Criterion VII: Institutional Values and Best Practices

7.1 Institutional Values and Social Responsibilities

7.1.3: Quality audits on environment and energy regularly undertaken by the Institution. The institutional environment and energy initiatives are confirmed through the following

Index

Green Audit Certificate

Green Audit

is awarded for the year **2022-23** & **2023-24** to the Esteemed Institution

Indapur Taulka Shikshan Prasarak Mandal's

Arts, Science & Commerce College, Indapur

Tal-Indapur, Dist- Pune. 413106

As part of the Institution's initiatives for a Healthy & Sustainable College the audit was conducted.

We appreciate the immense efforts taken by Management, Staff and students towards the Efficient Management of Premise.

Issued on 17 April 2024 valid till 16 April 2025.

Certificate ID: 0061

0061

Vikram Geoinfo Tech

Revealing Earth Information

(ISO 9001:2015 Certified)

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VIKRAM GEOINFO TECH Chalisgaon

V. M. Agone

Dr. Vikram Agone

Lead Auditor

VIKRAM GEOINFO TECH

GREEN and Environmental Audit

Year 2022-23 and 2023-24

Green Audit

Environmental Audit

Indapur Taulka Shikshan Prasarak Mandal's

Arts, Science & Commerce College, Indapur

Tal-Indapur, Pune-413106

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ACKNOWLEDGEMENT

Vikram Geoinfo Tech thanks the management of ***Indapur Taulka Shikshan Prasarak Mandal's Arts, Science & Commerce College, Indapur, Dist - Pune*** for assigning this important work of GREEN & Environmental Audit. Vikram Geoinfo Tech appreciates the cooperation in the completion of the study. Our special thanks are due to:

- Honourable Chairman
- Honourable Secretary
- Honourable Director Board Members of the college
- Honourable Principal
- IQAC Members
- Teaching & Supporting Staff of College

For giving us the necessary inputs to carry out this very vital exercise of GREEN and Environmental Audit. We are also thankful to other staff members who were actively involved while collecting the data and conducting field measurements.

Vikram Geoinfo Tech
Revealing Earth Information

(ISO 9001:2015 Certified)

(Dr. Vikram Agone)

Founder & Chairman

Vikram Geoinfo Tech

VIKRAM GEOINFO TECH Chalisgaon

DISCLAIMER

Vikram Geoinfo Tech has prepared this report for ***Indapur Taulka Shikshan Prasarak Mandal's Arts, Science & Commerce College, Indapur, Dist - Pune*** based on input data submitted by the representatives of the College complemented with the best judgment capacity of the expert team.

It is further informed that the conclusions have arrived following best estimates and no representation, warranty or undertaking, express or implied is made and no responsibility is accepted by Vikram Geoinfo Tech in this report or for any direct or consequential loss arising from any use of the information, statements or forecasts in the report.

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Report by: Lead Auditor

Vikram Geoinfo Tech
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Auditor

NAME	POSITION	QUALIFICATION
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Vikram Geoinfo Tech, ISO 9001:2015 certified (Reg. No.: UDYAM-MH-14-0037749 / ISO Cert. No.: 305023092154Q), specializes in GREEN, Environmental, and Energy Audits. Using scientific methodology, GIS, remote sensing, and geospatial tools, we deliver precise assessments and actionable recommendations. Our audits cover carbon footprint, water and waste management, biodiversity, air quality, and energy efficiency, providing institutions with sustainable, cost-saving strategies to reduce their environmental impact and align with global standards. Vikram GeoInfo Tech are ISO 9001:2015, Quality Research Organisation (QRO Certification LLP), EGAC, IAF certified Firm.

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INTRODUCTION

Indapur Taulka Shikshan Prasarak Mandal's Arts, Science & Commerce College, Indapur, Dist - Pune aims at creating awareness about environmental awareness. The college takes lead in organizing different events on green practices to know the knowledge among students, teachers, and non-teaching staff. This green message in the form of an environmental audit report being transferred along with its practical dimensions among the families, societies and thereby to the stakeholders, forms a chain and network to spread the message at large. College is additionally geared toward giving resolution to the various burning topics associated with the environment, its awareness still as its protection. As the government is taking initiative to inform about environmental protection, newer concepts are being introduced to make colleges eco-friendly. To create and conserve the environment within the ***Indapur Taulka Shikshan Prasarak Mandal's Arts, Science & Commerce College, Indapur, Dist - Pune*** college campus and to solve the environmental problems such as raising energy savings and conservation, water reduction, water harvesting, solid waste management, improvement in the air quality of the campus, control noise pollution, and minimizing the use of Plastic, etc. is one of the prime objectives of the college.

