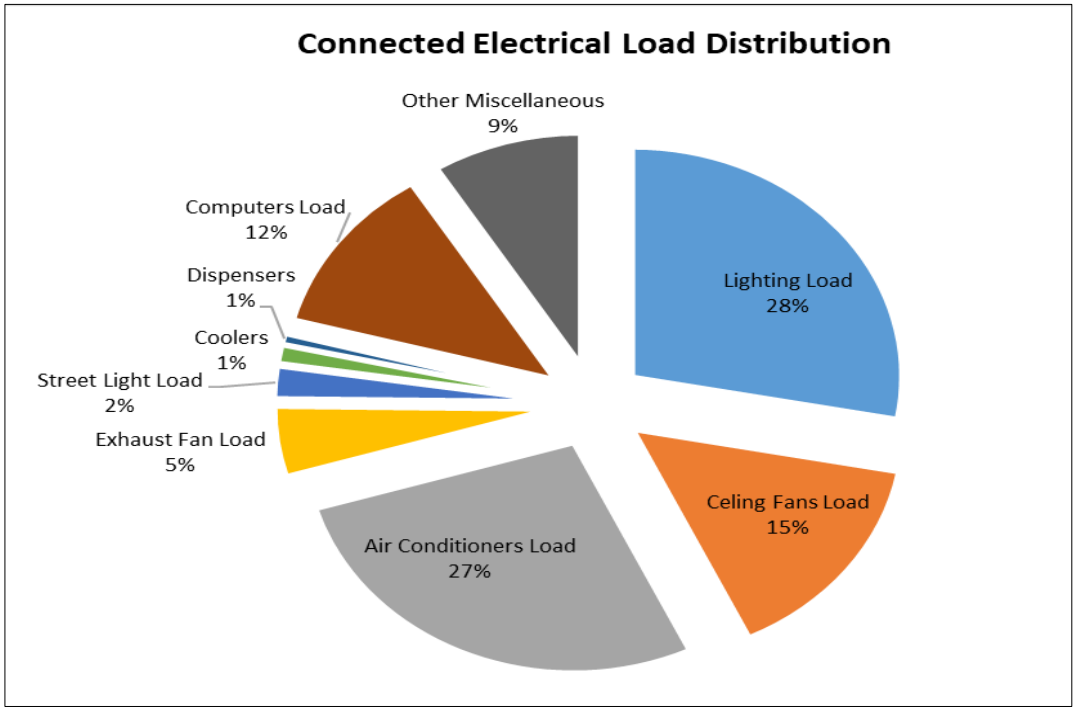
Particulars	Values in kWh
Total Energy Purchased from Grid in kWh	151473
Total Energy Consumption from Solar PV plant in kWh	175281
Total Solar Energy Export to Grid in kWh	-58128



As from the above table & figure it can be seen that collage is exporting energy in the grid and majorly solar generated energy being used. Thus, collage is self sufficient and independent in terms of energy requirement.

Connected Load Distribution and Mapping

Electrical Load	Connected Values in kW
Lighting Load	110
Celling Fans Load	59
Air Conditioners Load	108
Exhaust Fan Load	19
Street Light Load	8.5
Coolers	4.64
Dispensers	2.5
Computers Load	47
Other Miscellaneous	35



As from the above table and graph it can be seen that major energy consumer in the collage is lighting followed by air conditioner, and then ceiling fans. These 3 contributes for 70 % of the total consumption.

CHAPTER:4 STUDY OF CEILING FANS SYSTEMS

4.1 CELLING FANS DETAILS

The College have around 749 no. of ceiling fans with the wattage of 80. These fans were very old or some of them was not working. These fans can be replaced with new technology ceiling fans.

It is suggested to install new technology ceiling fans in the place of existing fans. The rating of these fan will be 28 watts. Thus, it will reduce the power Consumption.

Table 6: Details of existing Installed Fans in the campus

Sr No	Room No	Particular	No. of Ceiling Fan installed
1	1	Principal Room	4
2	2	Steno Room	1
3	3	Committee Room	6
4	3-A	First Aid Room	1
5	4	Administrative Office	12
6	5	Electric Substation	0
7	6	Smart Lecture Room-1	7
8	7	Staff Room	1
9	8	Smart Class Room	5
10	9	Class Room	4
11	10	e- Pathshala	6
12	11	Smart Class Room	2
13	12	Food Science Lab/Nutritional assessment Lab	2

Sr No	Room No	Particular	No. of Ceiling Fan installed
14	13	Cafeteria/ Institutional food administration lab	8
15	14	Microbiology Lab	15
16	15	Seminar Room	1
17	16	Store	0
18	17	Basement Hall No - 1	2
19	18	Basement Hall No-2	10
20	19	Basement Hall No-3	10
21	20	Store	1
22	21	Store	0
23	22	MSc Food Lab	13
24	23	Store	1
25	24	B.Sc. Food Lab	12
26	25	Lab Staff Room	2
27	26	Teaching Staff Room	2
28	27	Bio Chemistry lab	8
29	28	Diet Clinic/Staff room	2
30	29	Computer Lab	6
31	30	IQAC Room	3
32	31	Visitors Room	1
33	32	Library- Main Hall	31

Sr No	Room No	Particular	No. of Ceiling Fan installed
34	32-A	Newspaper, Periodical & Magazine Section Library	4
35	32-B	Reference Section	7
36	33	Conference Hall	1
37	34	NCC Cell	1
38	35	Smart Lecture Room-II	9
39	36	CAD Lab	3
40	37	Dyeing Lab	4
41	37-A	Printing Lab	6
42	38	Pattern Making Lab	6
43	39	Textile Testing Lab	5
44	39-A	Staff Room	1
45	40	Heritage Resource Centre	4
46	40-A	Weaving & Knitting Lab	2
47	41	PG Garment Construction Lab - I	5
48	42	PG Garment Construction Lab - II	7
49	43	Department Library	1
50	44	Seminar Hall	3
51	45	Staff Room	2
52	46	UG Garment Construction lab-I	12
53	47	Store Room	1

Sr No	Room No	Particular	No. of Ceiling Fan installed
54	48	Smart Class Room	2
55	49	Physics Lab	12
56	50	Nodal officer	1
57	51	Control Room	1
58	52	Chemistry Lab.	12
59	53	Staff Room	1
60	54	Home Management & Furnishing Lab House	6
61	54-A	Auto CAD Lab	2
62	54-B	Ergonomics Lab	2
63	54-C	FRM Staff Room	2
64	55	Family Resource Lab	12
65	55-A	Equipment Lab	2
66	55-B	Design Studio	4
67	56	Smart Lecture Theatre	7
68	57	NSS Room	1
69	58	Smart Class Room	5
70	59 -I	Smart Class Room	8
71	59-II	Smart Class/ HD Lab-III	9
72	60	Counselling Cell	11
73	61	Staff Room	1
74	62	Smart Class	5

