Bigeta Energy Solutions LLP
First Floor, Sri Dattatreya Complex #1489, Sy No 476/3,
Sarjapur- Attibele Road, Bengaluru, Karnataka 562125
info@bigetaenergy.com, +91 9900591000
www.bigetaenergy.com

Bangalore
27-02-2021

CERTIFICATE

This is to certify that we have carried out an energy audit and green audit of Andhra Loyola Institute of Engineering and Technology, Vijayawada, Andhra Pradesh during 10th to 12th February 2021 and detailed survey, observations, measurements, and verification were carried outto assess the energy, waste, water, and biodiversity aspects of campus. A detailed report consisting of key parameters, observations and recommendations was submitted to the management on 26-02-2021.

For Bigeta Energy Solutions LLP

BENET GEORGE V
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Date: 2021.02.27 22:49:04 +05'30'

BIGETA ENERGY SOLUTIONS LLP
AAK - 4585

Benet George V – CEM, CMVP, PMP, IGBC AP
BEE Accredited Energy Auditor – AEA0053
Chief Consultant
Bigeta Energy Solutions LLP

Acknowledgement

Bigeta Energy Solutions is thankful to Andhra Loyola Institute of Engineering and Technology for providing us an opportunity to conduct Energy and Green Audit at their Institution located in Vijayawada, Andhra Pradesh. We are grateful to Fr. Dr. A. Francis Xavier, S. J – Director, Fr. J. Chiranjivi S.J- Assistant Director, Fr. M. Anand S.J- Assistant Director, Dr.O.Mahesh – Principal , Mr. G. Ghantaiah Swamy- Assistant professor and other staffs for showing keen interest and for the help during audit.

We do hope that you will find the recommendations given in this report useful in helping you save energy and improve sustainability. While we have made every attempt to adhere to high quality standards, in both data collection and analysis, as well as in presentation through the report, we would welcome any suggestions from your side as to how we can improve further.

For Bigeta Energy Solutions LLP

BENET GEORGE V

Digitally signed by BENET GEORGE V
Date: 2021.02.26 22:49:55 +05'30'

BIGETA ENERGY SOLUTIONS LLP AAK - 4585

Benet George V

BEE Accredited Energy Auditor – AEA0053

Email: benet@bigetaenergy.com

Mobile- +91 99005 91000

#1489, Sy No.476/3, Sarjapur-Attibele Road,

Sarjapura, Bengaluru, Karnataka 562 125

Energy and Green Audit Report

February 2021

Andhra Loyola Institute of Engineering and Technology
Vijayawada, Andhra Pradesh

Bigeta Energy Solutions LLP
bigetaenergy.com

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In case of any suggestions or queries:

Bigeta Energy Solutions LLP

Mr. Benet George V

BEE Accredited Energy Auditor

Email: benet@bigetaenergy.com

Mobile- +91 99005 91000

#1489, Sy No.476/3, Sarjapur-Attibele Road,

Sarjapura, Bengaluru, Karnataka 562 125

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1.0 Introduction

The working details of assignment are as follows:

Project	**Energy and Green Audit**
Client	**Andhra Loyola Institute of Engineering and Technology**
Industry	Engineering College
Contact	Mr. G. Ghantaiah Swamy- Assistant Professor Department of Electrical and Electronics Engineering Mobile- +91 7075342409 Email: swamy_g12@yahoo.co.in
Site	ITI Rd, Beside Ramesh Hospital, Jayaprakash Nagar, Vijayawada, Andhra Pradesh 520008
Consultant	Bigeta Energy Solutions LLP Bangalore, India
Duration	February 2021
Project Scope	To conduct Energy And Green Audit at Andhra Loyola Institute of Engineering and Technology
Report	This document gives recommendations, details of findings and the way forward.
Consultants involved	Mr. Benet George V – BEE Accredited Energy Auditor- AEA0053 Chandra Subramanian M – Energy Engineer
Notes	The suggestions / alternatives in the audit report are based on the present operating conditions of equipment/systems and to the best of our knowledge.

1.1 About the college

Andhra Loyola Institute of Engineering and Technology (ALIET) is managed and administered by the members of the Society of Jesus, also known as Jesuits, belonging to 'Jesuit Province Society – Hyderabad', covering both the states of Andhra Pradesh and Telangana. It was established in 2008. The institution, recognized by the Government of Andhra Pradesh and affiliated to JNTU Kakinada, was approved by AICTE, New Delhi, on 4th June 2008.

ALIET is a sister-institution of Andhra Loyola College (ALC), Vijayawada, a well-reputed autonomous college started in 1953 and awarded the status 'College with Potential for Excellence' (CPE) by the UGC. Both these institutions, situated in the same 98-acre campus, are registered under the Loyola College Society, Guntur-Vijayawada.

It offers 6 UG programs viz., Computer Science and Engineering (CSE) with a sanctioned intake of 120 seats, Electronics and Communications Engineering with 120 seats, Mechanical Engineering with 120 seats, Electrical and Electronics Engineering with 60 seats, Civil Engineering with 60 seats and Information Technology with 60 seats, adding up to 540 seats in the B.Tech. The College also offers 3 PG programs Viz., 2 M.Tech. Programs- CSE and DECS (Digital Electronics and Communication Systems), with an intake of 18 students each and Master of Business Administration with an intake of 60 seats.

Situated at the foothills of the Eastern Ghats of Vijayawada, the campus of ALIET has a verdant look. This green campus engenders a conducive and serene ambience, giving a fillip to the learners' zeal and enthusiasm. ALIET has an efficient, experienced and dedicated 125 faculty to offer a holistic education to the students.

The Andhra Pradesh State Skill Development Corporation (APSSDC) has established a skill development centre in collaboration with Siemens, to train the students. Nearly 3000 students have been trained so far. This is a milestone in the history of ALIET.

The College provides a learning-and- conducive environment with the motto of 'Service & Excellence' by forming men and women for others.

Table 1. Students details.

Programme		From the State Where College is Located	From Other States of India	NRI Students	Foreign Students	Total
UG	Male	1291	10	0	0	1301
	Female	898	9	0	0	907
	Others	0	0	0	0	0
PG	Male	62	0	0	0	62
	Female	57	3	0	0	60
	Others	0	0	0	0	0

The Institution has required number of laboratories as per the norms of the University. It has procured software packages such as **Ansys, Creo, GIS, Stad, AutoCAD, MatLab, Xi-linx, Mentor graphics, Rational Rose, etc.** Apart from these laboratories the Institution provides comprehensive and integrated range of support, including space, training to **internal and external students** to gain hands-on experience in innovation and entrepreneurship through the following labs.

Table 2. Staff details

Highest Qualification	Professor			Associate Professor			Assistant Professor			
	Male	Female	Others	Male	Female	Others	Male	Female	Others	Total
D.sc/D.Litt.	0	0	0	0	0	0	0	0	0	0
Ph.D.	5	1	0	4	2	0	2	1	0	15
M.Phil.	0	0	0	0	0	0	2	2	0	4
PG	0	0	0	13	1	0	60	32	0	106

Tech courses. Today, the College has **2330** students in **6 UG** programs namely, CSE, ECE, MECH, EEE, CE and IT. The College also offers **3 PG** programs, viz. **2 M. Tech** programs CSE and DECS and MBA, **125** faculty members are placed in **7** Departments.

