Energy Audit

Greenserve Energy
Managment Solutions
Endless in Optimization

Registration Number: D-DURG-159/2016-17
Phone Number : 9752531330, 9098148400
Email-id : greenserve.energy@gmail.com

Date: 18/07/2022

Certificate

We hereby certify that we have conducted the "**Energy Audit**" of the building of "**Guru Ghasidas Vishwavidyalaya, Bilaspur**" **in July 2022** with the best of our ability. We have calculated the total Energy consumption, Energy saving analysis and given suggestions for Optimum utilization of resources by the university management. The Energy Savings potential in monitored areas are also mentioned in Energy Audit report.

We herewith certify that this study has been carried out by our BEE Certified Energy Auditor teams.

Greenserve Energy
Management Solutions
Durg (C.G.)

Mr. Rahul Agrawal
Certified Energy Auditor
(EA-20984)

Place : Durg (C.G.)

2022

ENERGY AUDIT REPORT

Guru Ghasidas Vishwavidyalaya, Bilaspur(C.G.)

July 2022

Prepared By:

Greenserve Energy Management Solutions

Vijay Nagar,

Durg (C.G.) - 491001

Acknowledgement

We are thankful to the administration and the Hon'ble Vice Chancellor of the Guru Ghasidas Vishwavidyalaya, Bilaspur for entrusting processes of Energy auditing with us. We thank all the participants of the auditing team especially students, 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

1	Rahul Agrawal	Certified Energy Auditor
2	Jayendra Mohabe	Senior Energy Engineer
3	Bhumesh Jagnit	Energy Engineer

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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 Fan in University Building	108.55	434200	26.052	50
2	Replacement of Existing FTL Light to LED Light in University Building	9.5	167855	10.07	12
3	Replacement of Existing Metal Halide Light to LED in University Building	1.02	15513	0.94	13
4	Replacement of existing window type AC to energy efficient Inverter type split AC (BEE- 5 star Rated).	0.4	3600	0.216	19
5	Installing Airtron Energy Savers for ACs with a higher duty cycle (> 6 hrs./day)	0.07	1575	0.016	9
	Total	**119.54**	**622743**	**37.294**	**38.46**

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

Total annual Energy savings, kWh	622743
Total Investment, Rs Lakh	119.5
Total Monetary savings, Rs Lakh	**37.29**
Simple Payback Period, Months	**38.46**

Section 2: Introduction

2. Introduction

2.1 About Guru Ghasidas Vishwavidyalaya, Bilaspur

Guru Ghasidas Vishwavidyalaya, is a Central University of India, located in Bilaspur C.G. State, established under Central Universities Act 2009, No. 25 of 2009. Formerly called Guru Ghasidas University (GGU), established by an Act of the State Legislative Assembly, was formally inaugurated on June 16, 1983. GGU is an active member of the Association of Indian Universities and Association of Commonwealth Universities. The National Assessment & Accreditation Council (NAAC) has accredited the University as B+.

Situated in a socially and economically challenged area, the university is appropriately named to honor the great Satnami Saint Guru Ghasidas (born in the 17th century), who championed the cause of the downtrodden and waged a relentless struggle against all forms of social evils and injustice prevailing in the society. The University is a residential institution, having its jurisdiction spread over Bilaspur Revenue Division of the state of Chhattisgarh. It covers almost the entire spectrum of the higher education requirements of the country along with the local people. It has several University Teaching Department (UTDs) on its campuses.

VISION AND MISSION

Vision

Motivated by the though & teaching of Guru Ghasidas, a great satnami sant of 18th century, Guru Ghasidas Vishwavidyalaya, Bilaspur(C.G.) is committed to Social empowerment Particularly of the weaker section of the Society with the help of quality higher education& Training.

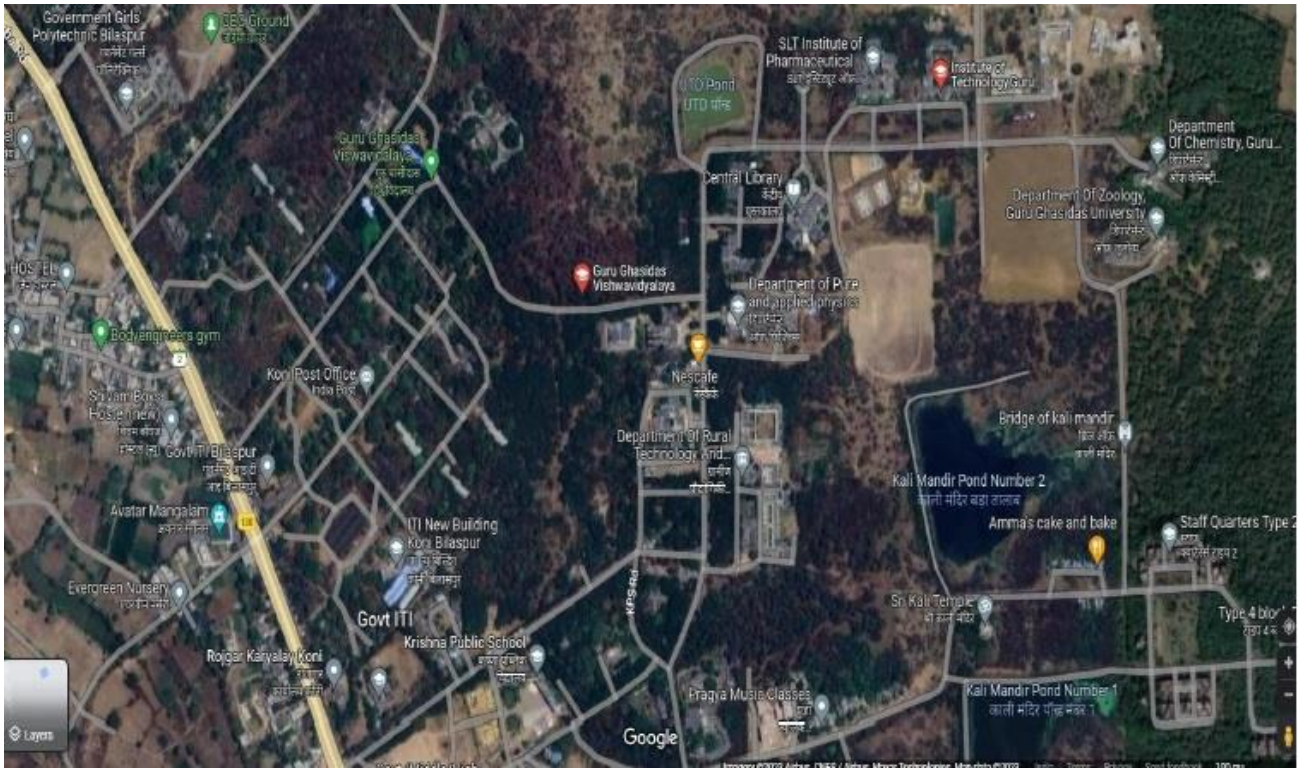
The focus of the university is on offering strengthening innovative academics programs in emerging interdisciplinary areas of science, social Science & Humanities with quality assurance so as contribute to the growth of the Knowledge base of the university in particular & academic in general. The university aims to provide value-based holistic Education, which will lead to the growth & development of a community better equipped to serve mankind.