Sr No	Room No	Particular	No. of Ceiling Fan installed
75	63 -A	HD Lab-I	6
76	63-B	HD Lab-II	8
77	64	HD Department HOD Office	1
78	65	HD Lab Staff Room	1
79	66	Botany Lab	15
80	67	Staff Room	1
81	68	HOD Botany Office	1
82	69	Zoology Lab	15
83	70	Staff Room	1
84	71	HOD Zoology office	1
85	72	Faculty Room	1
86	73	Art Lab	14
87	74	Staff Room	2
88	75	Art Lab Store	1
89	-	Multimedia Research Block	12
90	-	Academic Hall Lobby Ground Floor	12
91	-	Academic Hall Lobby First Floor	4
92	-	Academic Hall Lobby Second Floor	9
93	-	BSC Hostel Mess Hall (OLD Wing)	16

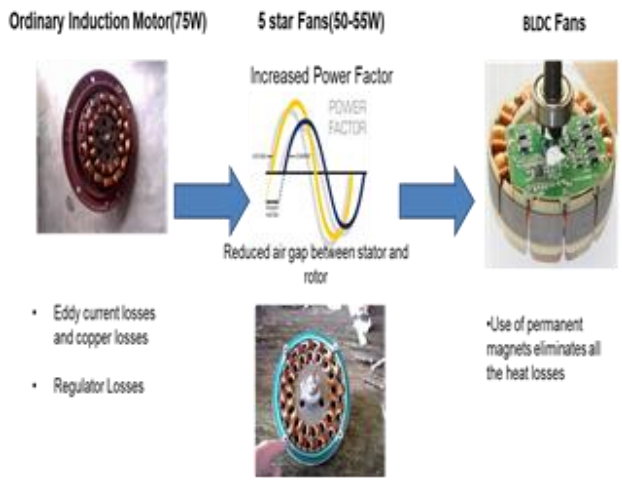
Sr No	Room No	Particular	No. of Ceiling Fan installed
94	-	BSC Hostel Mess Cooking Area (Old Wing)	6
95	-	BSC Hostel Common Room (Old Wing)	12
96	-	BSC Hostel Room & Others (Old Wing)	100
97	-	BSC Hostel Room & Others (New Wing)	100
98	-	M.Sc. Hostel Ground Floor	7
99	-	M.Sc. Hostel Rooms & Others	66
100	-	Auditorium	15
101		Leisure Lounge	0
102		Chatanya Nursery lab.	26
103		Indoor Badminton Hall	6
104		Music Room	1
105		Physical Education Room	3
106		Canteen	12
107		Administrative Office	0
108		Basement	0

4.2 ECM#1 Replace Existing Ceiling Fans with low wattage Ceiling Fans on Failure Replacement Basis

With technological advancements, new energy efficient BLDC fans consumed much less power for the same air flow, besides offering allied benefits like lesser noise and enhanced life,

New Technology Energy Efficient BLDC Fans

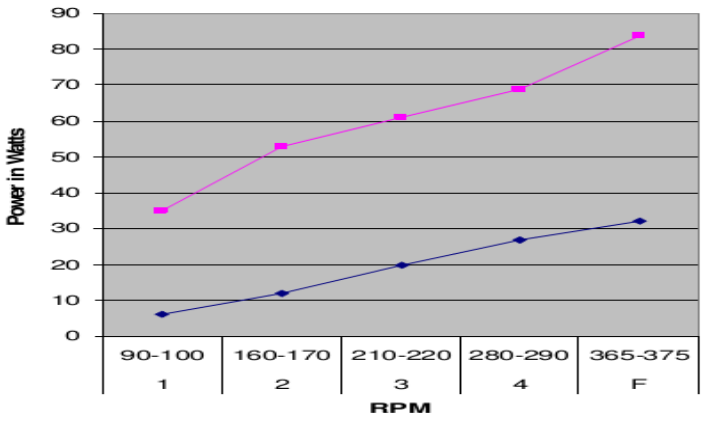
A brushless DC (BLDC) motor is a synchronous electric Motor powered by direct-current (DC) electricity and having an electronic commutation system, rather than mechanical commutator and brushes. In BLDC motors, current to torque and voltage to rpm are linear relationships. This linearity provides an excellent opportunity to use the BLDC motor in the conventional ceiling fans.



This paper presents practical implementation of such BLDC motor for ceiling fan application along with the actual power measurements in comparison with conventional ceiling fans. Complete electronics and the associated advantages and disadvantages of this BLDC ceiling fans are also presented.

Why BLDC Fans?

Today the typical ceiling fan is based on AC motors which are more power consuming. Along with this the typical AC motor-based fans have the rpm control through the capacitor or resistor-based regulators and is not efficient as there is loss in the regulator itself to some extent. In addition, the RPM control is by controlling the voltage and the voltage fluctuations of the mains make it very challenging to have constant RPM based on the AC mains supply. Further, existing AC motor solution, results in power factor (PF) degradation



with no improvement for PF and there are other side effects like harmonics injection to the AC mains, etc.

The total amount of air flow or displacement is based on the blade size & rpm and does not change due to any other factor. The proposed solution is to keep the same air flow or displacement with less of energy usage along with improving the PF using the BLDC motor-based ceiling fans. Typical BLDC motor-based ceiling fan has much better efficiency and excellent constant RPM control as it operates out of fixed DC voltage. The proposed BLDC motor and the control electronics operates out of 24V DC through an SMPS (switched mode power supply) having input AC which can vary from 90V to 270V. Following graph shows the comparison between BLDC and conventional ceiling fans

The power consumption is less than half at full speed and is about 20% at low speed for the BLDC motor compared to the conventional motor-based ceiling fan, as can be seen from the graph above. The Power Supply (PS) used is at 85% efficiency and the electronics circuit consumes less than 0.5 Watt. Generally, 210-220 RPM conventional fans are used which consumes almost 50-Watt power. From graph, as can be seen that same RPM BLDC motor consumes almost half power.

Rated specifications of various sizes is given below for ready reference:

	Gorilla 900 mm	Gorilla 1050 mm	Gorilla 1200 mm	Gorilla 1400 mm	Gorilla Premium Earth brown	Gorilla Premium Sand Grey
Power Consumption (Watts)	28	32	28	35	28	28
Air Delivery (CMM)	175	210	220	270	220	220
RPM	450	430	350	270	350	350
Service Value	7.1	6.6	7.8	7.7	7.8	7.8
Power Factor	0.98	0.98	0.98	0.99	0.98	0.98
Blade Span (mm/inch)	900/36	1050/42	1200/48	1400/56	1200/48	1200/48

We recommend to,

- Replace existing fans with energy efficient fans in failure replacement or by phase manner
- Replace existing ceiling fans of 70 -80 Watts with 35 watts BLDC fan.