1.2 Vision and Mission

Vision

In accordance with the Jesuit vision of higher education, ALIET imparts technical education in the realm of higher education through an integral formation which involves academic excellence, spiritual growth, social commitment, and value-based leadership.

Mission

The mission of the Jesuit Education at ALIET is to form 'men and women for others' and mould them as global citizens possessing competence, conscience and compassion. Special attention is given to socially and economically marginalized students.

1.3 Physical Infrastructure

The College has two blocks, spread across 11.67 acres, with a built-in area of 18722.29 Sq.m and is equipped with the appropriate Physical facilities.

Figure 1. *Location of College*

The Institution has 45 classrooms including seminar halls having an area surpassing the standards set by AICTE norms. The average area of each classroom is about 79 sq.m. The Institution has 36 UG classrooms, 4 PG classrooms and 5 seminar halls. Departments are provided with 55 LCD projectors.

1.4 Energy and Green Audit Field work

Energy and Green Audit field work has been carried out during 10th to 12th February 2021 and detailed observations, measurements and interviews were carried out.

1.5 Energy Audit methodology

Phase 1- Pre-Audit
Campus details, energy consumption details etc are collected and caried out initial analysis and planned for field work. Based on the initial details three days field work is decided.

Phase 2- Field work and data collection
On the first day opening meeting was done and key stake holders and members or the management team were present. Purpose of the audit, methodology, activities planned were explained. Selected student volunteers for data collection. Field visit, interviews, data verification, spot measurements are done. Closing meeting to discuss the initial findings and observation is done on the final day of the field work.

Phase3- Report
Analysis of the data and preparation of report.

1.6 Students participated in audit.

Students from the electrical and electronics departments were also participated to carry of survey and done field observations capturing photos of biodiversity, water and waste survey and energy survey.

Table 3. Students list who participated in the audit

SI.NO	STUDENT NAME	YEAR	REG.NO	TEAM
1	KRISHNA REDDY N	3RD	18HPIA0229	WATER
2	MUBASHERUDDIN V	4TH	17HPIA0233	
3	RITHUICK G	4TH	18HP5A0210	
4	SHALEEM K	4TH	17HP1A0248	
5	SREE SAI CHARAN N	4TH	17HPIA0249	BIODIVERSITY
6	PRATHYUSHA U	4TH	17HP1A0213	

SI.NO	STUDENT NAME	YEAR	REG.NO	TEAM
7	UMESH CHANDRA G	4TH	17HP1A0251	
8	RAKESH K	4TH	17HPIA0243	
9	JIGNESH G	3RD	18HP1A0227	ENERGY
10	HARIPARAN P	3RD	18HPIA0226	
11	SAMBHU J	3RD	19HP5A0209	
12	MOHAN K	3RD	18HP1A0233	
13	RAGHU M	4TH	17HPIA0241	
14	HARSHA I	4TH	18HP5A0207	
15	VISHNUPRIYA S	4TH	17HP1A0221	
16	YESHWANTH K	4TH	17HP1A0255	

The above students are actively participated in this energy and green audit conducted at ALIET. The students are divided into three teams: water, biodiversity, and energy. For each team task was assigned to collect the required data for energy management, water management and biodiversity. The gathered data by students was collected and analysed to suggest conservation and improvement measures to the institution to maintain the campus green and sustainable.

ENERGY AUDIT

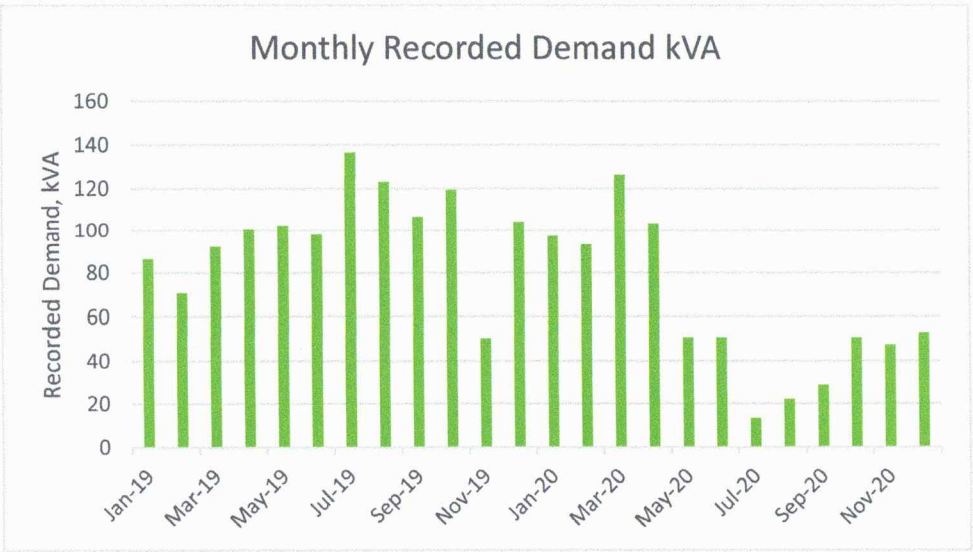
2.0 Energy Audit

An energy audit is an inspection, survey and analysis of energy flow for energy conservation in a building, process or system to reduce the amount of energy input into the system without negatively affecting the output. The energy audit consists of a detailed examination of how a facility uses energy and what it pays for the energy which is consumed. Reducing energy consumption while maintaining or improving human comfort, health and safety are of primary concern. The primary objective of energy audit is to determine ways to reduce energy consumption per unit of product output or to lower operating cost. Energy audit provides a "benchmark" for managing energy in the organization and provides the basis for planning a more effective use of energy throughout the organization. Therefore, by conducting an energy audit program the overall efficiency of a system can be improved.

2.1 Observations

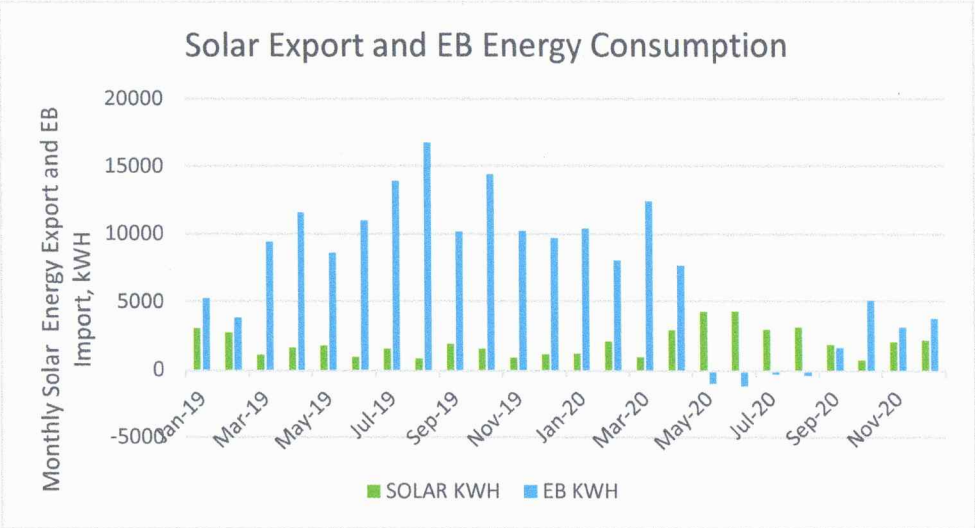
2.1.1 Historical Energy Consumption details