Mission:

- Providing greater access of inclusive quality higher education to all in particular to the socially &educationally underprivileged students.
- Promoting Academic excellence through the state of arts Undergraduate, Post Graduate, Doctoral programs.
- Offering equitable quality educational programs catering the current and future needs of the society, region & industry.
- Promoting Innovation in teaching, learning, and Research extension work & consultancy service.
- Extensive use of technology-enabled learning specially blended mode leering using ICT for Academic, administrative, financial, examination, and evaluation & students supports system of the university.
- Making students to serve humanity through the creation of well-rounded multi skilled & Socially Responsible global citizens in a multidisciplinary ecosystem.

Location:

Guru Ghasidas Vishwavidyalaya, Bilaspur and the GPS Coordinates of the University is **22°07'45.7"N 82°08'09.9"E.**



The installed capacity of each load is given as follows:

Sr. No.	Connected Load Breakup(kW)	
1	Lighting Load	233
2	Ceiling Fan	304
3	Exhaust Fan, Wall Fan & Cooler Load	53.5
4	A.C. Load	642
5	Computer Load	112
6	Projector & LED TV Load	11.8
7	Xerox & printers	17.34
8	Water Pumps	51.75
9	Fridge	20
10	Water Cooler & washing Machine Load	6.5
11	Geyser	120
12	Air Handling Unit (AHU) Load	74
Total Load		1645.9