4.3 Saving Calculation of ECM#1 Replace Existing Ceiling Fans with Low Wattage Ceiling Fans on Failure Replacement Basis

Table 7: Energy and Cost Saving Calculation for ECM#1

Particulars	Parameters	Future Scenario
Type of Recommendations	-	Install new technology BLDC ceiling fan
Present Ceiling fan	Nos	749
Present Ceiling fan Power	Watts	80
Annual Operational Days	Days/Annum	210
Daily Operational Hours	Hours/Day	7
Plant's Present ceiling fan energy Consumption	kWh/Annum	88082.4
Proposed New Ceiling Fan Power	Watts	28
Proposed Ceiling fan Energy Consumption	kWh/Annum	30828.84
Annual Energy Saving Potential	kWh/Annum	57253.56
Unit cost	Rs/Unit	3.46
Savings in Energy Bill Per Annum	Rs. Lakh/Annum	1.98
Investment	Lakhs Rupees	18.725

CHAPTER:5 STUDY OF LIGHTING SYSTEMS

5.1 INSTALLED LIGHTING STUDY & PERFORMANCE ANALYSIS

The College has already taken an energy efficient step to replace the FL tube lights with the LED tub light. College have around 774 no. of LED light of 36 watts or 263 FL lights of 36 watts. These FL Lights also be replaced with the LED light to reduce energy consumption. Following are the details of building wise this.

Table 8 Existing Installed Lighting System Details

Sr No	Room No	Particular	Tube Light		
			LED (36W)	FL(36W)	BULB (24W)
1	1	Principal Room	3	0	0
2	2	Steno Room	1	0	0
3	3	Committee Room	6	0	0
4	3-A	First Aid Room	0	0	0
5	4	Administrative Office	36	0	0
6	5	Electric Substation	0	0	0
7	6	Smart Lecture Room-1	13	0	0
8	7	Staff Room	2	0	0
9	8	Smart Class Room	0	4	0
10	9	Class Room	0	4	0
11	10	E- Pathshala	0	4	0
12	11	Smart Class Room	2	0	0
13	12	Food Science Lab/Nutritional assessment Lab	2	0	0

Sr No	Room No	Particular	Tube Light		
			LED (36W)	FL(36W)	BULB (24W)
14	13	Cafeteria/ Institutional food administration lab	6	0	0
15	14	Microbiology Lab	18	0	0
16	15	Seminar Room	1	0	1
17	16	Store	0	0	1
18	17	Basement Hall No - 1	0	2	0
19	18	Basement Hall No-2	0	3	0
20	19	Basement Hall No-3	2	0	0
21	20	Store	0	2	0
22	21	Store	0	0	1
23	22	M.Sc Food Lab	18	0	0
24	23	Store	0	0	1
25	24	B.Sc. Food Lab	18	0	0
26	25	Lab Staff Room	3	0	0
27	26	Teaching Staff Room	3	0	0
28	27	Bio Chemistry lab	9	9	0
29	28	Diet Clinic/Staff room	2	0	0
30	29	Computer Lab	18	0	0
31	30	IQAC Room	0	6	0
32	31	Visitors Room	1	0	0
33	32	Library- Main Hall	0	49	0

Sr No	Room No	Particular	Tube Light		
			LED (36W)	FL(36W)	BULB (24W)
34	32-A	Newspaper, Periodical & Magazine Section Library	8	0	0
35	32-B	Reference Section	8	0	0
36	33	Conference Hall	15	0	0
37	34	NCC Cell	0	2	0
38	35	Smart Lecture Room-II	13	0	0
39	36	CAD Lab	2	2	0
40	37	Dyeing Lab	2	0	0
41	37-A	Printing Lab	0	10	0
42	38	Pattern Making Lab	0	8	0
43	39	Textile Testing Lab	0	2	0
44	39-A	Staff Room	3	0	0
45	40	Heritage Resource Centre	2	0	0
46	40-A	Weaving & Knitting Lab	2	0	0
47	41	PG Garment Construction Lab - I	0	8	0
48	42	PG Garment Construction Lab - II	0	8	0
49	43	Department Library	2	0	0
50	44	Seminar Hall	6	0	0
51	45	Staff Room	0	2	0
52	46	UG Garment Construction lab-I	0	17	0

Sr No	Room No	Particular	Tube Light		
			LED (36W)	FL(36W)	BULB (24W)
53	47	Store Room	0	2	0
54	48	Smart Class Room	0	4	0
55	49	Physics Lab	18	0	0
56	50	Nodal officer	0	2	0
57	51	Control Room	2	0	0
58	52	Chemistry Lab.	0	17	0
59	53	Staff Room	0	2	0
60	54	Home Management & Furnishing Lab House	9	0	0
61	54-A	Auto CAD Lab	3	0	0
62	54-B	Ergonomics Lab	6	0	0
63	54-C	FRM Staff Room	3	0	0
64	55	Family Resource Lab	19	0	0
65	55-A	Equipment Lab	3	0	0
66	55-B	Design Studio	4	0	0
67	56	Smart Lecture Theatre	8	0	0
68	57	NSS Room	2	0	0
69	58	Smart Class Room	0	6	0
70	59 -I	Smart Classroom	0	5	0
71	59-II	Smart Class/ HD Lab-III	0	8	0
72	60	Counselling Cell	0	10	0

Sr No	Room No	Particular	Tube Light		
			LED (36W)	FL(36W)	BULB (24W)
73	61	Staff Room	0	1	0
74	62	Smart Class	0	4	0
75	63 -A	HD Lab-I	0	6	0
76	63-B	HD Lab-II	0	6	0
77	64	HD Department HOD Office	2	0	0
78	65	HD Lab Staff Room	2	0	0
79	66	Botany Lab	16	0	0
80	67	Staff Room	2	0	0
81	68	HOD Botany Office	2	0	0
82	69	Zoology Lab	0	23	0
83	70	Staff Room	3	0	0
84	71	HOD Zoology office	2	0	0
85	72	Faculty Room	2	0	0
86	73	Art Lab	17	0	0
87	74	Staff Room	2	0	0
88	75	Art Lab Store	2	0	0
89	-	Multimedia Research Block	24	0	30
90	-	Academic Hall Lobby Ground Floor	13	3	0
91	-	Academic Hall Lobby First Floor	12	3	0
92	-	Academic Hall Lobby Second Floor	12	6	0

Sr No	Room No	Particular	Tube Light		
			LED (36W)	FL(36W)	BULB (24W)
93	-	BSC Hostel Mess Hall (OLD Wing)	16	0	0
94	-	BSC Hostel Mess Cooking Area (Old Wing)	14	0	0
95	-	BSC Hostel Common Room (Old Wing)	12	0	0
96	-	BSC Hostel Room & Others (Old Wing)	110	0	0
97	-	BSC Hostel Room & Others (New Wing)	110	0	0
98	-	M.Sc. Hostel Ground Floor	20	0	0
99	-	M.Sc. Hostel Rooms & Others	86	0	0
100	-	Auditorium	0	70	0
101	-	Leisure Lounge	8	0	0
102	-	Chatanya Nursery lab.	19	15	0
103	-	Indoor Badminton Hall	7	0	0
104	-	Music Room	0	0	1
105	-	Physical Education Room	3	0	0
106	-	Canteen	14	0	0
107	-	Administrative Office	36	0	0
108	-	Basement	12	0	0

