YEAR 2024

ENERGY AUDIT REPORT

Arya Kanya Degree College, Prayagraj (U.P.)

December 2024

Prepared By:

Greenserve Energy Management Solutions

Vijay Nagar,

Durg (C.G.) - 491001

Energy Audit Report of Arya Kanya Degree College, Prayagraj (U.P.)

College Address:

Arya Kanya Degree College

Address: 886, Mutthiganj, Prayagraj, Uttar Pradesh, India

For More Information:

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Acknowledgement

We are thankful to the Management and the Administration of the Arya Kanya Degree College, Prayagraj for entrusting processes of Energy auditing with us. We thank all the participants of the auditing team especially students, IQAC coordinators, IQAC members, faculty and non-teaching staff who took pain along with us to gather data through survey. We also thank the office staff who helped us during the document verification.

Audit Team Members

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2	Jayendra Mohabe	Senior Energy Engineer
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Table of Contents

List of Figures

List of Tables

List of Abbreviations

Word	Meaning
ECM	Energy Conservation Measure
EE	Energy Efficiency
kVA	Kilo Volt Ampere
kVAh	Kilo Volt Ampere hour
kVAr	Kilo Volt Ampere reactive
kW	Kilo Watt
kWh	Kilo Watt hour
PF	Power Factor
RH	Relative Humidity
THD	Total Harmonic Distortion
TR	Tons of Refrigerant
INR	Indian Rupees
kV	Kilo Volt
V	Volt
A	Ampere
EB	Electricity Board
m/s	Meter per seconds
m2	Meter Square
CFL	Compact Fluorescent Lamp
FTL (T-12 & T-8)	Fluorescent Tube Light
LED	Light Emitting Diodes
FY	Financial Year
HP	Horse Power

Section 1: Executive Summary

1. Executive Summary

Sno	Energy saving measures	Investment (Lakh Rs.)	Energy Saving Electricity (kWh/Year)	Annual Energy Cost savings (Lakh Rs.)	Payback Period (Months)
1	Replacement of Existing Ceiling Fan to Energy Efficient BLDC Fan in College Building in a phase manner.	3.90	16380	1.146	41
	Total	**3.90**	**16380**	**1.146**	**41**

The Annual electrical energy savings (in kWh) are calculated and mentioned in the below table:

Total annual Energy savings, kWh	**16380**
Total Investment, Rs Lakh	**3.90**
Total Monetary savings, Rs Lakh	**1.146**
Simple Payback Period, Months	**41**

Section 2: Introduction

2. Introduction

2.1 About Arya Kanya Degree College, Prayagraj

Arya Kanya Degree College, is a prestigious College for women. The College was founded in 1975, the international year of women and is based on the noble principles of Swami Dayanand Saraswati, founder of Arya Samaj. It is a Constituent College of the University of Allahabad which achieved the status of Central University on 14 July, 2005. The College is located in Muthiganj, a thickly populated area of the city.

The goals and objectives of the College are focussed towards proper education of women. Our endeavour has been to promote independent thinking among young girls so that they may not only make responsible citizens that contribute to the growth of the national economy but play the role of an anchor in their own families.

The College takes pride in having rendered educational services to women in some of the most thickly populated areas of the city in which some of the poorest people reside and has produced the first female graduate from many a family. The college offers graduate degrees in Arts, Commerce and Postgraduate degree in subjects like English, Hindi, Sanskrit, Economics, Political Science, Philosophy, Education, Sociology, Ancient History, Medieval History, Music – Vocal, Instrumental, Fine Arts and Geography. B.A.LLB has also been started from the session 2024-25 and the syllabi is set by the University. Doctoral Programme is offered in Political science, Education, Hindi, English, Sociology and Music Vocal.

Teaching is done through class-room lectures and tutorials. Audio-visual aids, specially screening of films based on the syllabi and over-head projectors are deployed besides running of CD/DVD to ensure proper imparting of the intricacies of the subject. Students are also guided through written work and to ensure its proper utility periodical assessments and half yearly examinations are conducted to fathom their understanding. The annual examination is conducted by the University and the College acts as an examination centre.

The College has consistently been taking initiatives regularly to help its faculty develop itself. Our teachers have been attending seminars and symposiums throughout the year, attending workshops and making presentations at National and International level. To encourage interaction of faculty and students with distinguished experts we invite several academicians from different disciplines and their inputs are quite valuable.

VISION AND MISSION

Vision

To carry forward the vision of our founders of Arya Samaj providing affordable quality education to uplift society and to empower the socially and economically marginalized people and help the students to discover their hidden potentials.