GREEN and Environmental auditing is essentially an environmental management tool for measuring the effects of certain activities on the environment against set criteria or standards. GREEN and Environmental audit provides an assessment of the environmental performance of a business or organization. The environment audit report is one such initiative that has been introduced to create a college environmentally sustainable and active in spreading education concerning constant. it's a tool to assess general practices enforced by the organization in terms of the impact on the environment. The report additionally aims to unfold awareness of the adverse practices that are accountable for the degradation of the environment and the way powerfully the institute is concerned in curtailing those practices. It helps in recognizing the necessity for colleges to figure around the academic years **2022-23 and 2023-24** for environmental sustainability. Thus, the Environment audit forms the baseline survey to decide on the **green policy**.

The term "***GREEN***" means eco-friendly or not damaging the environment. This can acronymically be called "***Global Readiness in Ensuring Ecological Neutrality***" (GREEN). Green Audit can be defined as the systematic identification, quantification, recording, reporting and analysis of components of environmental diversity. Green accounting can be defined as the systematic identification quantification, recording, reporting & analysis of components of ecological diversity & expressing the same in financial or social terms. "***GREEN Audit***", an umbrella term, is known by another name "***Environmental Audit"***. The 'Green Audit' aims to analyze environmental practices within and outside the college campus, which will have an impact on the eco-friendly ambience. It was initiated with the motive of inspecting the work conducted within the organizations whose exercises can cause risk to the health of inhabitants and the environment. GREEN Audit can be a useful tool for a college or institute to determine how and where it uses the most energy, water or resources. The college or institute can then consider how it can implement changes and achieve savings. It can also be used to determine the type and amount of waste that can be used in a recycling project or to improve a waste minimization plan. It can create health awareness and promote environmental awareness, values and ethics. It gives staff and students a better understanding of the green impact on campus. It is therefore essential that the university evaluates its own contributions to a sustainable future. As environmental sustainability becomes increasingly important to the country, the role of higher education institutions in environmental sustainability is becoming increasingly important. An environmental audit is a type of assessment that aims to identify gaps in environmental compliance and the implementation of management systems, as well as related corrective actions. They therefore fulfil similar function to financial audits.

Educational institutions have broad impacts on the world around them, both negative and positive. The activities pursued by campus can create a variety of adverse environmental impacts. But they are also in a unique position as educational institutions to be leaders in pursuing environmentally sustainable solutions.

The rapid urbanization with economic development at the local, regional and global levels has led to numerous environmental and ecological catastrophes. Environment auditing is the process of documentation and determination of the institution's practices in creating awareness

and practising environment-friendly measures. Over the period overexploitation of natural resources like energy, water, soil, vegetation, etc. has resulted in environmental degradation which will be a crisis in future. It is necessary to check whether our way of living and handling resources is not going to cause detrimental effects on our surroundings.

In this context it becomes essential to adopt the system of the Green Campus for the college which will lead to sustainable development and at the same time decrease a sizable amount of atmospheric pollution from the environment, conserve water and many more. The National Assessment and Accreditation Council, New Delhi (NAAC) has made it compulsory that all Higher Educational Institutions should submit an annual Green Audit/ Environment Audit Report. Moreover, it is part of the Corporate Social Responsibility of Higher Educational Institutions to ensure that they contribute towards the reduction of global warming through carbon footprint reduction measures. The environment audit Report aims at summarising the college's contribution and its activeness in creating awareness and consciousness in practically applying environmentally friendly measures towards an institute in A.Y. **2022-23 and 2023-24**

ENVIRONMENTAL SETTING OF THE COLLEGE

The college has a sprawling pollution-free campus on the northern part of Indapur city. Indapur is a city and taluka in Pune district of Pune Division, Maharashtra, and It is located on state Highway NH 65. The Bhima River flows near the city. College has been situated at 545 m MSL altitude. Indapur has a tropical climate with hot and humid summers and mild winters. The average temperature ranges from 28°C to 40°C in the summer and 10°C to 20°C in the winter. The city receives an average rainfall of 600 mm per year, most of which falls during the monsoon season (June to September). The vegetation in Indapur is mainly tropical deciduous forest. The city is home to a variety of trees and plants.

The college campus is spread over 55675 m^2 (5.56 hectare or 13.74 acres) which include about 2.73-acre sports ground. College is easily accessible by road for the rural area which is 25 km away. Although the campus is located near the residential area, the presence of a green belt considerably reduced noise pollution and provided fresh air on the campus. The College campus area has an academic building, library, parking, canteen and sports ground.

OVERVIEW OF INSTITUTE

The Arts, Commerce, and Science College in Indapur is a renowned educational institution dedicated to providing quality education to students.

With a team of highly qualified faculty members, state-of-the-art infrastructure, and a focus on holistic development, the college has become a preferred choice for students aspiring for a well-rounded education.