Table 9: Total nos of different lighting fixtures are tabulated below

Type of Lamp	Wattage	Quantity
Tube light (CFL)	36 Watt	263
Tube Light (LED)	36 Watt	774
LED Bulb	24 Watt	30

5.2 ECM#2 Replace Existing old Conventional Lamps with LED Low wattage Lamps on Failure Replacement Basis

New technology LED lighting

An LED lamp is a light-emitting diode (LED) product that is assembled into a lamp (or light bulb) for use in lighting fixtures. LED lamps have a lifespan and electrical efficiency that is several times better than incandescent lamps, and significantly better than most fluorescent lamps, with some chips able to emit more than 100 lumens per watt. General-purpose lighting needs white light. LEDs emit light in a very narrow band of wavelengths, emitting light of a colour characteristic of the energy band-gap of the semiconductor material used to make the LED.

The comparison of power consumption for conventional fluorescent lamp and the energy efficient LED lamp is given below:

Advantages of Energy Efficient LED Lamps

- High efficacy (Lumens / Watt)
- Environmentally friendly
- Reduces work related headaches
- Reduces sick building syndrome
- Operates at low voltage

We recommend to

- Replace existing fluorescent lights with new energy efficient lights to reduce energy consumption. The details of proposed lighting fixture as mentioned in Table No-9.
- It was observed that campus do not have flood lights for surveillance during night hours. Thus, it is recommended to install flood lights at proper places in the campus for safety and security of Institute campus assets.

5.3 SAVING CALCULATION ECM#2 REPLACE EXISTING OLD CONVENTIONAL LAMPS WITH LED

Table 10: Energy and Cost Saving Calculation for ECM#2

Particulars	Parameters	Future Scenario
Type of Recommendations	Install new technology LED Lights	
Present FL Tube light	Nos	**263**
Present FL Tube light Power	Watts	43
Annual Operational Days	Days/Annum	245
Daily Operational Hours	Hours/Day	7
Plant's Present Light Energy Consumption	kWh/Annum	19394.9
Proposed New LED Tube light Power	Watts	18
Proposed LED Tube light Energy Consumption	kWh/Annum	8118.81
Annual Energy Saving Potential	kWh/Annum	11276.1
Unit cost	Rs/Unit	3.46
Savings in Energy Bill Per Annum	Rs. Lakh/Annum	0.39
Investment	Lakhs Rupees	0.58

CHAPTER:6 STUDY OF AIR CONDITIONING SYSTEMS

6.1 AIR CONDITIONING STUDY & PERFORMANCE ANALYSIS

The College have Splits ACs of 1.5 TR to 2 TR are installed in the building. During the audit measurement were not made to evaluate the performance of ACs due to winter season. Thus, Details of the ACs in building are collected and based on star rating by BEE of Existing Air conditioners we suggest to change the existing ACs with new 5 Star ACs:

Table 11: Air Conditioning installed at Institute

Sr No	Room No	Particular	Nos of ACs Installed	Type	Make	TR Capacity	Cooling Capacity (W)	Star Rating
1	1	Principal Room	2	Split	Carrier	1.5	6245	3 Star
2	3	Committee Room	2	Split	Carrier	1.5	6245	3 Star
3	4	Admin Office	3	Split	Carrier	1.5	6245	3 Star
4	4	Administrative Office	3	Split	Carrier	1.5	6245	3 Star
5	10	E- Pathshala	2	Split	Carrier	1.5	6245	3 Star
6	13	Cafeteria/ Institutional food administration lab	1	Split	Carrier	1.5	6245	3 Star
7	29	Computer Lab	2	Split	Carrier	1.5	6245	3 Star
8	30	IQAC Room	1	Split	Carrier	1.5	6245	3 Star
9	31	Visitors Room	1	Split	Carrier	1.5	6245	3 Star
10	32	Library- Main Hall	8	Split	Hitachi	2	6800	3 Star
11	36	CAD Lab	1	Split	Hitachi	2	6800	3 Star
12	39	C.T. Staff Room	1	Split	Hitachi	2	6800	3 Star

Sr No	Room No	Particular	Nos of ACs Installed	Type	Make	TR Capacity	Cooling Capacity (W)	Star Rating
13	54	Home Management & Furnishing Lab House	1	Split	Carrier	1.5	6245	3 Star
14	57	FRM Staff Room	2	Split	Hitachi	2	6800	3 Star
15	59	Smart class/HDFR Lab-III	1	Split	Carrier	1.5	6245	3 Star
16	62	Smart Class	1	Split	Carrier	1.5	6245	3 Star
17	32-A	Newspaper, Periodical & Magazine Section Library	1	Split	Carrier	1.5	6245	3 Star
18	-	Multimedia Research Block	4	Split	Carrier	4.5	15825	3 Star
19	-	Circulation Area	2	Split	Carrier	1.5	6245	3 Star
20	-	BSC Hostel Common Room (Old)	1	Split	Carrier	1.5	6245	3 Star
21	-	Auditorium	17	Split	Carrier	1.5	6245	3 Star
		Total	**57**					

6.2 ECM#3 Replace Existing 3 Star ACs with Inverter Technology 5 Star ACs on Failure Replacement Basis

The lower the kW/TR value, lower will be the power consumption AC and hence lower will be impact on energy cost. So, if we can see in above table 5 STARs ACs, having lower SEC i.e., kW/ TR as compared to 3-star ACs of the same rating. Thus, obviously it is recommended to install 5-star AC preferably to reduce operational cost.

Now -a – Days new star rated inverter-based air conditioners are coming in market having lower values of kW/ TR. this means lower specific energy consumption for the same output. The rated Specific energy consumption of split Air conditioner is in the range of 0.90-1.0 kW/ TR. this is much lower than the specific energy consumption of installed air conditioner. In addition to this these air conditioners are coming with inverter-based technology.

What is inverter technology?

A regular air conditioner will always run at peak power requirement when the compressor is running. An air conditioner with inverter technology will run continuously but will draw only that much power that is required to keep the temperature stable at the level desired. So, it's kind of automatically adjusts its capacity based on the requirement of the room it is cooling. Thus, drawing much less power and consuming lesser units of electricity.

Thus, it is advisable to replace air conditioners which are old and having higher specific energy consumption. Since the operational hours of air conditioners are very less, it will be beneficial if facility team replace old air conditioner having higher running hours on priority basis.

We recommend to

- Replace old air conditioner having higher running hours on priority on failure replacement basis
- Procure new air conditioner based on energy efficiency ratings provided by Bureau of energy efficiency.
- Replace rest other non-energy efficient air conditioner based on failure basis.