Mission

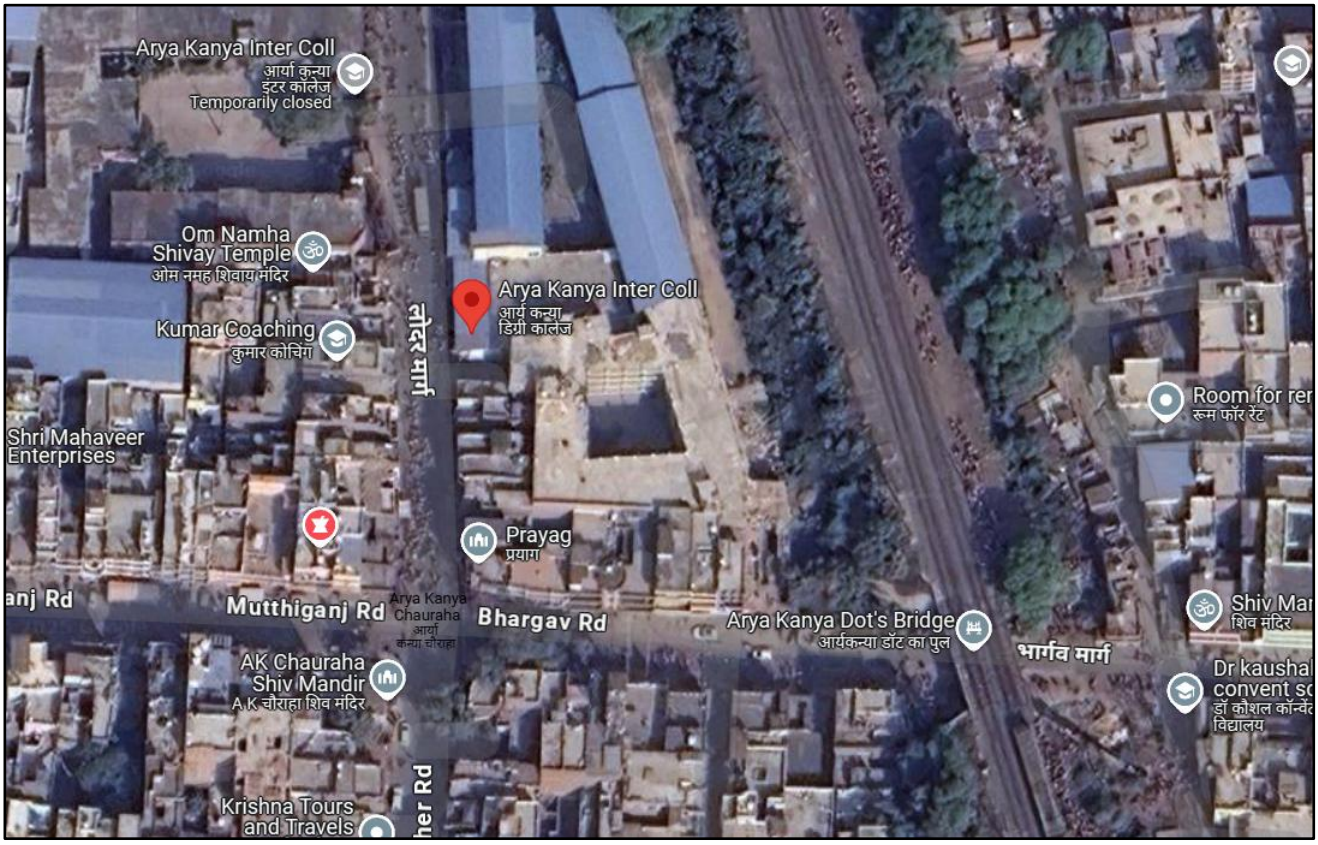
To create and maintain an environment of excellence in education and make the students independent, self-reliant and confident.

Objectives :

- To inculcate values and virtues of responsible citizens.
- To endeavor for removal of gender discrimination.
- To provide knowledge of human rights and duties.
- To inculcate environment consciousness and awareness.
- To educate about world peace and universal brotherhood.
- To make the students economically empowered and independent.
- To educate the students to serve the society.
- To teach the importance of health and hygiene.
- To encourage students to adopt modern technology.

Location:

Arya Kanya Degree College, Prayagraj 886, Mutthiganj, Prayagraj, U.P. and the GPS Coordinates of the College is 25°26'00.9"N 81°50'46.7"E.