Table 1: Connected Load Break up

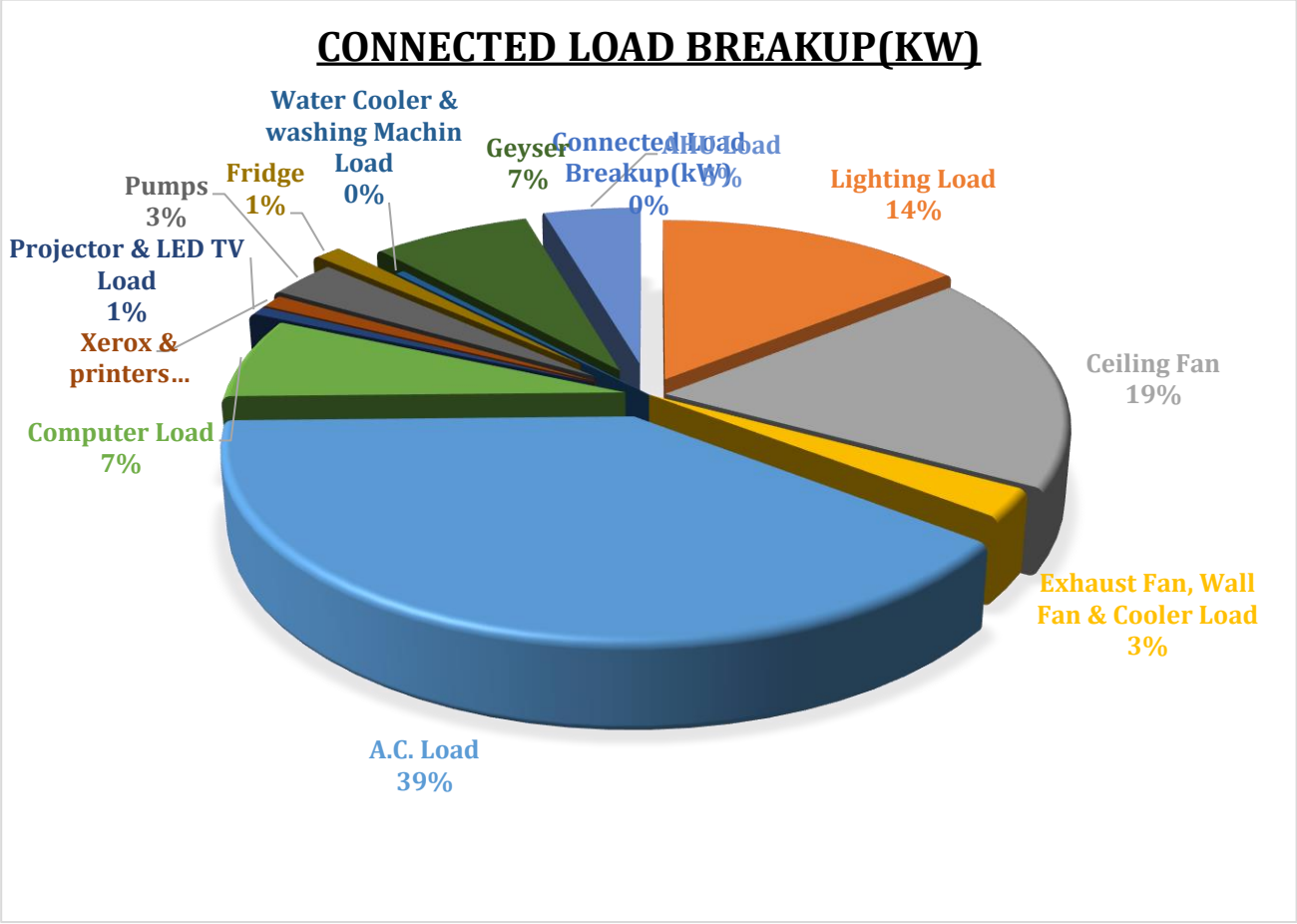


Figure 1: Connected Load Breakup

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:

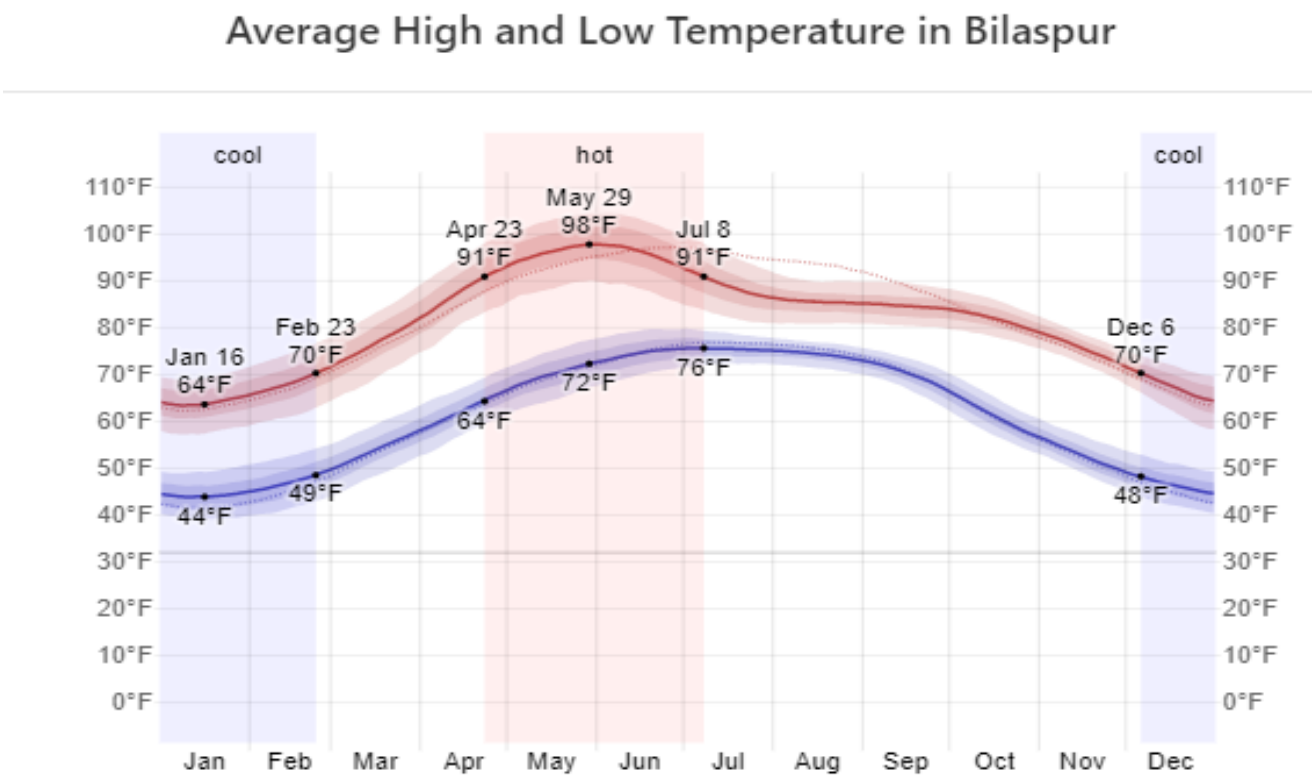
S. No	Name of the Instrument	Make of the instrument	Details
1.	Portable power quality analyser	Hioki	Range: 5A-5000Amps Accuracy: Uncertainty in measurement is ±0.77% Voltage & ±0.7% (current), ±0.31% (watts)
2.	Thermal Imaging camera	Fluke TS10	*T*temperature Range: -10 to 350 °C (14 to 662 °F)
4.	RH 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 Bilaspur is given as follows:

Figure 2: Climatic condition of Bilaspur



The hot season lasts for 2.5 months, from April 23 to July 8, with an average daily high temperature above 91°F. The hottest month of the year in Bilaspur is June, with an average high of 96°F and low of 75°F.

The cool season lasts for 2.6 months, from December 6 to February 23, with an average daily high temperature below 70°F. The coldest month of the year in Bilaspur is January, with an average low of 44°F and high of 64°F.

Section3: Performance Assessment

3. Performance Assessment

Guru Ghasidas Viswavidyalaya, Bilaspur has Common EnergyMeterFor all Department. The facility has AC's, Fans, lighting and Computers as the major energy consuming utilities.

3.1 Load Analysis

The power logging monitoring has been done for main incomer feeder.