The college campus is equipped with modern amenities, including a well-stocked library, laboratories, and sports facilities. It fosters a vibrant learning environment, encouraging students to excel in both academics and extracurricular activities.

The Arts, Commerce, and Science College in Indapur is a renowned educational institution. The college has a team of highly qualified faculty members, state-of-the-art infrastructure, and a focus on holistic development. The college campus is equipped with modern amenities, including a well-stocked library, laboratories, and sports facilities. The college fosters a vibrant learning environment, encouraging students to excel in both academics and extracurricular activities. The college has a strong focus on student development, with various events and activities like NSS camps, NCC, sports, and cultural programs. The college has a clear vision and mission to serve the rural population and uplift the rural youth. The college has received positive testimonials from students, management, university executives, parents, and employers.

VISION

विद्या परम् दैवतम्

We believe knowledge as a great power with divine quality.

MISSION

Our main goal is to serve the rural population & project every rural youth as the most competent individual with up-to-date knowledge.

Our dream is to uplift the rural youth in all respects.

AIMS AND OBJECTIVE

Indapur Taulka Shikshan Prasarak Mandal's Arts, Science & Commerce College, Indapur, Dist - Pune conducted a GREEN and Environmental auditing survey for the year 2022-23. The primary aim of this report is to analyse the environmental profile of the college for GREEN and Environmental Audit. The following were the objectives:

- A baseline survey to recognize the real status of green practices.
- Identification of the problems faced while practising green practices on the college campus.
- Inspection of the current practices that have an impact on the environment such as natural resource utilization, waste management, etc.
- Analysis and suggestion for the plausible solutions for problems identified from the Audit Report.
- Increasing and spreading the awareness for environmental awareness and sustainable use of resources amongst the students, teaching and non-teaching staff members.
- Identification and assessment of any environmental risk if any inside the college campus.
- Enhancement of College profile.
- Improving environmental standards of the institute.
- Financial savings through a reduction in resource use.
- Giving direction and guidance working on local environmental issues.

DATABASE AND METHODOLOGY

The present study is based on visits to the college, personal observations, and a primary database that was collected using sets of questionnaires and other survey tools. The audit report was divided into different areas viz, Carbon footprint, water and water management audit, waste management audit, etc. For a proper survey whole campus was divided into different sections, based on data requirements, sets of questionnaires about water consumption, fuel waste, solid waste collection etc. The WorldView-3's satellite 31cm resolution multi-spectral data is used for supervised classification for preparing a Land use map. The software ERDAS-2022, ArcGIS Pro 3.0.2, IBM SPSS and MS Excel is used for data processing. Calculating carbon footprint using the following formulas,

Electricity: use (kWh/yr) * EF (kg CO_2e/kWh) = emissions (kg CO_2e/yr)
Fuel Oil: use (litres/yr) * EF (kg CO_2e/litre) = emissions (kg CO_2e/yr)
Where EF = emissions factor

Electrical vehicles' CO_2 emissions have been calculated by their consumption of electrical energy. Consumed energy emission is calculated by its generation of energy emission. A noise measuring app, Noise test pro, was used to measure the noise level. Noise test pro detects any noise, music or sound in your surroundings. It will show maximum, minimum and average decibels. Light intensity was measured using the Lux Meter app.

ANALYSIS OF THE DATABASE

The database has been prepared for statistical analysis for the Environment audit using Minitab and IBM SPSS statistical software. The surveys from each group were tabulated in MS Excel spreadsheets. The tabulated data were further analyzed through statistical analysis and computing. For a better understanding of the results and to avoid complications, averages and percentages of the tables were taken. A graphical representation of these results was made to give a summarized picture of the status. The outcome was interpreted with the overall consequences, conclusion and plausible solutions or steps for them.

CARBON FOOTPRINT

A carbon footprint is the total greenhouse gas emissions caused directly and indirectly by an individual, organization, event or product. A carbon footprint is the total amount of greenhouse gases including carbon dioxide and methane that are generated by our actions. carbon footprint, the amount of carbon dioxide (CO_2) emissions associated with all the activities of a person or other entity e.g., building, corporation, country, etc. It includes direct emissions, such as those that result from fossil fuel combustion in manufacturing, heating, and transportation, as well as emissions required to produce the electricity associated with goods and services consumed. It is calculated by summing the emissions resulting from every stage of a product or service's lifetime. The calculations for CO_2 emission were done using the method reported in the methodology. CO_2 emission has been calculated annually by vehicle category of college staff and students.