Connected Load Breakup

The connected load breakup of loads installed in College are given as follows:

Sr.No.	Type of Fitting	Qty.	Total KW
1	Spot Light	185	6.7
2	Tube Light	154	2.8
3	Fans	156	10.9
3	AC	21	43.0
4	Computer(200W)	46	9.2
5	Other	11	5.0
	Total Load		**77.6**

Table 1: Connected Load Break up

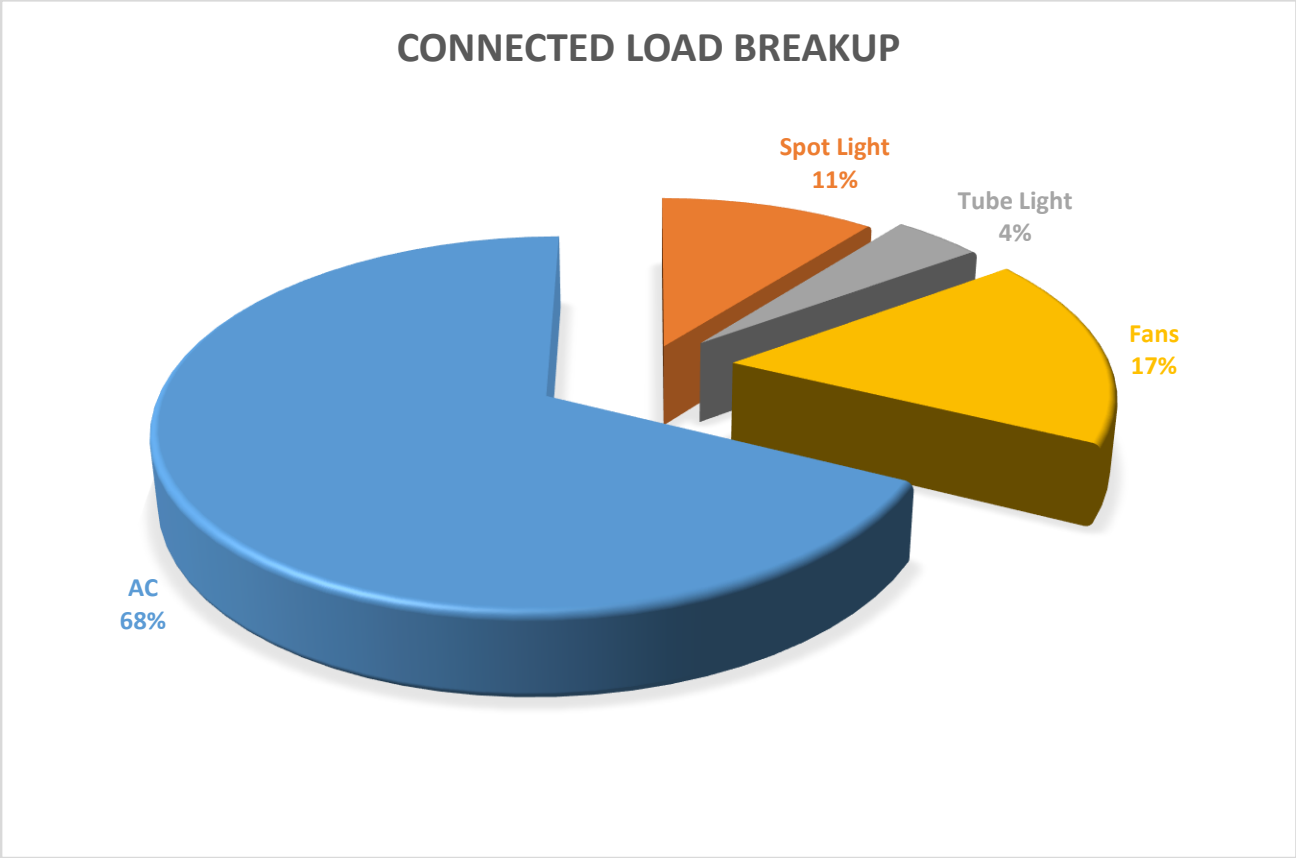


Figure 1: Connected Load Breakup

2.2 Methodology

The methodology adopted for energy audit study is given below:

- Kick off meeting
- Analysis of past performance data
- Measurements of required electrical parameters
- Conduct of efficiency and performance improvement trials (if required)
- Discussion of the findings and recommendations with Electrical Team.
- Detailed techno-economic analysis
- Report submission

2.3 Instruments used for study

The following Instruments were used during energy audit study:

S. No	Name of the Instrument	Make of the instrument	Details
1.	Portable power quality analyser	Hioki	Range: 5A-5000Amps Accuracy: Uncertainty in measurement is ±0.77% Voltage & ±0.7% (current), ±0.31% (watts)
2.	Thermal Imaging camera	Fluke TS10	*T*emperature Range: -10 to 350 °C (14 to 662 °F)
4.	RH meter	TESTO	Temperature range: 0°C to 50°C. with 100% RH
5.	Lux meter	Ten mars (NEDA 1604)	Range:0-2000, 0-20000 & 0-50000 Lux (3 Ranges)
6.	Digital Pressure Meter	Metravi	Range : 0 to 2.131 PSI
7.	Anemometer	Lutron (AM 4201)	Range of Velocity: 0-30 m/s
8.	Ultrasonic flow meter	ADOPT Fluid Dynamics, pune	Range: 0-2500 m^3/hr Resolution: 0.01m^3/hr