6.3 SAVING CALCULATION OF ECM#3 FOR AIR CONDITIONING

Table 12: Energy and Cost Saving Calculation for ECM#3

Particulars	Parameters	Future Scenario
Type of Recommendations	-	5-Star Split AC
Present Split AC	Nos	57
Total Cooling LOAD	TR	103
Present Split AC Power	kW/TR	1.05
Present Power Consumption	kW	108.15
Annual Operational Days	Days/Annum	150
Daily Operational Hours	Hours/Day	7
Plant's Present AC energy Consumption	kWh/Annum	113557.5
Proposed 5-Star AC Power	kW/TR	0.75
Proposed Power Consumption	kW	77.25
Proposed 5-Star AC Energy Consumption	kWh/Annum	81112.5
Annual Energy Saving Potential	kWh/Annum	32445
Unit cost	Rs/Unit	3.46
Savings in Energy Bill Per Annum	Rs. Lakh/Annum	1.12
Investment	Lakhs Rupees	22.8

CHAPTER:7 STUDY OF WATER PUMPING SYSTEMS

7.1 WATER PUMPING SYSTEMS

Institute uses Municipal Corporation water from domestic water consumption. For the primary storage of water, it is first collected on underground tank. After that through pumping the water with the help of Boosting station is transferred to over-head tank at roof of different block present at college. Further distribution of water is tabulated below. For calculating the actual efficiency of pump, the measurement done for the flow pressure and power of the existing running pump.

7.2 ECM#4 REPLACE THE EXISTING RAW PUMPS WITH NEW ENERGY EFFICIENT PUMPS

As the pumps motor are rewind more thrice we recommend to change the existing pumps with new efficient pumps. Measured parameter during the audit is tabulated below

Measured Parameter							
Particulars	Flow (m3/hr)	Head (m)	Efficiency	Voltage in Volt	Current in Amps	P.F	Power in kW
Pump-1 M.Sc. Block	6	20	6.8%	411	12.26	0.560	4.8
Pump-2 Academic Block	12	22	5.78%	412	19.36	0.898	12.56

We recommended to change the pumps with below proposed pumps

Particulars	Flow (m3/hr)	Head (m)	Power in kW
Pump-1 M.Sc. Block	15	20	1.3 kW
Pump-2 Academic Block	15	20	1.3 kW

7.3 SAVING CALCULATION OF ECM#4 REPLACE OLD PUMPS WITH NEW ENERGY EFFICIENT PUMPS.

Particulars	UoM	Pump-1 M.Sc. Block	Pump-2 Academic Block
Motor rating of the existing Pump	kW	7.5	3.73
Actual power drawn		12.56	4.85
Total input power of both the pumps		12.56	4.85
Overall Design Efficiency of the existing pump motor set	%	0.61	0.61
Suggested Rating of the new Pump Motor set		25 mH; 4 lps; 1.5 kW	25 mH; 4 lps; 1.5 kW
Overall Design Efficiency of the new Pump Motor Set		0.718	0.718
Motor		0.925	0.925
Pump		0.776	0.776
Estimated reduction in the power drawn for the same work done	kW	1.42	1.42
Working Hour per annum	Hrs/annum		1800
Existing Energy Consumption	kWh/annum	31338	
Energy Saving	kWh/annum	5120	
Grid Power Rate	Rs per kWh		3.46
Monetary Benefit	Rs Lakhs per annum	0.185	
Estimated Investment for new energy efficient pump motor set with drive	Rs Lakhs		0.25

CHAPTER:8 LUX LEVEL STUDY

The lux level study of different areas or rooms were done during the audit in the College. Some area has good lux level but some has to improve.

Table 13: Lux Level Measured Values

Particular	Measured Lux Level				Average Lux Level	Recommended AS per IS 3646
Principal Room	264	241	380	376	315.25	250-300
Steno Room	291	276	262	298	281.75	250-300
Committee Room	192	182	270	261	226.25	250-300
First Aid Room	186	191	177	166	180	250-300
Administrative Office	242	281	231	188	235.5	250-300
Electric Substation	116	109	131	95	112.75	300-350
Smart Lecture Room-1	260	310	198	268	259	400-500
Staff Room	261	272	281	255	267.25	250-300
Smart Class Room	116	125	91	102	108.5	250-300
Class Room	120	91	99	115	106.25	250-300
E- Pathshala	138	166	152	148	151	250-300
Smart Class Room	255	270	281	299	276.25	250-300
Food Science Lab/Nutritional assessment Lab	719	616	849	900	771	400-500
Cafeteria/ Institutional food administration lab	198	216	248	186	212	400-500

Particular	Measured Lux Level				Average Lux Level	Recommended AS per IS 3646
Microbiology Lab	216	248	259	231	238.5	300-400
Seminar Room	900	1100	1058	1256	1078.5	400-500
Store	316	289	296	305	301.5	200-250
Basement Hall No - 1	105	98	116	109	107	300-400
Basement Hall No-2	316	289	296	305	301.5	300-400
Basement Hall No-3	216	208	246	253	230.75	300-400
Store	116	98	105	117	109	200-250
Store	152	148	168	159	156.75	200-250
M.Sc. Food Lab	98	105	116	89	102	300-400
Store	166	176	181	216	184.75	200-250
B.Sc. Food Lab	118	104	109	111	110.5	300-400
Lab Staff Room	181	176	162	156	168.75	250-300
Teaching Staff Room	170	186	177	162	173.75	250-300
Bio Chemistry lab	153	146	132	128	139.75	300-400
Diet Clinic/Staff room	350	366	372	398	371.5	250-300
Computer Lab	170	187	182	178	179.25	300-400
IQAC Room	358	399	402	386	386.25	250-300
Visitors Room	112	118	126	132	122	200-250
Library- Main Hall	670	708	750	799	731.75	300-400
Newspaper, Periodical &	688	716	820	777	750.25	200-300

Particular	Measured Lux Level				Average Lux Level	Recommended AS per IS 3646
Magazine Section Library						
Reference Section	66	72	48	56	60.5	250-300
Conference Hall	40	42	36	39	39.25	300-350
NCC Cell	289	276	254	249	267	250-300
Smart Lecture Room-II	287	266	258	247	264.5	250-300
CAD Lab	108	121	115	103	111.75	300-400
Dyeing Lab	104	105	127	99	108.75	300-400
Printing Lab	215	198	205	209	206.75	300-400
Pattern Making Lab	335	398	298	356	346.75	300-400
Textile Testing Lab	215	256	243	221	233.75	300-400
Staff Room	198	186	175	182	185.25	250-300
Heritage Resource Centre	150	200	158	220	182	250-300
Weaving & Knitting Lab	198	216	248	186	212	300-400
PG Garment Construction Lab - I	216	248	259	231	238.5	300-400
PG Garment Construction Lab - II	215	256	243	221	233.75	300-400
Department Library	198	186	175	182	185.25	300-400
Seminar Hall	150	200	158	220	182	300-400
Staff Room	186	191	177	166	180	250-300