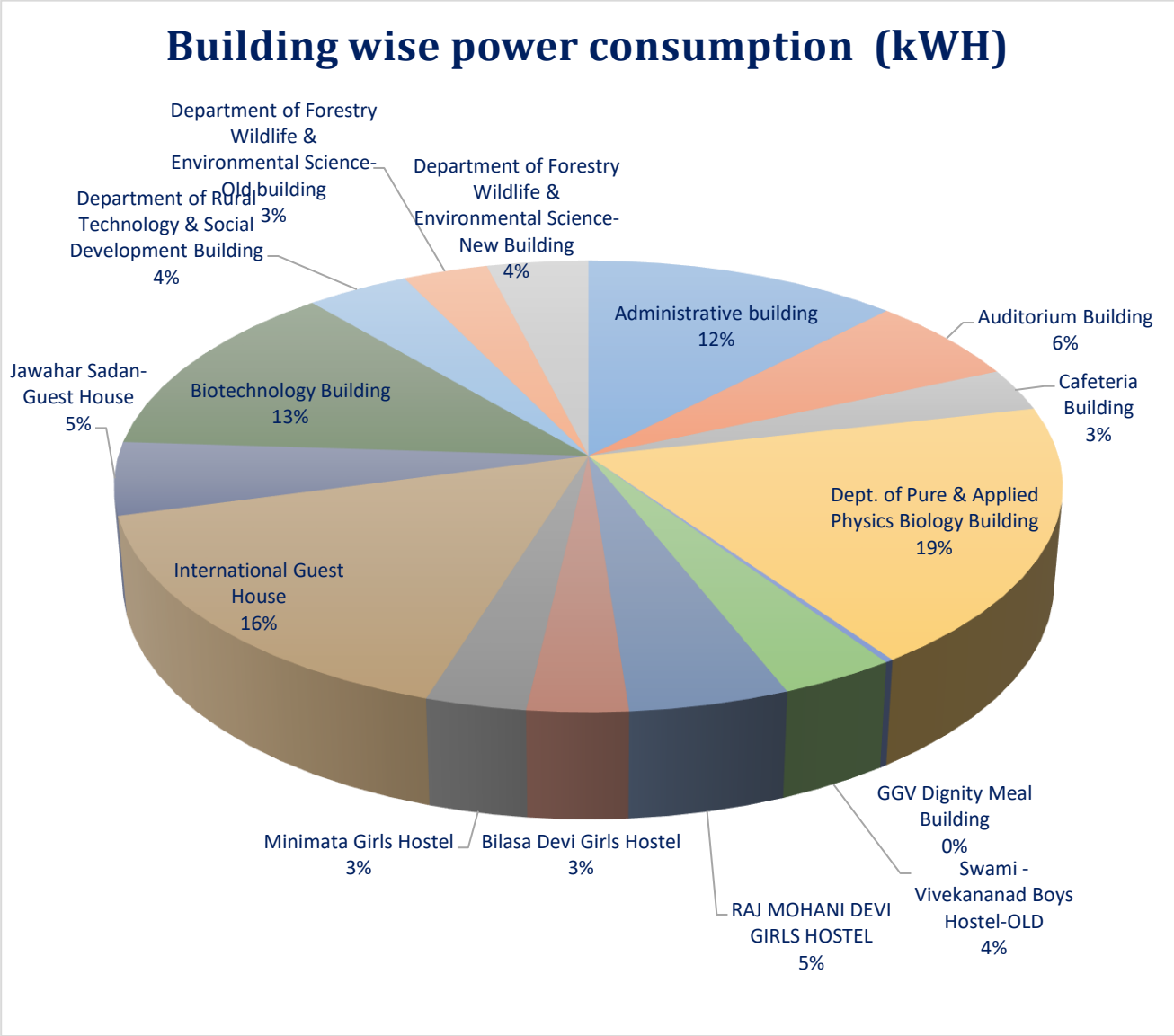
Main Incomer reading

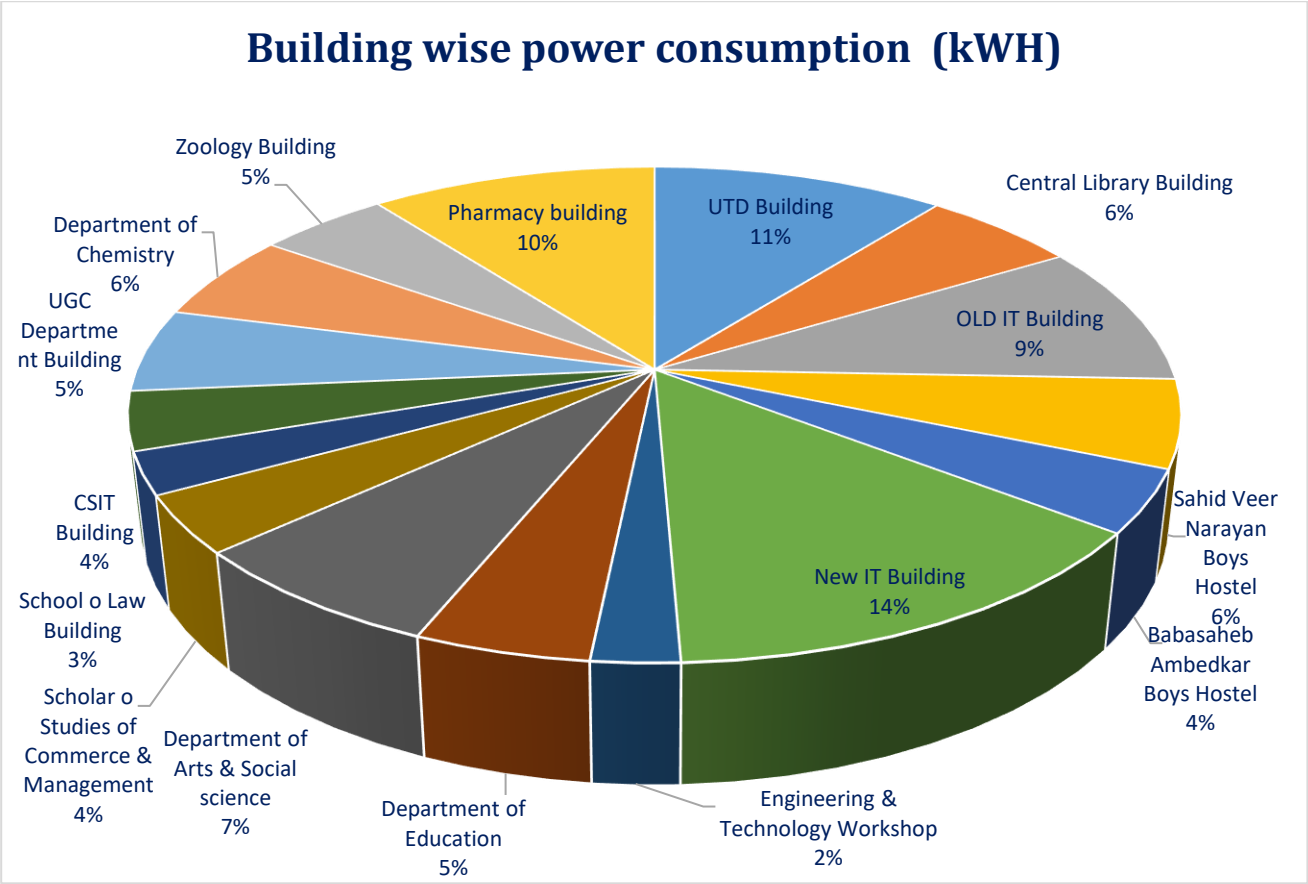
Panel Name	Voltage(V)					Current(A)					Power Factor	Power	
	RY	YB	BR	Average	Imbalan	RY	YB	BR	Average	Imbalan		kW	KVA
Main Incomer	11002	11004	11004	11003	0.01	53	53	51	52	1.27	0.892	890	997

3.2 Building wise Energy Consumptions

SR. No.	Building Name	Consumption (kWh)
1	Administrative building	540
2	Auditorium Building	272
3	Cafeteria Building	134
4	Dept. of Pure & Applied Physics Building	827
5	GGV Dignity Meal Building	11
6	Swami Vivekanand Boys Hostel-OLD	154
7	Raj Mohani Devi Girls Hostel	213
8	Bilasa Devi Girls Hostel	133
9	Mini-mata Girls Hostel	133
10	International Gust House	702
11	Jawahar Sadan- Guest House	230
12	Biotechnology Building	563
13	Department of Rural Technology & Social Development Building	176
14	Department of Forestry Wildlife & Environmental Science-Old building	145
15	Department of Forestry Wildlife & Environmental Science-New Building	174
16	UTD Building	411
17	Central Library Building	218
18	OLD IT Building	355
19	Sahid Veer Narayan Boys Hostel	219
20	Babasaheb Ambedkar Boys Hostel	157
21	New IT Building	535
22	Engineering & Technology Workshop	88
23	Department of Education	176
24	Department of Arts & Social science	271

SR. No.	Building Name	Consumption (kWh)
25	Scholar o Studies of Commerce & Management	144
26	School o Law Building	105
27	CSIT Building	147
28	UGC HRDC Department Building	209
29	Department of Chemistry	219
30	Zoology Building	183
31	Pharmacy building	403
Total Consumption (kWh)		**8248**