Table 2: Instruments used for the study

Climatic Condition

The average high temperature and low temperature profile of Prayagraj is given as follows:

Parameter	Temperature, °C			
	Minimum	Maximum	Average	Standard Deviation
January	5.8	23.8	13.9	± 4.3
February	11.4	32.1	20	± 4.4
March	17	36.6	26.1	± 4.8
April	22.4	39.5	30.9	± 4.4
May	24.5	43.4	33.8	± 3.9
June	27	42.3	34.2	± 3.4
July	25.3	36.7	29.9	± 2.6
August	25	34.3	28.6	± 1.9
September	24	34	28.4	± 2.4
October	18.8	34.5	26.7	± 3.9
November	13.6	31.8	21.7	± 4.2
December	6.2	24.1	15.8	± 4.2

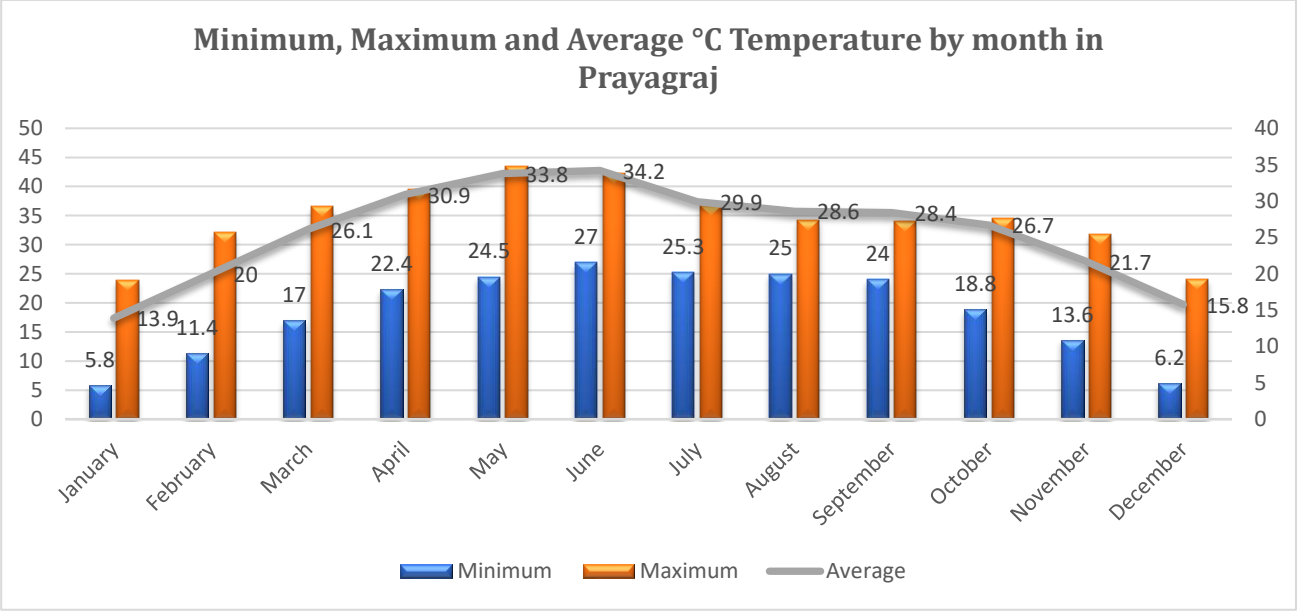


Figure 2: Climatic condition of Bilaspur

The average Temperature of Prayagraj is around 26°C although it vary from around 14°C during Winter (January) to 34°C during the Monsoon (June). The hottest month of the year is June with temperature varies from 27.0°C to 42.3°C. The coolest month is of the year is January, with temperature varies from 5.8°C to 23.8°C.