Figure 2. *Recorded demand*



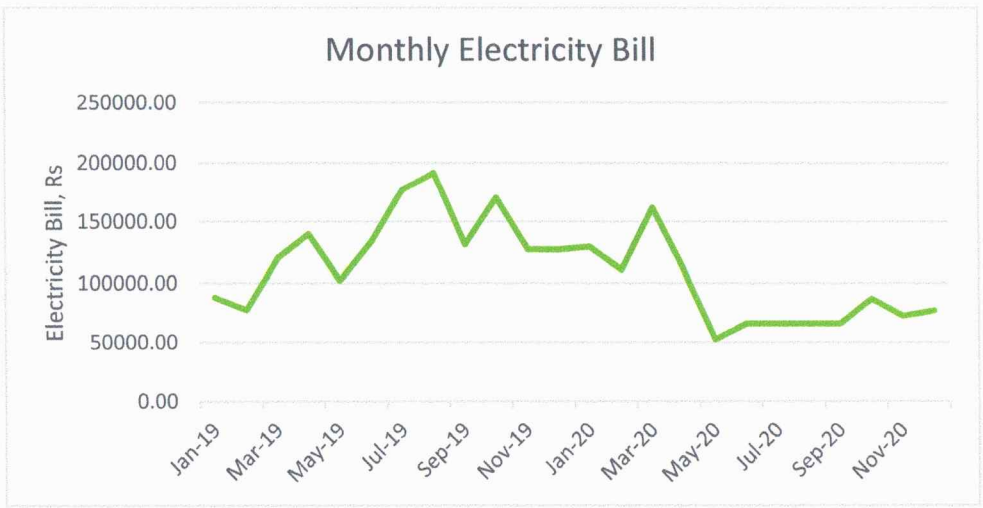
Contract demand is 120 kVA and recorded demand crossed in few months. Highest demand recorded was 136.6 kVA in July 2019 and minimum demand was 13.2 kVA in July 2020. Due to covid 19 college was not fully functional in many months and that leads to lower demand.

Figure 3. *Solar Export and EB Import*



As campus is having 100 kW solar plant every month there is partial export of solar energy which above internal consumption. In 2020 May to August months there was net export to grid due low internal consumption. Average monthly export was 1986 kWh and import were 7396 kWh.

Figure 4. *Annual energy charge profile*



Maximum electricity bill was Rs191554 in August 2019 and minimum bill was 52346 in May 2020. Reduction in energy bill in 2020 is mainly due to partial operation of the campus due to covid-19.

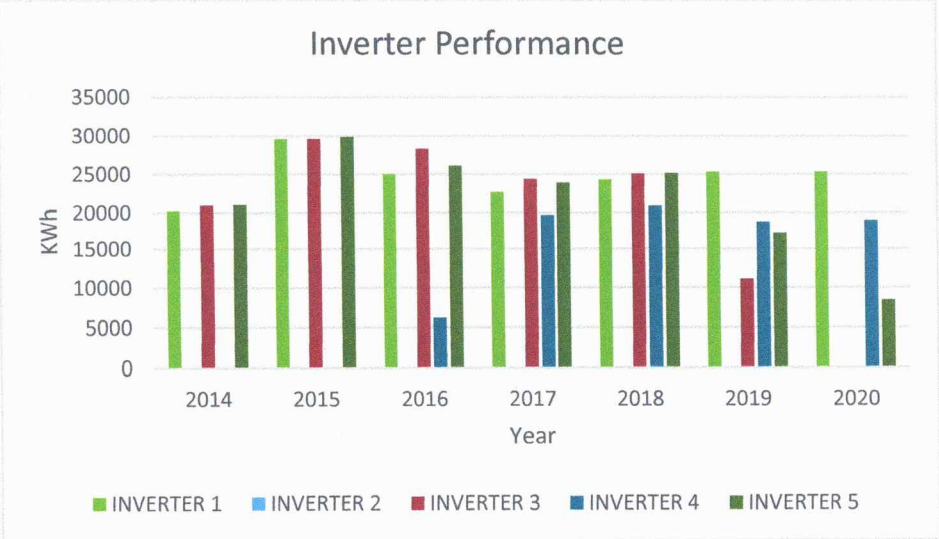
Table 4. Inverter data

YEAR	INVERTER 1	INVERTER 2	INVERTER 3	INVERTER 4	INVERTER 5
2014	20254	NA*	20998	NA	21093
2015	29610	NA*	29594	NA	29902
2016	25001	NA*	28228	6200	26047
2017	22684	NA*	24337	19699	23843
2018	24286	NA*	25060	20905	25128
2019	25379	NA*	11101	18762	17087
2020	25379	NA*	0	18996	8372

* Display buttons are not working. So data could not verify.

Above table gives the overall energy generated and energy supplied to the grid. The annual power requirement met by the institution through renewable energy source is 36.31%. The total renewable energy generated is 114745 kWh and the energy supplied to the grid is 20861 kWh. Inverter 2 data cannot be taken because the buttons not working. As per observation inverter 3 is not working from august 2020 to present.

Figure 5. *Inverter Performance*



Over the years the inverter performance starts declining due to lack of maintenance of inverter. And from the observations in the year 2020 some inverters are not working. Highest total power generated

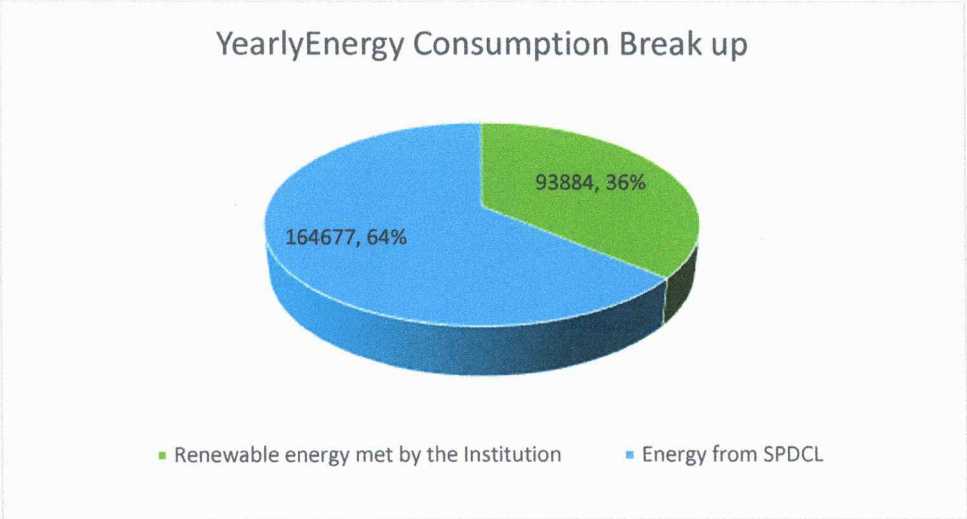
recorded is 29902 kWh. Recorded lowest power generated is 6200kWh. Proper maintenance is required for inverters to increase its efficiency in the coming years.