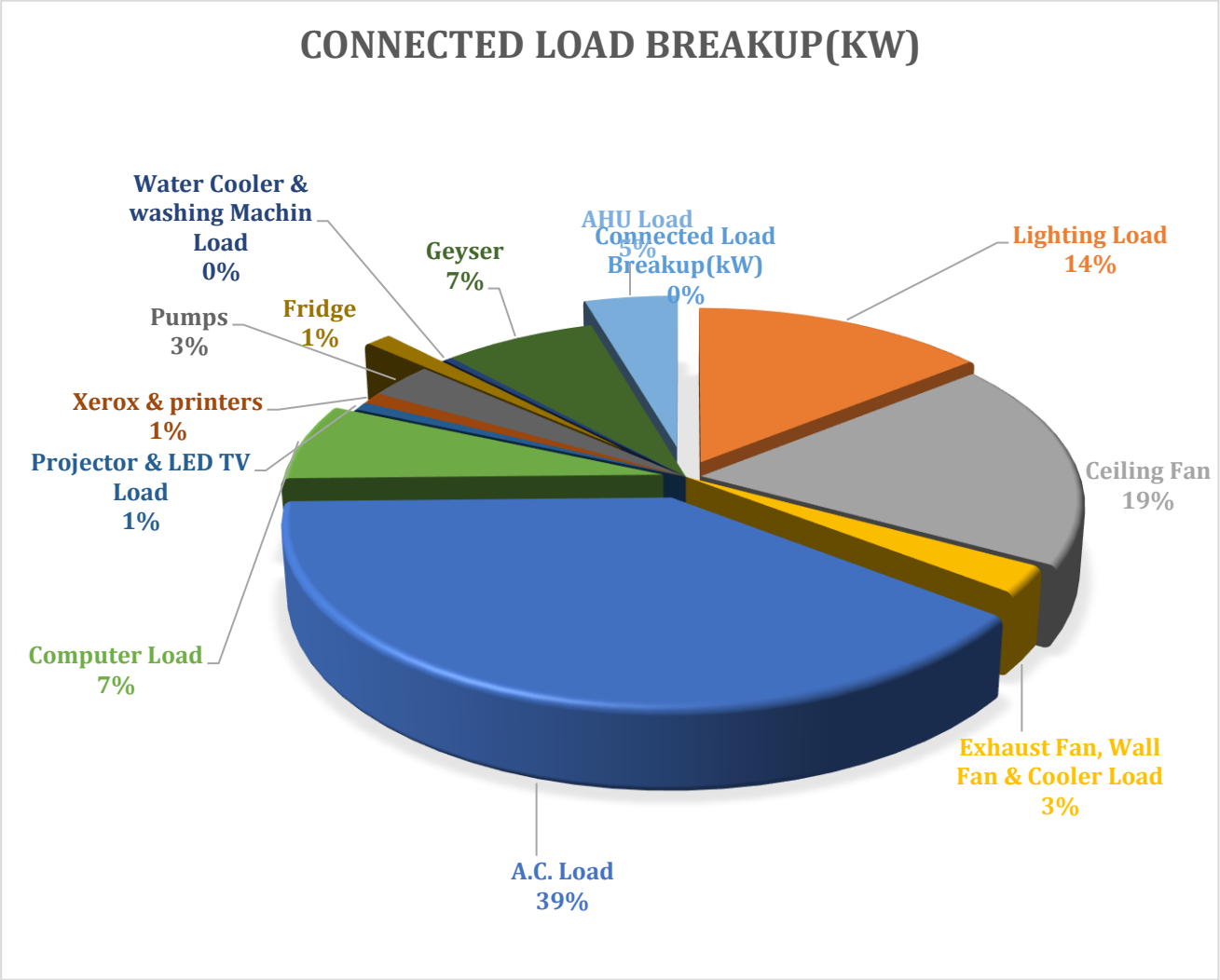




3.3 Connected Load

SR. No.	Fittings	Wattage	Total Nos.	Total wattage(kW)
1	LED-Panel Light-36W	36	141	5.1
2	LED-T-5-20 W	20	3642	72.8
3	LED-10W	10	266	2.7
4	LED Bulb-9W	9	10	0.1
5	LED-15 W	15	332	5.0
6	LED-150W	150	26	3.9
7	T-8-36W	36	3669	132.1
8	T-12- 48W	48	50	2.4
9	18 CFL	18	16	0.3
10	250W MH (Metal Hallide)	250	34	8.5
11	Ceiling fan-70W	70	4342	303.9
12	Wall Fan-65W	65	87	5.7
13	Cooler-250W	250	116	42.5
14	Exhaust Fan-65W	65	84	5.5
15	PC (Desktop Computers)	120	931	111.7
16	Printer	110	134	14.7
17	Xerox	260	10	2.6
18	Split AC-1.5 T	1800	291	523.8
19	Window AC-1.5 T	1800	17	30.6

SR. No.	Fittings	Wattage	Total Nos.	Total wattage(kW)
20	Cassette AC	3000	6	18.0
24	AC 8.5T	10000	7	70.0
21	Fridge	500	40	20.0
22	Projector	350	24	8.4
23	LED TV	200	17	3.4
25	AHU 18.5 kW	18500	4	74.0
26	Water Cooler	400	15	6.0
27	Gyser-2kW	2000	60	120.0
28	Washing Machine	500	1	0.5
29	1 HP water Pumps	750	30	22.5
30	1.5 HP water Pumps	1125	26	29.3
Total				**1645.9**



Section4: Energy Conservation Measures (ECM)

4. Energy Conservation Measures

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

Replacement of Conventional Fans of 70 Watt by Energy Efficient Fans of 30 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.

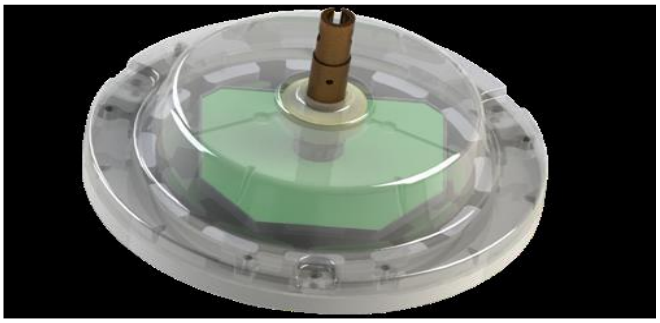


Figure 15: BLDC motor of Energy Efficient fan

To explain, BLDC technology in simpler terms, BLDC uses a 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.

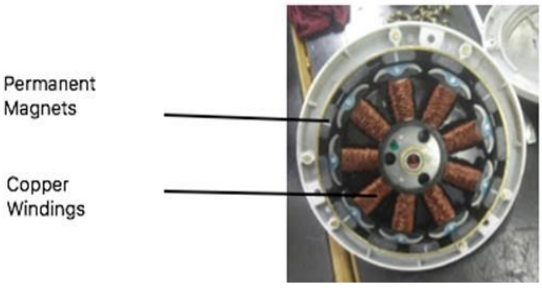


Figure 16: Inside view of BLDC motor

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

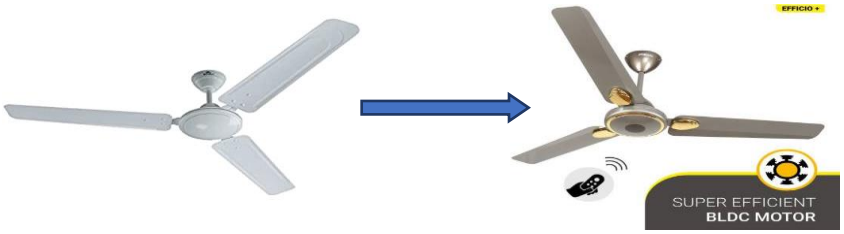
Energy Consumption: Ordinary Fans Vs BLDC Fans