Section3: Performance Assessment

3. Performance Assessment

Electricity Board Bill Analysis

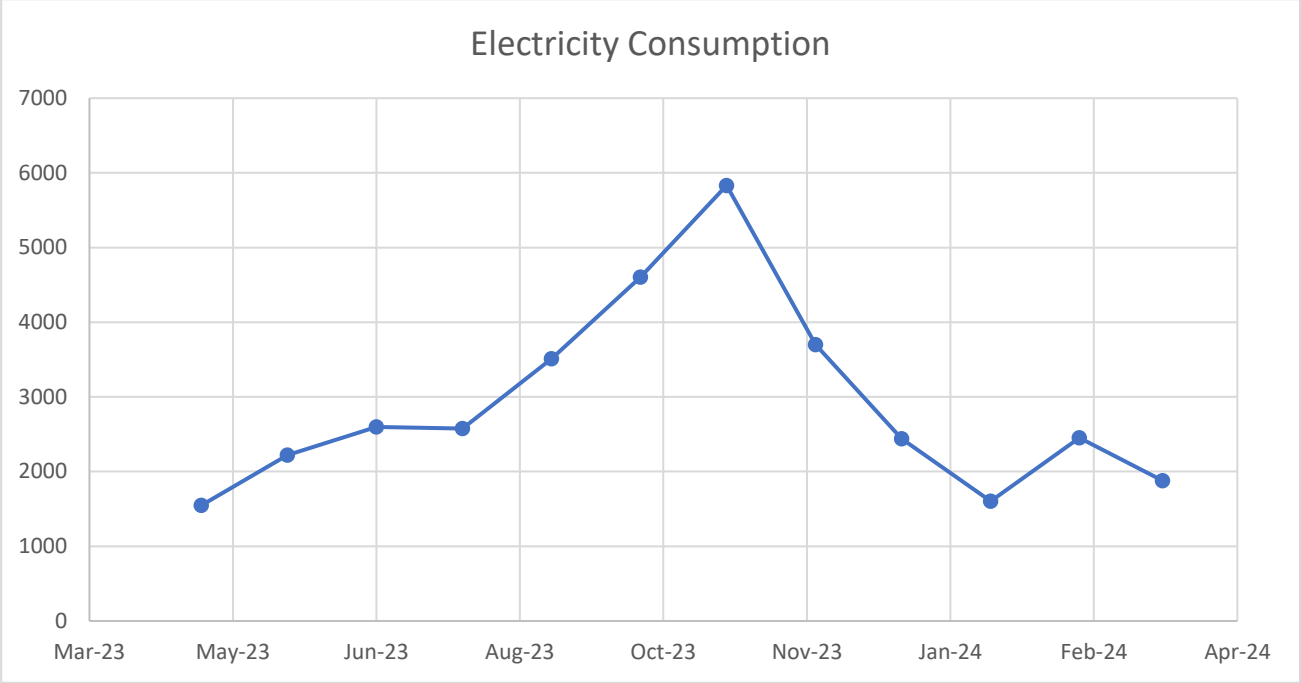
Account/Service No.	8643326000	
Consumer Name	Arya Kanya Degree College	
Sanctioned Load	28	KVA
Category	LMV-4	

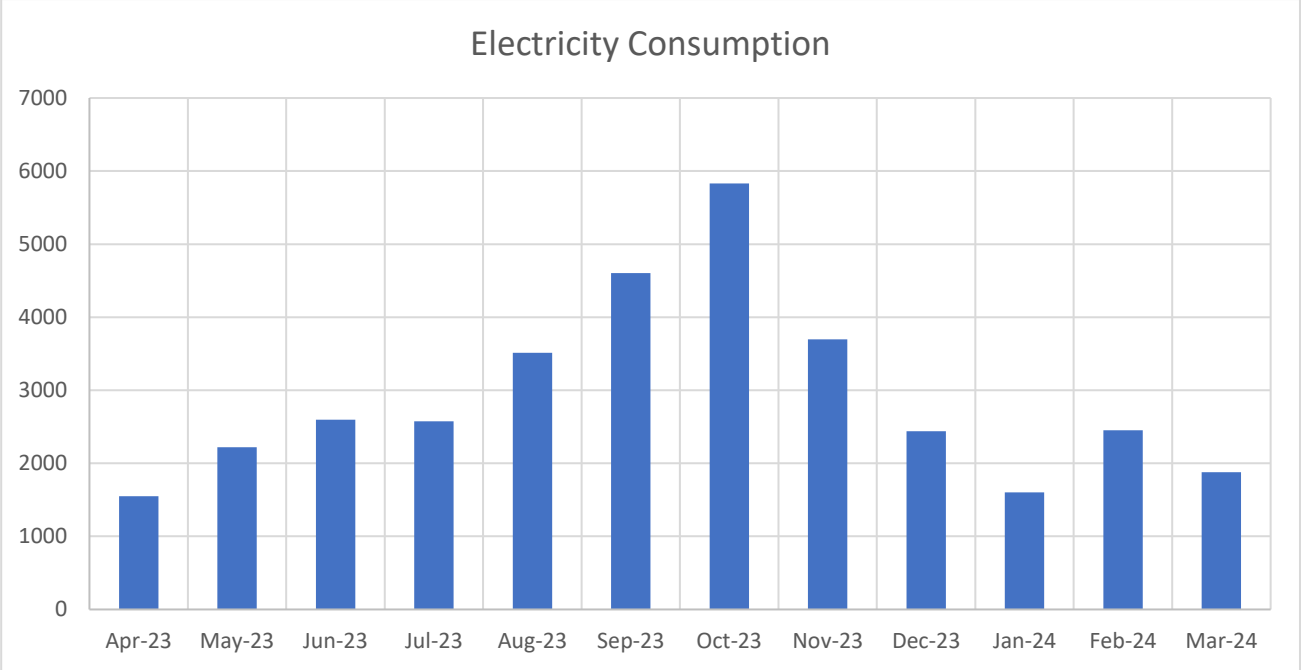
Electricity bill data of the Arya Kanya Degree College from April 2023 to March 2024 is analysed as per billing month and summarised as follows:

The tariff structure of the electricity, connection type, electricity consumption pattern for previous months were analysed. The electricity bills were collated and studied to understand the types of charges applied and rebate/ penalty imposed during operation of the unit. The analysis of electricity consumption profile for period April - 2023 to March 2024 is provided in below table

Sr. No.	Month	Total kVAH consumption
1	Apr-23	1548
2	May-23	2220
3	Jun-23	2596
4	Jul-23	2576
5	Aug-23	3512
6	Sep-23	4604
7	Oct-23	5832
8	Nov-23	3698
9	Dec-23	2439
10	Jan-24	1603
11	Feb-24	2451
12	Mar-24	1877.7
Total		**34956.7**

Month wise energy consumption (kWh) and associated bills paid pattern from April- 2023 to March 2024 of the university is shown below:





3.2 Building wise Energy Consumptions

Room/Area	Fittings	Quantity	Wattage per Unit (W)	Total Wattage (W)
Principal Room	Spot Light	9	7	63
	Tube Light	1	18	18
	Fan	3	50	150
	AC	1	1500	1500
	LED Bulb	1	9	9
	Exhaust Fan	1	7	7
Office (Ground Floor)	Exhaust Fan	1	7	7
	Tube Light	10	18	180
	Fan	2	50	100
	AC	1	1500	1500
	LED Bulb	1	9	9
Vice-Principal Room	Tube Light	2	18	36
	Fan	1	50	50
	AC	1	1500	1500
Corridor	Fan	2	50	100
	Tube Light	1	18	18
Washroom	Bulb	1	9	9
Conference Room	Fan	3	50	150
	AC	2	1500	3000
	Spot Light (Big)	10	9	90
	Spot Light (Small)	5	7	35

Room/Area	Fittings	Quantity	Wattage per Unit (W)	Total Wattage (W)
Room No. 1	Tube Light	3	18	54
	Fan	2	50	100
Room No. 2	Tube Light	3	18	54
	Fan	2	50	100
Room No. 3	Tube Light	4	18	72
	Fan	6	50	300
	LED Bulb	2	7	14
Room No. 4	Tube Light	3	18	54
	Fan	3	50	150
	LED Bulb	1	7	7
Room No. 5	Tube Light	4	18	72
	Fan	3	50	150
Room No. 6 (Lecture Room)	Tube Light	12	18	216
	Fan	9	50	450
Kitchen	Tube Light	1	18	18
Geography Room	Tube Light	2	18	36
	Fan	1	50	50
	AC	1	1500	1500
Staff Room	Spot Light	19	7	133
	Fan	4	50	200
	AC	2	1500	3000
Girls' Toilet	LED Bulb	1	9	9
Grievance Cell Room	Tube Light	1	18	18
	Fan	1	50	50

Room/Area	Fittings	Quantity	Wattage per Unit (W)	Total Wattage (W)
Main Gate	Tube Light	2	18	36
	Fan	1	50	50
Guard Room	Tube Light	1	18	18
	Fan	1	50	50
Research Section	Tube Light	7	18	126
	Fan	7	50	350
Research Section Balcony	Tube Light	2	18	36
Research Section Toilet	LED Bulb	2	9	18
IQAC Room	Tube Light	2	18	36
	Fan	2	50	100
	LED Bulb	2	9	18
Parni Sabhagaar	Fan	7	50	350
	Spot Light	49	7	343
	Centralized AC	2	18	36
Stairs First Floor	Tube Light	2	18	36
Economics Room	Tube Light	1	18	18
	Fan	1	50	50
Room No. 06 (Durgawati)	Tube Light	3	18	54
	Fan	4	50	200

Room/Area	Fittings	Quantity	Wattage per Unit (W)	Total Wattage (W)
Room No. 07 (LaxmiBai)	Tube Light	4	18	72
	Fan	4	50	200
Room No. 08	Tube Light	4	18	72
	Fan	4	50	200
Room No. 18	Tube Light	2	18	36
	Fan	2	50	100
Common Room	Tube Light	5	18	90
	Fan	6	50	300
	LED Bulb	1	9	9
Room No. 09	Tube Light	3	18	54
	Fan	2	50	100
Room No. 10 (Saraswati Sikshan Kaksh)	Tube Light	3	18	54
	Fan	2	50	100
Room No. 11 (Ganga Sikshan Kaksh)	Tube Light	3	18	54
	Fan	2	50	100
Room No. 12 (Yamuna Sikshan Kaksh)	Tube Light	3	18	54
	Fan	4	50	200