Based on the historical data one-year total generation, export and total consumption is given below

Table 5. Annual Energy Consumption data

Duration June 19-May 20	Total Renewable energy generated	Solar generated and supplied to grid	Renewable energy met by the Institution	Energy from SPDCL	Total Energy through Solar + SPDCL
	kWh	kWh	kWh	kWh	kWh
Energy Consumption	114745	20861	93884	164677.00	258561.00

Figure 6. *Energy Consumption Breakup*



DG generation details are not recorded but based on Diesel consumption details average diesel consumption is less than 30 litters per month that includes test run and hence not considered.

2.1.2 Good Practices

- 100kW grid connected solar plant is installed at the roof-top of the campus as an alternate renewable source of energy.
- The solar power generated by the 100kw plant is also supplied to the grid.
- In classrooms tube lights are replaced with the LED lights.
- Good energy conservation practices such as switching off AC and fans when not required.
- Staffs and students are encouraged to come by bicycle or by public transport.

- Conducting seminars every year on the topic of Energy Conservation.

2.1.3 Main Observations

- Daily energy recording and monitoring is not available.
- DG energy recording is not available.
- Solar inverter performance is decreasing due to lack of continuous monitoring and timely maintenance.

2.1.4 East Block

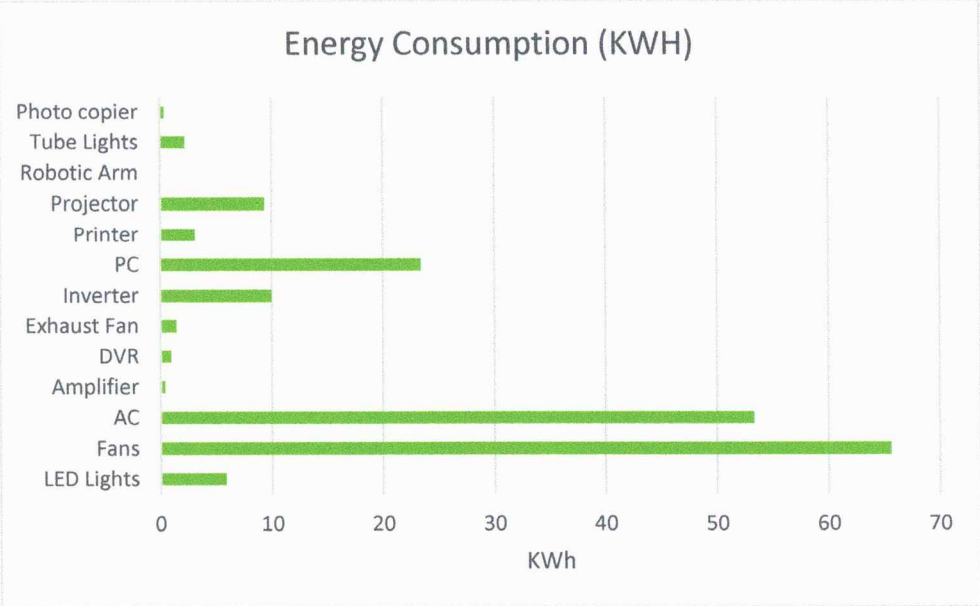
Table 6. East block power consumption

Sl. No	EQUIPMENT	Wattage(W)	No. of Equipment	Energy Consumption (KWH)
1	LED Lights	10	12	0.1
2	LED Lights	20	20	5.8
3	Fans	70	127	58.2
4	Fans	50	7	0.3
5	Fans	36	28	7.1
6	AC	1760	10	53.3
7	Amplifier	350	2	0.4
8	DVR	40	1	1.0
9	Exhaust Fan	60	3	1.4
10	Inverter	1000	3	10
11	PC	100	51	23.4
12	Printer	340	7	3.1
13	Projector	240	20	9.4
14	Robotic Arm	120	2	0.1
15	Tube Lights (T5)	18	6	0.9
16	Tube Lights (T8)	36	20	1.4
17	Photo copier	100	4	0.4

Above table gives a detailed data about the power consumption of every individual equipment in the east block. The per day energy consumption of the college was estimated with the data provided after the survey. From the above data, East Block of the campus shows high consumption of energy followed by west and north blocks. The usage hours of fans and ac's are more in the east block. Other than that PC's,

projectors and lights consume more power next to fans. Estimated East block total power consumption per day is 176.265 kWh on full working condition. But the actual power consumption may fluctuate based upon the occupants in the classrooms, staff rooms and in labs.

Figure 7. *East block energy consumption*



Above figure describes the individual energy consumption of the equipment. In east block major power consumption is by fans next to that ACs consuming more power. Fans consume 65.59 kWh per day and ACs consume 53.32 kWh per day. This is an estimated power consumption of individual equipments. Actual power consumption may vary based on the occupants, working hours as per schedule.

2.1.5 West Block

Table 7. West block power consumption

SI.NO	EQUIPMENT	WATTAGE	NO. OF EQUIPMENTS	ENERGY CONSUMPTION (KWH)
1	LED Lights	20	149	15.3
2	LED Lights	15	24	0.7
3	LED Lights	12	38	0.9
4	LED Lights	40	2	0.2
5	Ceiling fans	70	137	43.5
6	AC	1760	8	28.1
7	Tube Lights T8	36	44	8.6

SI.NO	EQUIPMENT	WATTAGE	NO. OF EQUIPMENTS	ENERGY CONSUMPTION (KWH)
8	Tube Lights T12	40	1	0.2
9	Incandescent Lamps	60	3	0.6
10	Focus Lights	10	2	0.04
11	Focus Lights	20	2	0.1
12	Sodium vapour lamps	300	2	1.2
13	Amplifiers	350	3	2.1
14	Speakers	200	2	0.8
15	Speakers	100	1	0.2
16	Speakers	10	8	0.03
17	Batteries	120	20	2.4
18	Camera	3	11	0.7
19	Camera	5	5	0.6
20	Computers	100	63	39.8
21	DVR	40	3	2.9
22	Printer	400	2	0.4
23	Projector	240	2	1.9
24	Refrigerator	130	1	3.1
25	UPS	1600	1	0.8

Table above gives a detailed data about the power consumption of every individual equipment in the west block. The per day energy consumption of the college was estimated with the data provided after the survey. From the above data, West Block of the campus consume low power compared to east and south blocks. The usage hours of fans and computers are more in the west block. Other than that LED lights, ac's and tube lights consume more power next to fans and computers. Estimated west block's total power consumption per day is 155.08 kWh on full working condition. But the actual power consumption may fluctuate based upon the occupants in the classrooms, staff rooms and in labs.