Particular	Measured Lux Level				Average Lux Level	Recommended AS per IS 3646
UG Garment Construction lab-I	242	281	231	188	235.5	300-400
Store Room	116	109	131	95	112.75	200-250
Smart Class Room	202	198	260	302	240.5	250-300
Physics Lab	261	272	281	255	267.25	300-400
Nodal officer	155	200	310	298	240.75	250-300
Control Room	200	265	198	301	241	300-400
Chemistry Lab.	250	360	307	296	303.25	300-400
Staff Room	230	250	280	260	255	250-300
Home Management & Furnishing Lab House	312	280	306	213	277.75	300-400
Auto CAD Lab	216	356	288	296	289	300-400
Ergonomics Lab	186	191	177	166	180	300-400
FRM Staff Room	242	281	231	188	235.5	250-300
Family Resource Lab	289	320	268	366	310.75	300-400
Equipment Lab	186	191	177	166	180	300-400
Design Studio	242	281	231	188	235.5	300-400
Smart Lecture Theatre	264	241	380	376	315.25	250-300
	291	276	262	298	281.75	
NSS Room	172	206	198	222	199.5	250-300
Smart Class Room	212	196	160	178	186.5	250-300
Smart Classroom	222	196	170	163	187.75	250-300

Particular	Measured Lux Level				Average Lux Level	Recommended AS per IS 3646
Smart Class/ HD Lab-III	900	1100	1058	1256	1078.5	300-400
Counselling Cell	316	289	296	305	301.5	300-400
Staff Room	178	155	102	96	132.75	200-250
Smart Class					#DIV/0!	250-300
HD Lab-I	105	98	116	109	107	300
HD Lab-II	316	289	296	305	301.5	300-400
HD Department HOD Office	215	270	280	311	269	300-400
HD Lab Staff Room	261	272	281	255	267.25	300-400
Botany Lab	155	200	310	298	240.75	300-400
Staff Room	200	265	198	301	241	250-300
HOD Botany Office	250	296	307	246	274.75	250-300
Zoology Lab	263	196	263	265	246.75	300-400
Staff Room	213	216	302	186	229.25	200-250
HOD Zoology office	262	206	198	222	222	200-250
Faculty Room	200	196	160	178	183.5	200-250
Art Lab	200	265	198	301	241	300-400
Staff Room	250	296	307	246	274.75	250-300
Art Lab Store	186	191	177	166	180	200-250
Multimedia Research Block	242	281	231	188	235.5	300-350
Academic Hall Lobby Ground Floor	116	109	131	95	112.75	150-200

Particular	Measured Lux Level				Average Lux Level	Recommended AS per IS 3646
Academic Hall Lobby First Floor	202	198	260	302	240.5	150-200
Academic Hall Lobby Second Floor	261	272	281	255	267.25	150-200

Lux Level in some areas of the library was found very low, it recommended to increase lux level by installed suitable LED light system for the area.

Table 14: Library Lux Level

Particular	Measured Lux Level				Average Lux Level	Standard Values
Library First Floor						
Rack No-1	136	142	126	139	136	200-500 (average 300)
Rack No-2	24	16	34	29	26	200-500 (average 300)
Rack No-3	115	102	96	89	101	200-500 (average 300)
Rack No-4	106	98	109	92	101	200-500 (average 300)
Library Ground Floor						
Rack No-1	19	9	15	12	14	200-500 (average 300)
Rack No-2	26	32	21	29	27	200-500 (average 300)
Rack No-3	56	66	52	74	62	200-500 (average 300)
Rack No-4	123	105	115	109	113	200-500 (average 300)

Particular	Measured Lux Level				Average Lux Level	Standard Values
Rack No-5	169	184	198	162	178	200-500 (average 300)
Rack No-6	146	159	168	143	154	200-500 (average 300)
Rack No-7	68	56	10	3	34	200-500 (average 300)
Rack No-8	109	115	105	121	113	200-500 (average 300)
Library Second Floor						
Rack No-1	22	18	36	29	26	200-500 (average 300)
Rack No-2	86	98	102	110	99	200-500 (average 300)
Rack No-3	115	102	96	89	101	200-500 (average 300)
Rack No-4	56	66	52	74	62	200-500 (average 300)
Rack No-5	166	176	158	149	162	200-500 (average 300)
Rack No-6	78	69	86	72	76	200-500 (average 300)
Rack No-7	18	15	29	23	21	200-500 (average 300)
Rack No-8	113	109	118	120	115	200-500 (average 300)

8.1 WATER COOLERS

Table 15: Water Coolers

Sr No	Location	Quantity	Wattage
1	Ground Floor Academic Block	1	1550
2	1st Floor	1	1550
3	2nd Floor	1	1550
	Total		**4.65 kW**

8.2 WATER DISPENSERS

Table 16:Water Dispenser

Sr No	Location	Quantity	Wattage
1	HD Lab	1	500
2	C.T. Lab	1	500
3	FRM Staff Room	1	500
4	Admin Office	1	500
5	Computer Lab	1	500
	Total		**2.5 kW**

CHAPTER:9 SUMMARY

9.1 CUMULATIVE ENERGY SAVING OPPORTUNITIES

Particulars	Annual Savings				Estimated Investment
	kWh	ToE	CO2	Rs in Lakh	(Rs in Lakh)
Replace Existing Ceiling Fans with low wattage Ceiling Fans on Failure Replacement Basis	57253	4.92	46.9	1.98	18.75
Replace Existing old Conventional Lamps with LED Low wattage Lamps on Failure Replacement Basis	11276	0.97	9.2	0.39	0.58
Replace Existing 3 Star ACs with Inverter Technology 5 Star ACs on Failure Replacement Basis	32445	2.79	26.6	1.12	22.8
Replace the Existing Raw Pumps with new Energy Efficient Pumps	5120	0.44	4.2	0.18	0.25
Total	**106094**	**9.12**	**86.9**	**3.67**	**42.38**

Except Pumps replacement project all other projects are to be implemented on phase manner and on failure replacement basis. Otherwise, payback period will be high

CHAPTER:10 ANNEXURE

10.1 ANNEXURE-1: AGENCY CERTIFICATE

Otabu

Certificate of Registration

INNOVATIVE ENERGY CONSERVATION SOLUTIONS

#205, ECO TOWER, SHIVALIK ENCLAVE, SECTOR 125, GREATER MOHALI, SAS NAGAR, PUNJAB, 140301, INDIA

has been assessed and Certified by Otabu Certification Pvt. Ltd.
as meeting the requirements of:

ISO 9001:2015

Quality Management System

For the following scope of activities:

DETAILED ENERGY AUDIT, DETAILED GREEN AUDIT, DETAILED ENVIRONMENTAL AUDIT, DETAILED WATER AUDIT, HVAC SYSTEM AUDIT, THERMAL SYSTEM AUDIT, THERMOGRAPHY AUDIT, ELECTRICAL SYSTEM AUDIT, COMMERCIAL AND ADMINISTRATIVE BUILDING AUDIT, COMPRESSED AIR AUDIT, COMPRESSED AIR LEAKAGE TESTING, POWER QUALITY & HARMONICS AUDIT, PUMPING SYSTEM AUDIT, ELECTRICAL SAFETY AND EARTHING SYSTEM AUDIT, ELECTRICAL PLANT DESIGNING & CONSULTANCY, RENEWABLE ENERGY ADVISORY, SUSTAINBILITY ASSESSMENT REPORT, VIBRATION MONITORING AUDIT, NOISE LEVEL TEST AUDIT, ENERGY CONSERVATION TRAINING PROGRAM

Issue No : 01
Date of Certification: 05 December 2022
1st Surveillance Due: 04 December 2023

Revision No ( ) : NA
2nd Surveillance Due: 04 December 2024
Certificate Expiry: 04 December 2025
(subject to the company maintaining its system to the required standard)

Certificate No:- 1205Q169822

To Verify this Certificate please visit at www.otabucert.com

MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT IAF

EGAC 115001A

OTABU CERTIFICATION PRIVATE LIMITED Otabu

Dr. Anita Gupta
(Managing Director)

*Validity of the certificate is subject to successful completion of surveillance audit on or before due date (in case surveillance audit is not allowed to be conducted, this certificate shall be suspended/withdrawal). *This Certificate of Registration remains the Property of Otabu Certification Pvt. Ltd. and shall be returned immediately upon request.

Otabu Certification Pvt. Ltd., RZ-9 (Ground Floor), Prem Nagar, Uttam Nagar, New Delhi-110059 (India)

Email:- info@otabucert.com website:-www.otabucert.com

10.2 ANNEXURE-2: AUDIT CERTIFICATE

INNOVATIVE ENERGY CONSERVATION SOLUTIONS

An ISO 9001:2015 Certified Organisation,
Certificate No:- 1205Q169822

A: 205, Eco Towers, Shivalik Enclave Sector 125, Greater Mohali-140301
E: Pankaj@iecsolutions.in
T: +91-9685613238

DATE
February 24, 2023

No: CERT/2023/09

PLACE OF WORK: CHANDIGARH

Energy, Environment & Green Audit Certificate

Is Issued To

GOVERNMENT HOME SCIENCE COLLEGE SECTOR 10, CHANDIGARH

for successful completion of Energy, Environment & Green Audit of the College for the Period FY 2022-23, conducted by **M/s Innovative Energy Conservation Solutions.** This Energy, Environment & Green Audit included Sectoral Audits in the reports i.e., Water, Energy, Waste cum Material, Air Quality & Noise, Bio-diversity, outdoor environment, Health & well-being, Activities and Institutional management aspect cover.

The College is certified to have done exceptionally well to conserve energy, environment and ensuring sustainable development for the assessment period.

Duration of Audit: Feb-2022 to Jan-2023

Date of Issue: 24/02/2023

PANKAJ DHOTE
Digitally signed by PANKAJ DHOTE
Date: 2023.02.24 17:27:16 +05'30'

Innovative Energy Conservation Solutions

Innovative Energy Conservation Solutions Proprietor

Innovative Energy Conservation Solutions

An ISO 9001:2015 Certified Organisation,
Certificate No:- 1205Q169822

Thank You

www.iecsolutions.in
Pankaj Dhote

10.3 ANNEXURE-3: ENERGY EFFICIENT EQUIPMENT SUPPLIERS

Product/ Equipment	Name	Website
Capacitors and APFC Panels	Standard Capacitors	www.standardcapacitors.com
Capacitors and APFC Panels	Ashish Consultant	www.ashishconsultant.com
Capacitors/ Switch Gears/ Reactors etc.	Shreem Electric Ltd	www.shreemelectric.com
Lighting Systems	Asian Electronics Ltd.	www.aelgroup.com
Lighting Systems	Philips India Ltd	www.india.philips.com
Lighting Systems	OSRAM India Ltd.	www.osram.in
Lighting Systems	Wipro Lighting	www.wiprolighting.com
Solar Products	Synergy Solar (P) ltd	www.synergysolar.net
Solar Products	Inter Solar Systems (P) Limited	www.intersolarsystems.com
Energy Efficient Pumps	Danfoss Industries Pvt. Ltd.	www.danfoss.com
Energy Efficient Pumps	Mather & Platt Pumps Ltd.	www.matherplatt.com
Energy Efficient Pumps	Xylem Water Solutions India Pvt. Ltd. (Distributor of Lowara, Italy)	www.lowara.com

Note: - The suppliers mentioned above are not the only ones or the best in the market. The management may contact other suppliers for competitive rates/ specifications.

10.4 ANNEXURE-4: RECOMMENDED LUX LEVELS

- **Entrance**

Entrance halls, lobbies, waiting rooms	=	200
Enquiry Desks	=	500
Gate Houses	=	200

- **Circulation Areas**

Lifts	=	100
Corridors, passageways, stairs	=	100
Escalators, revelators	=	150

- **Staff Rooms**

Offices	=	300
Changing, locker and cleaners' room, Cloak rooms, lavatories	=	100
Rest Rooms	=	150

- **Staff Restaurants**

Canteens, Cafeterias, dining rooms, mess rooms	=	200

- **Communication**

Switch board rooms	=	300
Telephone, apparatus rooms	=	150
Telex room, post rooms	=	500
Reprographic room	=	300