Tag Name	Wattage	Daily Electricity Consumption
Regular Fan	75 Watts	1.125 units
BLDC Fan	**30 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	**4342**	**303940**	**2500**	**759850**
Saving Calculation				
Operating days per years				250 Days
Total Annual Energy Consumption (kWh) of old CF				759850
Proposed Total BLDC Fan (30W) Energy Consumption (kWh)				**325650**
Saving due to installation of BLDC Fan -kWh				**434200**
Total Monitory Saving considering Rs.6 @ per kWh				**26,05,200**
Total Investment of installing 4342 nos. BLDC Fan @ Rs. 2500 per Fan				**1,08,55,000**
Simple Payback period in Months				**50**

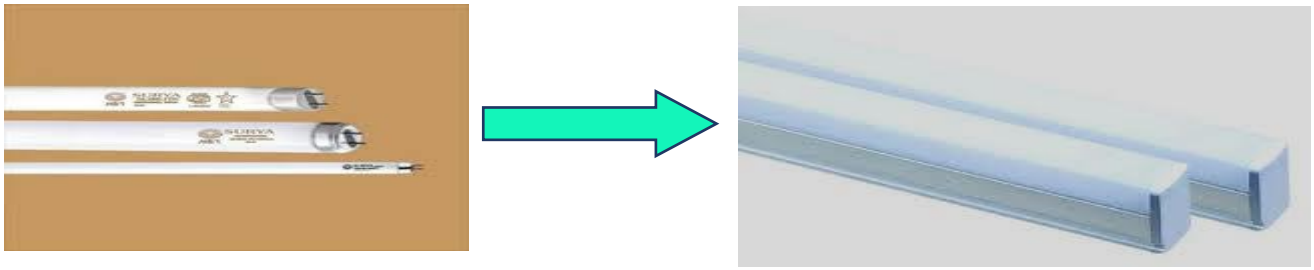
These existing Fan can be replaced in a phase manner.



ECM 2: Replacement of Existing Ceiling FTL Light to LED in University Building.

By Installation of Energy Efficient Lighting T5 LED Tube light in place of 50, Nos. conventional T-12(40W) tube lights, 3669 nos. conventional T-8 (36W) tube lights in university campus, these existing lights can be replaced in a phase manner.

	Conventional FTL	LED T5 Lamp
Power Consumption	T-12 –40 W – 50Nos. T-8 – 36 W – 3669 Nos.	18 W- T-5- LED
	CFL - 18 W - 16 Nos.	9 W LED Bulb
Efficacy	68 lum/W	104 lum/W
Life hours	5000	20000



Power Saving	=	(((40 – 18)x50)+((36 – 18)x3669)) = 67.142kW
Annual Power Saving	=	67.142 kWx10Hr. x 250Days
	=	167855 kWh
Annual Cost Saving	=	167855kWh x Rs. 6
(@ Rs.6/Unit)	=	Rs. 10.07Lacs.
Investment (@ Rs.250 /T-5 LED)	=	Rs. 9.50 Lakh (LS)
Simple Payback Period	=	12 Months. (LS)

ECM 3: Replacement of Existing Metal Halide Light to LED in University Building.

By installation of Energy Efficient LED Lighting in place of conventional MV High Bay Lights in, Campus, these existing lights can be replaced in a phase manner.

Particulates	Conventional MH High-bay &Surface Mounted Lights	HIGH BAY LED LIGHTS
Power Consumption	250 Watt - 34 Nos.	125 W
Efficacy	90 lum/W	104 lum/W
Life hours	10000	20000

FORCEBAY

169857	BJHFL 80W LED	1	11000
169858	BJHFL 100W LED	1	12500
169859	BJHFL120W LED	1	13500
169860	BJHFL 150W LED	1	14500

User friendly and reliable solution suitable for multipurpose applications in the industry segment. IP66 protection.

'MAGNUM' floodlights

112716	BJFL 30W LED	2	3000
112717	BJFL 60W LED	1	6000

LED Floodlight Luminaire with high pressure die cast housing and IP65 Protection.

Power Saving = (250–125) x 34 =4.25 kW

Annual Energy Saving = 4.25 x10 x 365 day
= 15513 kWh

Annual Cost Saving = 15513 x 6

(@ Rs.6/Unit) = Rs. 0.94Lac.

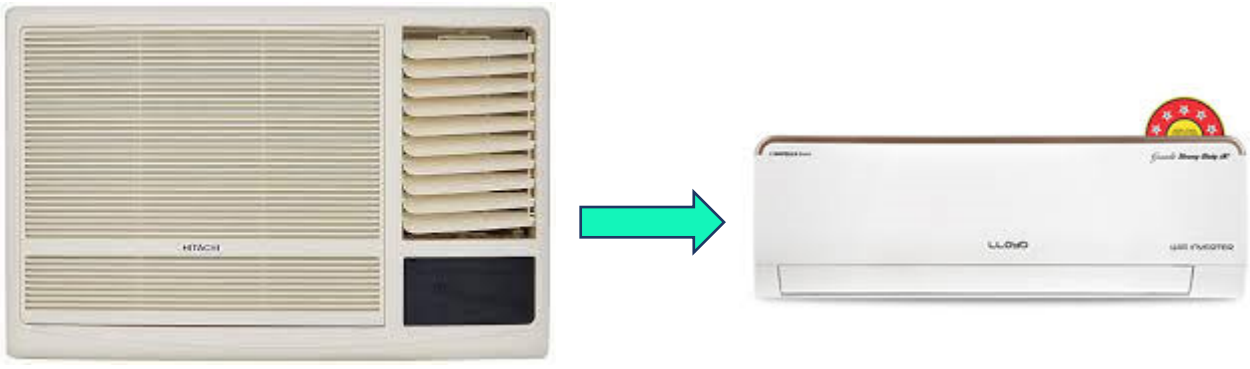
Investment = Rs. 1.02 Lac. (Rs. 3000/-)

Pay back = 13 Months.