Room/Area	Fittings	Quantity	Wattage per Unit (W)	Total Wattage (W)
Music Room (Vocal Jhankaar Kaksh)	Tube Light	2	18	36
	Fan	2	50	100
	LED Bulb	1	9	9
Music Room (Instrumental Malhaar Kaksh)	Tube Light	2	18	36
	Fan	2	50	100
	LED Bulb	1	9	9
Kala Sangam	Tube Light	3	18	54
	Fan	2	50	100
Gunjar Kaksh	Tube Light	3	18	54
	Fan	2	50	100
Canteen	Tube Light	1	18	18
	Fan	2	50	100
	LED Bulb	1	9	9
Swami Dayanand Sabhagaar Hall	Fan	12	50	600
	AC	10	1500	15000
	Spot Light	83	7	581
Hall Corridor	Tube Light	5	18	90
Smart Class	Spot Light	10	7	70
	Fan	6	50	300

Room/Area	Fittings	Quantity	Wattage per Unit (W)	Total Wattage (W)
	AC	1	1500	1500
Moot Court	Tube Light	6	18	108
	Fan	6	50	300
Law Toilet	LED Bulb	3	9	27
Library	Tube Light	13	18	234
	Fan	14	50	700
	AC	1	1500	1500
	LED Bulb	7	9	63
Law Library	Tube Light	16	18	288
	Fan	18	50	900
	Spot Light	44	7	308
Office Law	Tube Light	2	18	36
	Fan	2	50	100
Law Department Rooms	Tube Light	4	18	72
	Fan	4	50	200
	AC	2	1500	3000
Staff Room (Law)	Tube Light	2	18	36
	Fan	2	50	100
Director Room	Tube Light	2	18	36
	Fan	2	50	100
	AC	1	1500	1500
NCC Room	LED Bulb	2	9	18
	Fan	1	50	50
Stair Light (2nd Floor)	Tube Light	4	18	36
Electrical Appliances	Computer	46	200	9200
	Printer	5	500	2500

Room/Area	Fittings	Quantity	Wattage per Unit (W)	Total Wattage (W)
	Photocopy Machine	2	1500	3000
	Smart Board	2	500	1000
	Refrigerator	2	200	400

Section4: Energy Conservation Measures (ECM)

4. Energy Conservation Measures

ECM 1: Replacement of Existing Ceiling Fan to Energy Efficient BLDC Fan in College Building.

Replacement of Conventional Fans of 70 Watt by Energy Efficient Fans of 28 watt:

A BLDC fan takes in AC voltage and internally converts it into DC using SMPS.

The main difference between BLDC and ordinary DC fans is the commutation method. A commutation is basically the technique of changing the direction of current in the motor for the rotational movement. In a BLDC motor, as there are no brushes so the commutation is done by the driving algorithm in the Electronics. The main advantage is that over a period of time, due to mechanical contact in a brushed motor the commutators can undergo wear and tear, this thing is eliminated in BLDC Motor making the motor more rugged for long-term use.

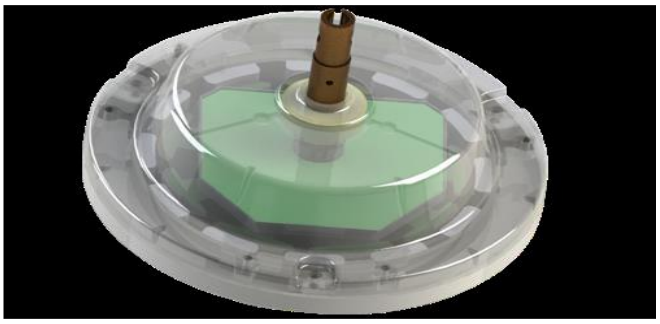
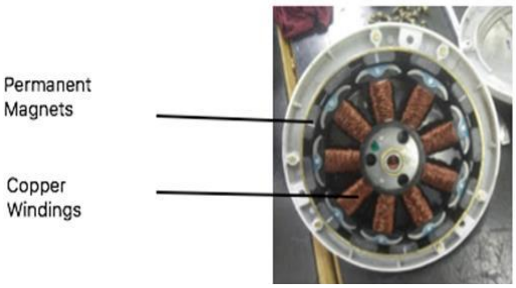


Figure 15: BLDC motor of Energy Efficient fan

To explain, BLDC technology in combination of Permanent Magnets and Electronics to achieve the kind of efficiency and performance it delivers. A BLDC fan composes of 3 main components:



1.Stator 2. Rotor 3. Electronics.