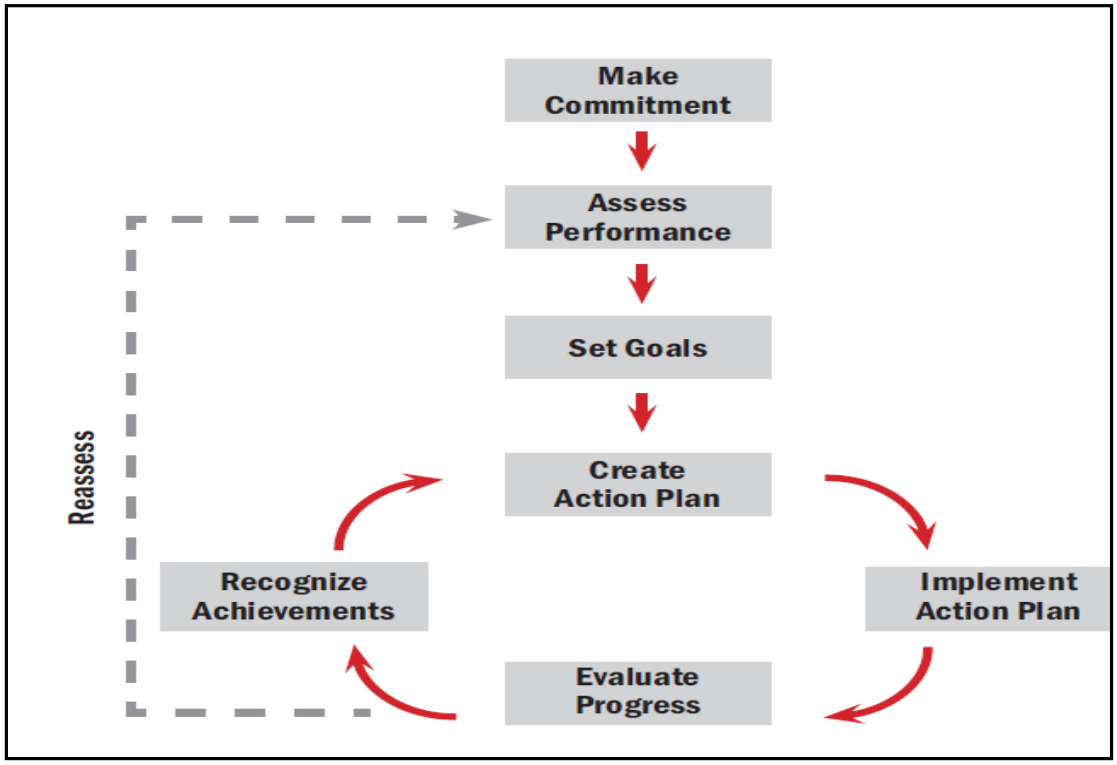
- **Education**

Assembly Halls	=	200-500 (average 300)
Teaching Places	=	200-500 (average 300)
Lecture Theatres	=	200-500 (average 300)
Seminar Rooms	=	300-750 (average 500)
Art Rooms	=	300-750 (average 500)
Needle Work Rooms	=	300-750 (average 500)
Laboratories	=	300-750 (average 500)
Libraries	=	200-500 (average 300)
Music Rooms	=	200-500 (average 300)
Sports Halls	=	200-500 (average 300)
Workshops	=	200-500 (average 300)

10.5 ANNEXURE-5: ENERGY MONITORING AND ACCOUNTING

Present Energy Monitoring & Accounting System: There is a proper metering system for the purchased power. However, the data related to the power generated using DG sets is not being monitored on a monthly basis. There are no prescribed formats available to maintain such records. As a result of this, there is no periodic performance analysis of the energy consumption in the building.

Recommended Energy Monitoring & Accounting System



Energy Management should be seen as a continuous process. Strategies should be reviewed annually and revised as necessary. The key activities suggested have been outlined below:

- Clear **accountability for energy consumption** needs to be established, appropriate financial and staffing resources must be allocated and reporting procedures initiated. An energy management programme requires commitment from the whole organization in order to be successful.
- A **record of Energy consumption** both Electrical and Thermal must be kept and monitored on a regular basis. For this, sub meter on the DG set is required. This will enable an overview of energy use and its related costs, as well as facilitating the identification of savings that might otherwise not be detected. The system needs to record both historical and ongoing energy use, as well as cost information

from billing data, and capable of producing summary reports on a regular basis. This information will provide the means by which trends can be analyzed and reviewed for corrective measures.

- Some facts and figures related with energy may be displayed on boards or **posters in the premises**, to create awareness among the workmen and staff. A key ingredient to the success of an energy management program is maintaining a high level of awareness among staff. This can be achieved in a number of ways, including formal training, newsletters, posters and publications. It is important to communicate program plans and case studies that demonstrate savings, and to report results at least at 12-month intervals. As an incentive, new ideas and implementation of energy saving point must be recognized and awarded.
- The findings and **implementation status of Energy audits** should be reviewed periodically/annually for further action plan.

Figure 1: ***Format for Maintaining a Monthly Record of the Purchased Power Consumption***

Particulars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Actual Demand (KVA)												
KWH Consumption												
KVAh Consumption												
Operating Power factor												
Fixed Demand Charges (Rs)												
Energy Charges (Rs)												
Penalty / Rebate, if any (Rs)												
Other Charges (Rs)												
Total Amount Payable (Rs)												

10.6 ANNEXURE-6: CHECKLIST FOR PREVENTIVE MAINTENANCE

➲ **Building Envelope**

Windows and Skylights

- Replace broken or cracked window panes
- Replace worn weather stripping and caulking
- Replace defective sealing gaskets and cam latches

Doors

- Replace worn weather stripping and caulking

Exterior Surfaces

- Replace worn weather stripping, caulking, and gaskets at exterior joints and at openings for electrical conduits, piping through-the-wall units, and outside air louvers

Stairwells and Shafts

- Replace worn seals and weather stripping in stairwells on penthouse machine-room doors, in elevator shafts in vertical service shafts and on basement and roof equipment room doors when they are connected by a vertical shaft that serves the building

➲ **Self-Contained Units (Such as Window and Through-The-Wall Units and Heat Pump**

- Clean evaporator and condenser coils
- Clean air intake louvers, filters, and controls
- Keep airflow from units unrestricted
- Replace worn caulking in openings between the units and windows or wall furnace
- Check the voltage to ensure that the unit is operating at full power
- Follow applicable maintenance guidelines for compressors, condensers and fans.

➲ **Motors, Fans, Pumps, Engines and Turbines**

Motors

- Check the alignment of the motor to the equipment it drives. Align and tighten as necessary
- Check for and repair loose connections and bad contacts regularly
- Determine the cause of excessive vibration and repair as necessary
- Clean motors regularly

- Lubricate the motor and drive bearings regularly
- Tighten belts and pulleys
- Check for overheating. If overheating is present, check for functional problems or inadequate ventilation and repair as necessary
- Balance three-phase power sources to motors
- Check for over voltage or low-voltage conditions and correct as necessary

Fans

- Check for excessive noise and vibration and correct as necessary
- Clean fan blades & Inspect and lubricate bearings regularly
- Inspect drive belts for proper tension. Adjust or replace as necessary to ensure proper operation
- Keep inlet and discharge screens on fans free of dirt and debris

Pumps

- Check for packing wear and repack as necessary. Replace glandular packing with mechanical seals
- Inspect bearings and drive belts for wear and binding. Adjust, repair, or replace as necessary

Lighting

- Wipe lamps clean at regular intervals. Lamps that are exposed to substantial amounts of dirt, dust, grease, or other contaminants should be cleaned more frequently than lamps in a relatively clean atmosphere
- Maintain luminary efficiency by properly cleaning the reflecting surfaces and shielding media
- Replace lens shielding that has yellowed or become hazy with a clear acrylic lens with good non-yellowing properties. A clear glass lens can be considered if it is compatible with the luminary and does not present a safety hazard
- Clean ceilings, walls, and floors frequently to improve reflective qualities
- If day lighting contributes to lighting, wash windows frequently to maintain illumination levels
- Replace all lamps used for area illumination after they have been in service for a substantial portion (approximately 70 percent) of their rated life, instead of simply replacing lamps one at a time as they burn out.