ECM 4: Replacement of existing window type AC to energy efficient Inverter type split AC (BEE- 5 star Rated)..

Saving Calculation for Single AC

Name of Particulars	wattage	Quantity	Annual Operational Hours	Values
1.5 TR window AC,Make - Blue Star	2500	17	3000	-
Existing Power Consumption of window AC (kW)				2.5
Existing Annual kWh Consumption				7500
Proposed Power Consumption of Split AC (kW)				1.3
Proposed Annual kWh Consumption				3900
Saving due to installation of New energy efficient Inverter type split AC (kWh)				3600
Total Monitory Saving considering Rs. @ 6 per kWh				21600
Total Investment of New energy efficient Inverter type split AC @ Rs. 40000/-				40000
Simple Payback period in Months				19



ECM 5: Installing Airtron Energy Savers for ACs with a higher duty cycle (> 6 hrs./day)

How it Works?

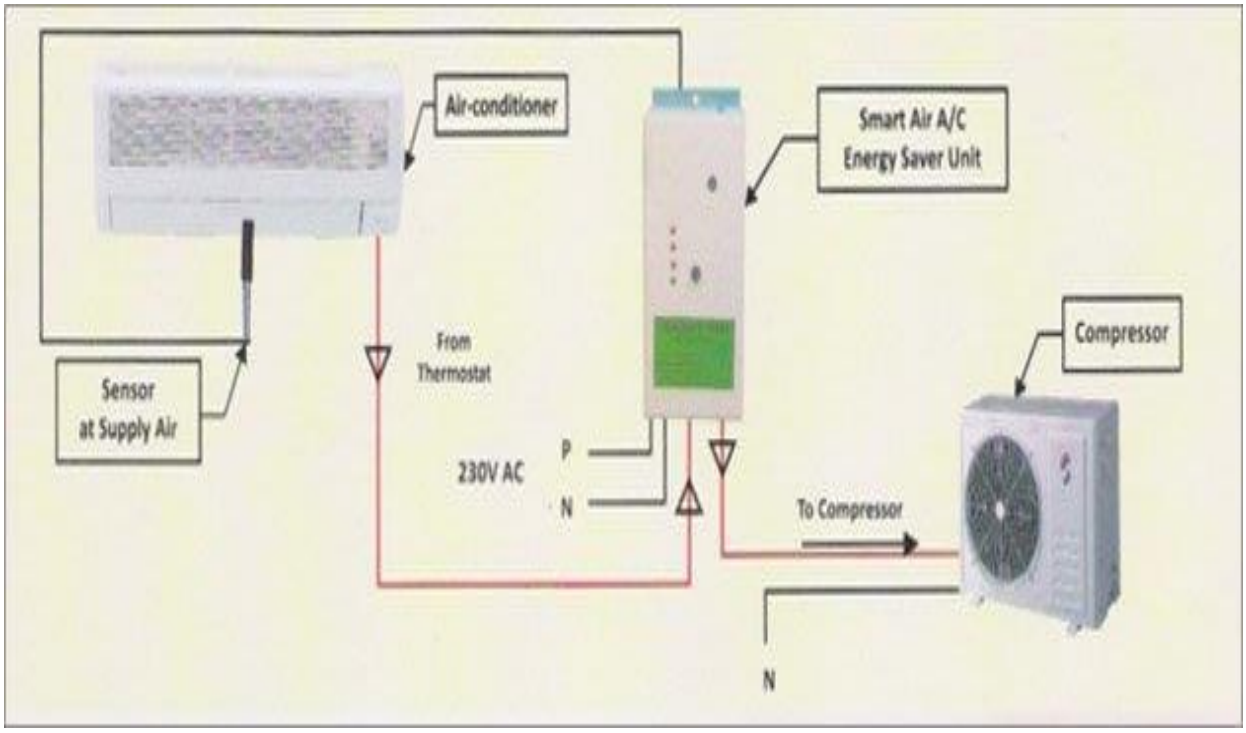
ACs are only controlled by mechanical relays & timers and there is no "intelligence". AIRTRON (Patented Technology) is an Intelligent microprocessor and its dual sensors reference the Room ,Coil & Ambient Temp, and uses complex, multiple algorithms in a " closed -loop circuit" to reduce the Compressor run-Time ,to ensure the high savings while maintaining and displaying the Set Temp. accurately.

No compromise on comfort as Airtron allows you to program your AC to climate and geographical locations & automatically itself to change ambient conditions to save electricity. It comes with Remote where you can set your own room Temp.

Compatible with all kind of window, Split , Inverter ACs , Package & Duct-able Air conditioners .

- Airtron is programmable and automatically adjusts to changes in climate and ambient conditions and is offered with a remote for your maximum comfort
- Airtron is the world's most advanced AC SAVER can cut your AC bills up to 35%, It is easy to install and easy to use!!! Enjoy savings for many years to come.
- Airtron received the National Award for Energy Innovation from CII -GBC 2018 (- the nodal agency in India for sustainable solutions and policy.).
- Airtron gives you a payback of 4-6 months
- Now Available in 60 countries and pan-India. Business partners wanted globally and in India - sales@magnatron.in

Eligible for claiming 40 % Depreciation in IT under "Energy saving devices''



Saving Calculation for Single Unit

Name of Particulars	wattage	Quantity	Annual Operational Hours	Total Unit Consumption (kWH)
2 TR Split	2100	1	3000	6300
Saving Calculation				
Saving due to installation of Airtron Energy Saver@ 25% kWh				1575
Total Monitory Saving considering Rs. @ 6 per kWh				9450
Total Investment for energy saver @ Rs. 7000 per Airtron				7000
Simple Payback period in Months				9

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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