Figure 8. *West block energy consumption*

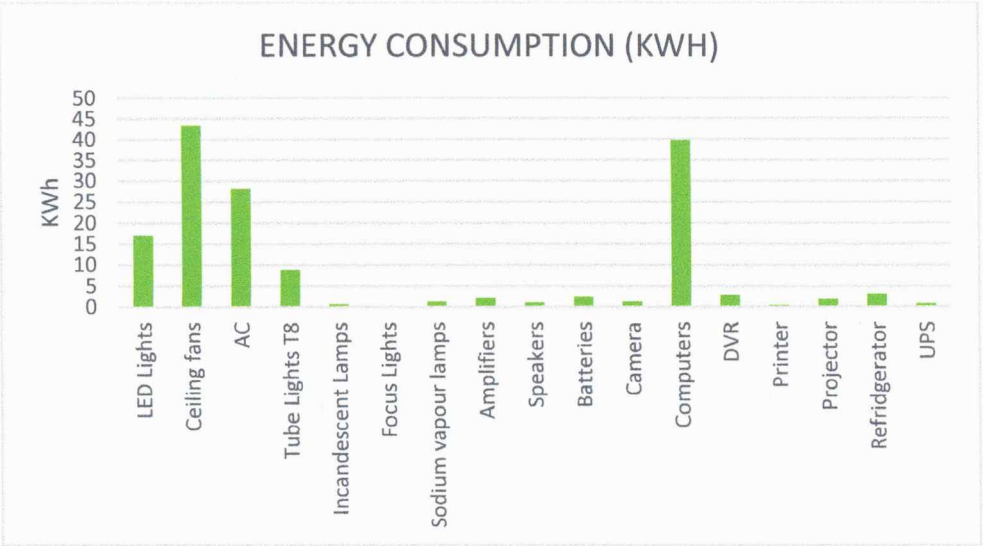


Figure above describes the individual energy consumption of the equipment's. In west block major power consumption is by fans next to that computers consuming more power. Fans consume 43.47 kWh per day and ACs consume 28.14 kWh per day. Since computer labs are more in the west block power consumption of computers is high next to fans. This is an estimated consumption of individual equipment's actual power consumption may vary based on the occupants, working hours as per schedule.

2.1.6 North Block

Table 8. North block power consumption

SI.NO	EQUIPMENT	WATTAGE	NO. OF EQUIPMENTS	ENERGY CONSUMPTION (kWh)
1	LED Lights	20	44	2.3
2	LED Lights	10	2	0.2
3	Fans	53	27	12.9
4	Exhaust Fan	6	3	0.2
5	DC machine	35	1	0.04
6	Projector	240	3	1.8

Table above gives a detailed data about the power consumption of every individual equipment in the north block. The per day energy consumption of the north block was estimated with the data provided after the survey. From the above data, north block of the campus consumes low power compared to east and south blocks. The usage hours of fans are more in the north block. And based on the lab sessions the

power consumption may vary. Estimated north block's total power consumption per day is 17.48 kWh on full working condition. But the actual power consumption may fluctuate based upon the occupants in the classrooms, staff rooms and in labs.

Figure 9. *North block energy consumption*

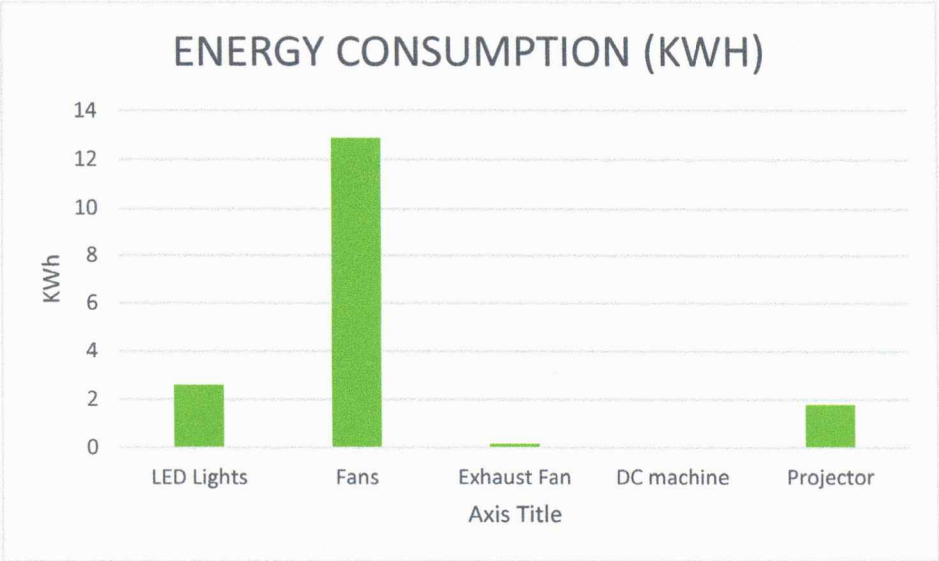


Figure above describes the individual energy consumption of the equipments. In north block major power consumption is by fans next to that LED lights consuming more power. Fans consume 12.87 kWh per day and LED lights consume 2.34 kWh per day. Lab equipments power consumption may vary based on the lab schedule. This is an estimated consumption of individual equipment. Actual power consumption may vary based on the occupants, working hours as per schedule.

2.1.7 South Block

Table 9. South block power consumption

SI.NO	EQUIPMENT	WATTAGE	NO OF EQUIPMENT	ENERGY CONSUMPTION (kWh)
1	TUBE LIGHTS (T5)	18	77	6.7
2	TUBE LIGHTS (T8)	36	90	15.5
3	TUBE LIGHTS (T12)	40	5	0.4
4	LED Lights	20	110	6.7
5	Fans	70	269	74.4
6	AC	1760	62	411.8

SI.NO	EQUIPMENT	WATTAGE	NO OF EQUIPMENT	ENERGY CONSUMPTION (kWh)
7	Amplifier	350	1	0.18
8	Computers	100	638	294.5
9	DVR	40	5	1.6
10	Exhaust fan	40	2	0.6
11	Laptops	50	4	7.2
12	Printers	340	2	1.0
13	Printers	240	4	1.0
14	Printers	100	1	0.2
15	Projector	240	21	7.0
16	Welding	250	1	0.1
17	Welding	9	1	0.1
18	Welding	27	2	0.1

Table 8 gives a detailed data about the power consumption of every individual equipment in the south block. The per day energy consumption of the south block was estimated with the data provided after the survey. From the above data, south block of the campus power consumption is high compared to east and west blocks. The usage hours of ACs are more in the south block. Since there are more computer labs in south block the power consumption of computers is observed high. Estimated south block's total power consumption per day is 17.48kWh on full working condition. But the actual power consumption may fluctuate based upon the occupants in the classrooms, staff rooms and in labs.