Figure 16: Inside view of BLDC motor

The electronics contains a driving algorithm which drives the BLDC motor. As discussed earlier in a BLDC motor the position of magnets in the fan is sensed by electronics that either uses a Hall effect sensor or back EMF. Modern BLDC motors use Back EMF for commutation due to proven disadvantages of hall effect sensor over period of time. To explain it in easier terms, we can take an example of a donkey who has a carrot fixed over his head as per shown in the picture below:

Consider the Stator to be the Carrot and the donkey to be the Magnets. The polarity of the stator will keep changing, due to attraction the magnets will create rotational moment, just like how the donkey tries hard to reach the carrot in the picture.

Permanent magnets used in rotor are responsible for mass reduction in power consumption compared to windings used in the stator in an ordinary induction fan. One added advantage in a BLDC fans due to use of an electronic circuit is that you can add several additional features to increase convenience, few example of the same are sleep mode, timer mode also it is compatible with Home automation systems. Most of the BLDC Ceiling fans are operated by remote unlike traditional regulator reducing the purchase cost of regulator.

Compared to regular induction fan, a BLDC fan can save upto Rs 1000-1500/ Year/fan. And because there is no heating of the motor, the life of a BLDC fan is also expected to be much higher than ordinary

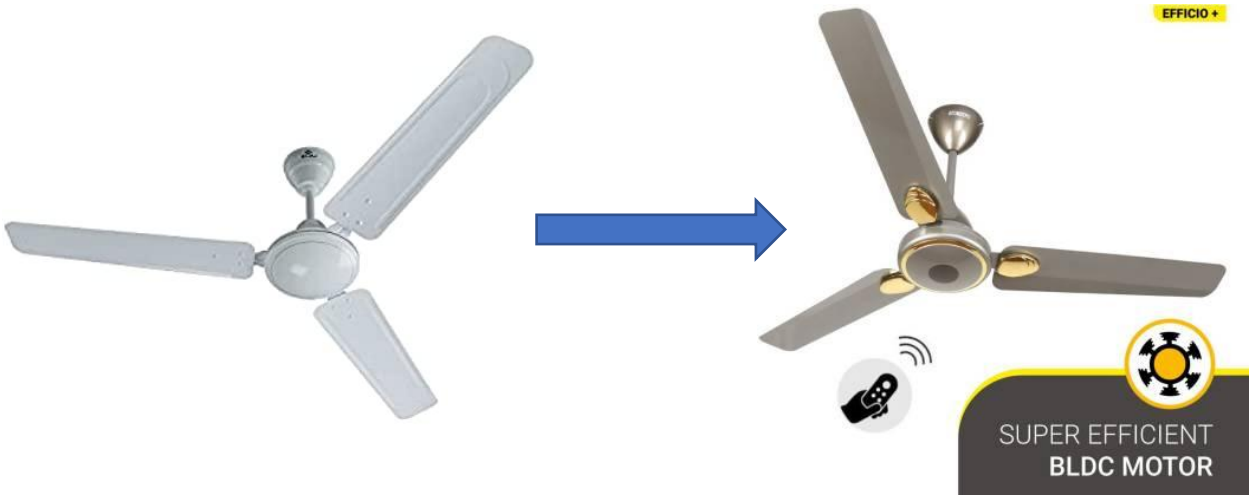
Energy Consumption: Ordinary Fans Vs BLDC Fans

Tag Name	Wattage	Daily Electricity Consumption
Regular Fan	70 Watts	1.125 units
BLDC Fan	**28 Watts**	0.45 units

Saving Calculation

Name of Particulars	Quantity	Total Wattage	Annual Operational Hours (10hr / D)	Total Unit Consumption (kWH)
Ceiling Fan (1400 mm), 70 W	**156**	**10920**	**2500**	**27300**
Saving Calculation				
Operating days per years				250 Days
Total Annual Energy Consumption (kWh) of old CF				**27300**
Proposed Total BLDC Fan (28W) Energy Consumption (kWh)				**10920**
Saving due to installation of BLDC Fan -kWh				**16380**
Total Monitory Saving considering Rs.7 @ per kWh				**1,14,660**
Total Investment of installing 156 nos. BLDC Fan @ Rs. 2500 per Fan				**3,90,000**
Simple Payback period in Months				**41**

These existing Fan can be replaced in a phase manner.



CERTIFICATION

This Part shall indicate certification by Certified Energy Auditor stating that: -

I. The data collection has been carried out diligently and truthfully.
II. All data monitoring devices are in good working condition and have been calibrated or certified by approved agencies authorized and no tampering of such device has occurred.
III. All reasonable professional skill, care and diligence had been taken in preparing the Energy Audit Report and the contents thereof are a true representation of the facts.
IV. Adequate training provided to personnel involved in daily operation after implementation of recommendation.

Signature:

Name of the Certified Energy Auditor: Mr. Rahul Agrawal
Certification Detail: EA-20984

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