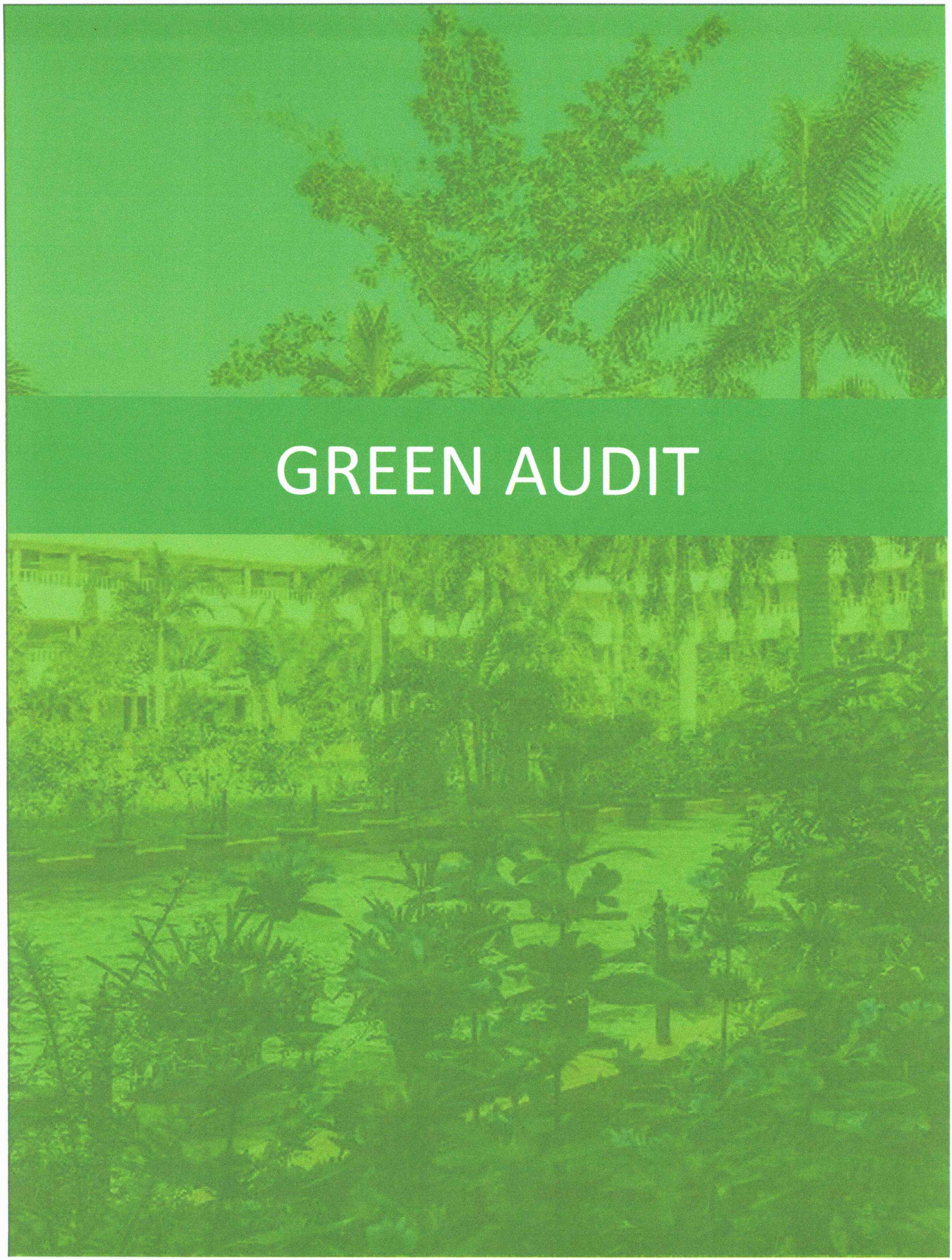
Figure 10. *South block energy consumption*

Figure 7 describes the individual energy consumption of the equipment's. In south block major power consumption is by ACs followed by computers. ACs consume 411.84 kWh per day and computers consume 294.55 kWh per day, since computer labs consume more power due to continuous running of ACs and computers during lab sessions. This is an estimated consumption of individual equipments. Actual power consumption may vary based on the occupants, working hours as per schedule.

2.2 Recommendations

- Measurement and monitoring is important step in energy management. Record daily demand, solar generation, EB consumption, DG diesel consumption and generation and monitor the deviations. This will help to plan the demand and identify reduction in solar energy generation due to faults.
- Replace derated capacitor and change to APFC to maintain PF near unity at incomer.
- Few places like computer labs and corridors tube lights are found. Replace them with the LED lights which will reduce lighting energy and also reduces heat load in the lab. Hence it will reduce AC energy consumption.
- Keep set temperature as 24 degree Celsius for all air conditioners in the campus.
- Connect RO line to tank near the tank and allow overflow to staff tank which will avoid usage of pump for pumping back.
- Replace 70W ceiling fans with 28W energy efficient BLDC fans to reduce power consumption.

- Disable screen savers and set automatic sleep mode in computers, so that energy can be saved when the computers are not in use.
- Provide high SRI paint coating on terrace which will reduce heat gain and hence AC energy consumption.
- Provide false ceiling at computational fluid dynamics lab to reduce the heat load in the room
- Provide reflective film in window glasses in air-conditioned rooms.
- Install smaller pump to utilise harvested rain water which will reduce usage of bore well water for irrigation and energy consumption.
- Purchase 4 star/5 star rated equipment's which consumes less energy.
- Purchase only IE3 motors, in case of replacement of existing motors.
- Ensure photocopiers and printers is switched-off when not in use, so that idle power consumption can be avoided.
- Fix occupancy sensors in classrooms, washrooms and staffrooms to avoid power consumption when the occupants are not there.
- Conduct switch off drills at regular intervals.



GREEN AUDIT

3.0 Green Audit

Green Audit is a process of systematic identification, quantification, recording, reporting and analysis of components of environmental diversity of an institution. It aims to analyse environmental practices within and outside the concerned sites, which will have an impact on the eco-friendly ambience. Green audit can be a useful tool for a college to determine how and where the energy, water or other resources are used the most; the college can then consider how to implement conservation measures and make savings. It can also be used to determine the type and volume of waste, which can be used for a recycling project or to improve waste minimization plan. Green audits can be a highly valuable tool for college in a wide range of ways to improve their environmental, economic performance and reputation, while reducing wastages and operating costs. The main objective of the green audit is to promote Environment Management and Conservation in the College Campus.

3.1 Waste Management

Waste management is a process used to measure the type and amount of waste generated by an organization. Waste generated in the campus varies from paper, plastic, food, and sanitary items. Their sources include academic blocks, hostels, office and canteen. Special attention should be given to the handling and management of hazardous waste generated in the college. Bio-degradable waste can be effectively converted to fertilizer by composting mechanism. Non-biodegradable waste can be utilized through recycling and reuse. This waste audit gives the overview of existing waste disposal methods and suggest effective and safe disposal of waste in the campus. Thus, minimization of waste is essential for a college to be sustainable.

3.1.1 Observations

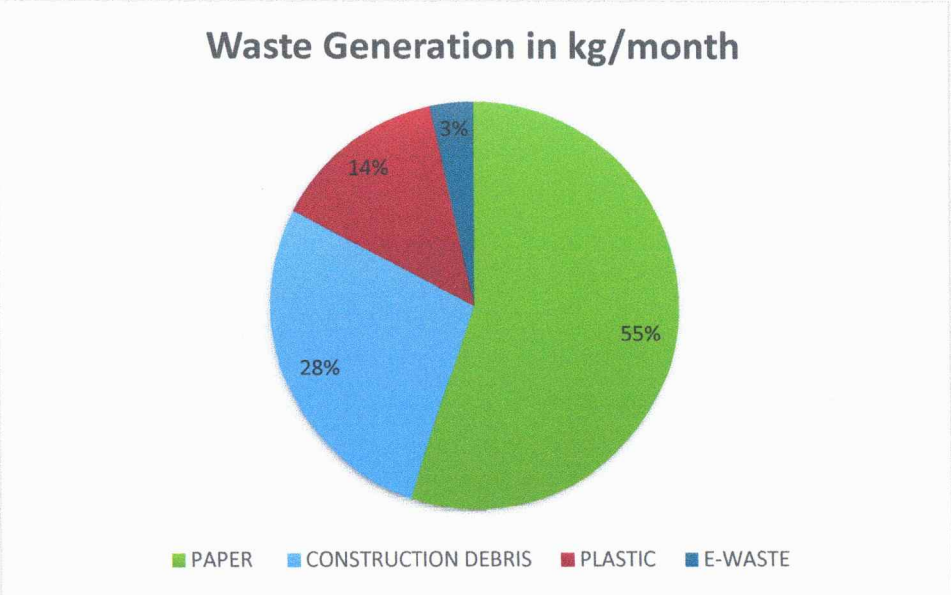
- Everyday 8kg of paper and 2kg of plastic waste is generated.
- For E-Waste disposal MOU signed with Clean Earth Green Earth Solutions.
- Paper waste from office/class and labs are stored and sent for recycling
- Incinerator is fixed for safe disposal of sanitary waste.
- Separate bins are not there for bio-degradable and non-biodegradable waste
- No quantification of waste daily or monthly basis.

- Other solid waste is collected and disposed by the municipal corporation.
- DG changed oil is taken back by DG service person.
- Garden waste is collected and dumped in backyard.
- Waste from chemistry lab is going to same drain.
- Complete sewage line is connected to municipal sewage system.
- Steel glasses are provided for drinking water.

Table 10. Waste generation

S.NO	TYPE OF WASTE	QUANTITY IN KG/DAY	QUANTITY IN KG/MONTH
1	PAPER	8	200
2	CONSTRUCTION DEBRIS	4	100
3	PLASTIC	2	50
4	E-WASTE	0.5	12.5

Figure 11. *Total waste generation*



In the campus generate nearly 12.5kg of waste is everyday including paper, plastics, construction debris and E-waste. By per month data, 70% waste come from paper, 17% waste from plastic, 28% waste from construction debris and 4% waste from E-waste. As per observations the college should take initiative to reduce their overall waste. Most of the waste come from used papers in classrooms. Use reusable

resources and containers. Avoid unnecessary packaging where-ever possible. Keep the generation of plastic waste to a minimal. Waste from construction debris is found around the campus. So, this waste can be effectively reused for landscaping. Only minimum amount of E-waste is generated inside the campus and they have signed a MOU with Clean Earth Green Earth Solutions for collection and disposal of E-waste. Incinerator is fixed for the safe disposal of sanitary waste. Separate bins should be placed for bio-degradable and non-biodegradable waste disposal. Educate the students on how to use the bins and their purpose. Maintain proper records on type of waste, quantity of waste and the vendor details on daily basis. Establish vermicompost pits for dumping garden and wet waste from campus. Monitoring waste generation is a must to become a zero-waste campus. Paper waste can be reduced by using both the sides before disposal. Yearly target should be set by the college in reducing the waste generation. Nearly 1.87 tonnes of papers are sent to Academy of Gandhian studies for recycling. Awareness programs to be conducted among staffs and students on effective use of resources and contributing to the environment.

3.1.2 Recommendations

- Reduce the absolute amount of waste that is produced from classrooms.
- Keep biodegradable and non-biodegradable waste bins for segregation of waste.
- Establish vermicompost pits for dumping dry leaves, green waste and wet waste.
- Use construction debris waste for landscaping.
- Maintain records for type of waste and amount of waste disposed.
- Use concrete block from civil lab for landscaping application.
- Keep proper record of DG oil replaced and ensure proper disposal.

3.2 Water Management

Water Audit is a qualitative and quantitative analysis of water consumption to identify means of reducing, reusing and recycling of water. Water audit is a method of quantifying all the flows of water in a system to understand its usage and improve water conservation. Water audit gives an idea about the amount of water that is consumed in the college for activities like washing hands, drinking, in the laboratories, watering for garden and flushing toilets and urinals. From the results obtained, students and staffs will consider better ways to improve water conservation throughout the building and on college campus. It is therefore essential that any environmentally responsible institution should examine its water use

practices. Water audit provides overview of the water use trends, effectiveness of conservation measures and potential cost and water savings.

3.2.1 Observations

- Three borewells are available in the campus to meet the water requirement.
- Overhead tanks of 2X 5000 litters for fire water, 6 X 2000 liters for raw water and 1X 1000+1 X 750 liters RO water are installed in Main block.
- Overhead tanks of 2X 5000 liters for fire water, 3 X 2000 liters for raw water and 1X 1000 liters RO water are installed in MBA block.
- Exact consumption details are not available as water meters are not installed.
- Rainwater harvesting system is implemented in the campus.
- Rainwater harvesting tank and pits are overflowing as stored water is not used.
- In Block-2 rainwater harvesting pits are not connected to drainpipes.
- In Block-2 overhead main tank is leaking.
- RO water system is provided for drinking water.
- Wastewater from RO plant is reused for flushing and hand washing.
- Found two taps leaking in chemistry lab washrooms.
- The main source of water is from three borewells inside the campus.
- Approximate water consumption is 10000 litres/day.
- Periodic testing of raw water and drinking water is done.
- Open pipe irrigation is used in the campus.
- Around 200 taps are installed in the campus.
- Water flow varies from 5 lpm to 12 lpm.
- Solar panels cleaned once in two weeks using fresh water and approximately 5000 litres.

Table 11. Water testing results

Sl.NO	Parameters	Unit	Drinking Water 1 Result	Drinking Water 2 Result	Bore Well Water Result	IS: 10500-2012 Specification
1	Color	Hazen	<1.0	<1.0	<1.0	5
2	Odor	-	Agreeable	Agreeable	Agreeable	Agreeable
3	Turbidity	NTU	<0.01	<0.01	<0.01	1

Sl.NO	Parameters	Unit	Drinking Water 1 Result	Drinking Water 2 Result	Bore Well Water Result	IS: 10500-2012 Specification
4	Ph	-	7.06	6.94	7.77	6.5-8.5
5	TDS	mg/l	51	31	742	500
6	Total Alkalinity	mg/l	26	18	424	200
7	Total Hardness	mg/l	20	17	556	200
8	Calcium as Ca	mg/l	4	2.4	60.9	75
9	Magnesium as Mg	mg/l	2.43	2.67	96.7	30
10	Chlorides	mg/l	13.1	8.25	161	250
11	Fluorides	mg/l	0.22	0.21	0.58	1
12	Nitrates	mg/l	2.55	<1.0	20.6	45
13	Sulphates	mg/l	<1.0	1.3	18.4	200
14	Iron	mg/l	<0.01	<0.01	0.03	0.3

3.2.2 Recommendations

- Install water meters (Bore well, RO, irrigation) and monitor overall consumption of water inside the campus and take necessary actions when required.
- Store wastewater from RO in the rainwater harvesting tank and use the water for gardening.
- Connect block-2 drainpipes to the rainwater harvesting pits so as to conserve rainwater.
- Repair leakage taps and tanks to avoid wastage of water.
- Implement automatic on/off pump system to avoid overflowing of overhead tanks.
- Use aerated taps to conserve more water.
- Conduct awareness programs on water conservation for students.
- Adjust the main pipe regulator to reduce the water flow to 5 lpm in hand washing areas.
- Check the option for drip irrigation.
- Planting native trees in place of exotic plants will reduce the water requirement for irrigation.

3.3 Biodiversity

Biodiversity audit ensures greenery and sustainability of the campus. The biodiversity audit is conducted to analyse the present biodiversity status of the college and to propose plans to enhance the existing biodiversity. In this audit focus has been given on assessment of present status of diversity which includes trees, shrubs, birds, and other habitats in and around campus. Efforts are also made by the college authorities to conserve the nature. In this audit, student volunteers were involved to identify the flora and fauna present inside the campus. The focus is also given on pollution control methodology, best practice for environment conservation, etc. This audit gives recommendations to the college for the conservation, protection of the natural vegetation and animal life by involving students and faculty members to make the institute campus biodiversity rich.

3.3.1 Observations

- Nearly 59 floral species are found in the campus.
- Food and water pots are kept inside the campus for feeding the animals and birds.
- Inside the campus landscaping has been done in an attractive way.
- The faunal diversity is less compared to floral diversity.
- Many exotic trees are found inside the campus.
- Flowering plants are more compared to medicinal and herb plants.

Table 12. Floral species in the campus

S.NO	Common Name	Scientific Name
1	Mauritius hemp	Furcraea foetida
2	Oleander spurge	Euphorbiaceae
3	Kudzu	Pueraria montana
4	Asian spyder flower	Clomeviscosa
5	Prostrate shrub	Euphorbiaceae
6	Dogbanes	Apocynaceae
8	garden croton	Codiaeum variegatum
9	Pink periwinkle	Catharanthus roseus
10	Travers palm	Ravenala madagascariensis
11	Corn plant	Dracaena fragrans
12	Bermuda grass	Cynodon dactylon

S.NO	Common Name	Scientific Name
13	Bismarck Palm	Arecaceae
14	African arrowroot	Canna indica
15	Cedar	Juniperus communis
16	Candelabra spurge	Euphorbia lactea
17	Caricature Plant	Graptophyllum pictum
18	Garden croton	Codiaeum variegatum
19	Cactus	Cactaceae
20	Cycus	Cycadaceae
21	Prickly pear	Cactaceae
22	Tulsi	Ocimum tenuiflorum
23	Copper leaf	Acalypha Wilkesiana
24	Dumb cane	Dieffenbachia seguine
25	Caricature Plant	Graptophyllum pictum
26	poinsettia	Euphorbia ingens
27	Eggplant	Solanum melongena
28	Oleander	Nerium oleander
29	Cypress	Cupressus sempervirens
30	Santa Maria	Parthenium hysterophorus
31	Crane flower	Strelitzia reginae
32	Moses in the Cradle	Tradescantia spathacea
33	Spanish dagger	Yucca gloriosa
34	Lobster-claw	Heliconia rostrata
35	Lamiaceae	Teucrium marum
36	Waffle plant	Strobilanthes alternata
37	Cape periwinkle	Catharanthus roseus
38	Grand crinum lily	Crinum asiaticum
39	Purple heart	Tradescantia pallida
40	Christ plant	Euphorbia milii
41	Dunchi	Legume Sesbania bispinosa
42	Paper reed	Cyperus papyrus
43	Chinese ixora	Ixora chinensis
44	Ashoka	Saraca asoca
45	Peepal	Ficus religiosa
46	Fishtail palm	Caryota mitis

S.NO	Common Name	Scientific Name
47	Ceylon cherry	Prunus ceylanica
48	Tree of heaven	Ailanthus excelsa
49	Latan palm	Latania
50	Silver palm	Bismarckia nobilis
51	Indian almond	Terminalia catappa
52	Batai wood	Falcataria moluccana
53	Pongam	Millettia pinnata
54	Flamboyant	Delonix regia
55	European nettle	Celtis australis
56	Coconut palm	Cocos nucifera
57	Toddy palm	Caryota urens
58	Pandan	Pandanus amaryllifolius
59	Banyan	Ficus benghalensis

Table 13. Faunal species in the campus

Sl.NO	Common Name	Scientific Name
1	Spotted dove	Streptopelia chinensis
2	Common hawk-cuckoo	Hierococcyx varius
3	Asian koel	Eudynamys scolopaceus
4	House sparrow	Passer domesticus
5	Lizard	Lacertilia
6	Pigeon	Columbidae
7	Ants	Formicidae
8	Butterflies	Rhopalocera
9	Rat	Rattus
10	Snake	Serpentes
11	Beetles	Coleoptera
12	Dragonfly	Anisoptera

3.3.2 Recommendations

- To maintain the college campus green and eco-friendly, more trees need to be planted so that carbon neutrality can be maintained.
- Plant more native trees rather than exotic species to maintain plant diversity.

- Review the list of trees planted in the garden periodically, allot numbers to the trees and keep records. Assign scientific names to the trees.
- Create awareness of environmental sustainability among students and take actions to ensure environmental sustainability.
- Indoor plantation to be encouraged, Bonsai can be planted in corridor to bond a relation with nature.
- All trees in the campus should be named scientifically.
- Establish drip irrigation system for watering plants and trees to save more water.
- Plant more medicinal plants and fruit bearing trees to maintain plant diversity.
- The faunal diversity is low; however, it can be improved by planting more flowering and fruit bearing plants.

3.4 Carbon Foot Print

Carbon footprint due to transport, energy consumption and internal diesel consumption is analysed, and the details are given below.

Table 14. Carbon Foot Print Analysis

Carbon Footprint Analysis	Unit	CO2
Total number of vehicles used by the stakeholders of the college. (per day)	Nos	1895
No of cycles used	Nos	70
No of two wheelers used	Nos	630
Average distance travelled	km	7
No of cars used (average distance travelled and quantity of fuel and amount used per day)	Nos	8
No of persons using public transportation	Nos	1195
No of persons using college conveyance	Nos	NA
No of generators used per day	Nos	1
Average Amount of fuel used for fuel	liters/moth	25
Grass cutting machines consumption Diesel	Liters/month	10
Estimated average diesel consumption for two weeler (Considered mileage of 45 km)	Liters/day	98
Estimated average diesel consumption for car (Considered mileage of 17km)	liters/Day	3.29
Average monthly diesel consumption (Average 20 Days)	Liters/month	2026

Carbon Footprint Analysis	Unit	CO2
Average net monthly electricity from grid	kWh/month	13723
Annual CO2 Emissions for grid power (Factor 0.91 TCO2/MWh)	Tons of CO2	150
Annual CO2 Emissions for internal diesel use (Factor 2.5 kg/liter)	Tons Co2	1
Annual CO2 Emissions for transport (Factor 2.5 kg/liter)	Tons Co2	61
Total CO2 emission	Tons Co2	212

3.4.1 Observations

- Major carbon emission is for the electricity usage.
- Encourage carpooling and usage of cycles planting more trees will help to reduce net carbon emission.

Registered Office

Bigeta Energy Solutions LLP

K 206, Confident Atik, Sompura Gate, Sarjapura,
Bangalore-562 125, Karnataka
info@bigetaenergy.com, +91 99 00 591 000
www.bigetaenergy.com

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