In the A.Y. 2022-23 and 2023-24 there are 99 & 98 teaching and 29 & 24 non-teaching staff respectively, while 2063 & 2166 students enrolled respectively in the college. The highest CO_2 emissions 36917.10 & 46146.38 kg has been reported by Public Transport use by students respectively, followed by two-wheeler use by students reported 31371.75 & 31887.45 kg of CO_2 emissions in the A.Y. 2022-23 & 2023-24, while the lowest CO_2 emissions has been reported by electrical vehicles used by college staff and students in the A.Y. 2022-23 & 2023-24. Total CO_2 emissions for this academic year of all the vehicles have been **91441.26 & 97691.67 kg** by the college into the atmosphere. Electrical vehicles used by staff and Student's CO_2 emissions have been low i.e., for both academic year emission has **1935 and 1455.13** kg. The college contributes average **321.054 and 300.762** kg per day of CO_2 emission to the atmosphere by using electrical energy, in this way in this A.Y. 2022-23 & 2023-24 total CO_2 emission to the atmosphere by using electrical energy was **40156.425 and 67671.45 kg respectively**. Overall CO_2 emission to the atmosphere from A.Y. 2022-23 & 2023-24 by all activity was **131597.685 and 165363.12 kg** i.e., **131.59 and 165.36 Metric Ton.** Academic year 2022-23 & 2023-24 CO_2 emission particulars are mentioned in the following tables. In India's forests, trees absorb between 41 and 48 kg of CO_2 per square meter annually; in non-forest areas, the absorption is only 4 kg. Therefore, the vegetation on campus has carbon

sequestration of approximately **64769.96 kg** and **74069.36 kg** CO_2 in the years 2022–23 and 2023–24 respectively. In this way, the total activity of the college emits **66827.725 and 91293.76 kg** of **Carbon** into the atmosphere within the years 2022–23 and 2023–24 respectively.

The analysis of aggregate CO_2 emissions across different types of vehicles for the academic years 2022-23 and 2023-24 highlights several trends in transportation emissions. In the 2023-24 academic year, CO_2 emissions from four-wheeler vehicles among staff rose significantly, with an increase in the number of vehicles from 3 to 8, causing a corresponding rise in emissions from 818.78 kg to 2183.40 kg. Conversely, no emissions were recorded from four-wheelers for students in both years, indicating limited or no use of this vehicle category by students. Emissions from two-wheelers used by staff slightly decreased in 2023-24, with a small reduction in the number of vehicles from 87 to 79, resulting in a decrease in emissions from 7477.65 kg to 6790.05 kg. Student two-wheelers showed a slight increase in both the number of vehicles (from 365 to 371) and emissions (from 31371.75 kg to 31887.45 kg), suggesting a consistent reliance on two-wheelers by students, albeit with a minor increase in overall emissions.

For electric vehicles, emissions for staff decreased marginally from 483.75 kg to 454.73 kg, while student electric vehicle emissions also declined significantly from 1451.25 kg to 1000.40 kg. This decrease could be attributed to fewer electric vehicles used by students, dropping from 15 to 11. Interestingly, emissions from public transport showed divergent trends for staff and students. Staff emissions from public transport decreased from 12920.99 kg to 9229.28 kg despite an increase in usage, suggesting more efficient or greener options in 2023-24. In contrast, public transport emissions for students rose significantly from 36917.10 kg to 46146.38 kg, despite a reduction in users, likely due to increased travel distance or other factors affecting public transport emissions. Overall, while some shifts toward sustainable options, such as increased use of bicycles and slight decreases in electric vehicle emissions, are evident, reliance on two-wheelers and public transport remains prominent. These findings highlight the need for promoting more sustainable transport solutions to reduce the institution's carbon footprint in the coming years.

Table 1 Aggregate CO_2 emission for the year 2022-23 & 2023-24 of all the vehicles

Academic Year	2022-23		2023-24	
Type of Vehicles	**No of vehicles**	**CO_2 emission (kg)**	**No of vehicles**	**CO_2 emission (kg)**
Four-Wheeler (Staff)	***3***	818.78	***8***	2183.40
Four-Wheeler (Students)	*0*	0.00	*0*	0.00
Two-Wheeler (Staff)	*87*	7477.65	*79*	6790.05
Two-Wheeler (Students)	*365*	31371.75	*371*	31887.45
Electrical vehicles (Staff)	*5*	483.75	*5*	454.73
Electrical vehicles (Students)	*15*	1451.25	*11*	1000.40
Bicycles (Staff)	*0*	0.00	*1*	0.00
Bicycles (Students)	*25*	0.00	*25*	0.00
Public Transport (Staff)	*21*	12920.99	*29*	9229.28
Public Transport (Students)	*809*	36917.10	*628*	46146.38
Diesel Generator	0	0	0	0

(Source: CO_2 emissions were calculated by using counting of vehicles)

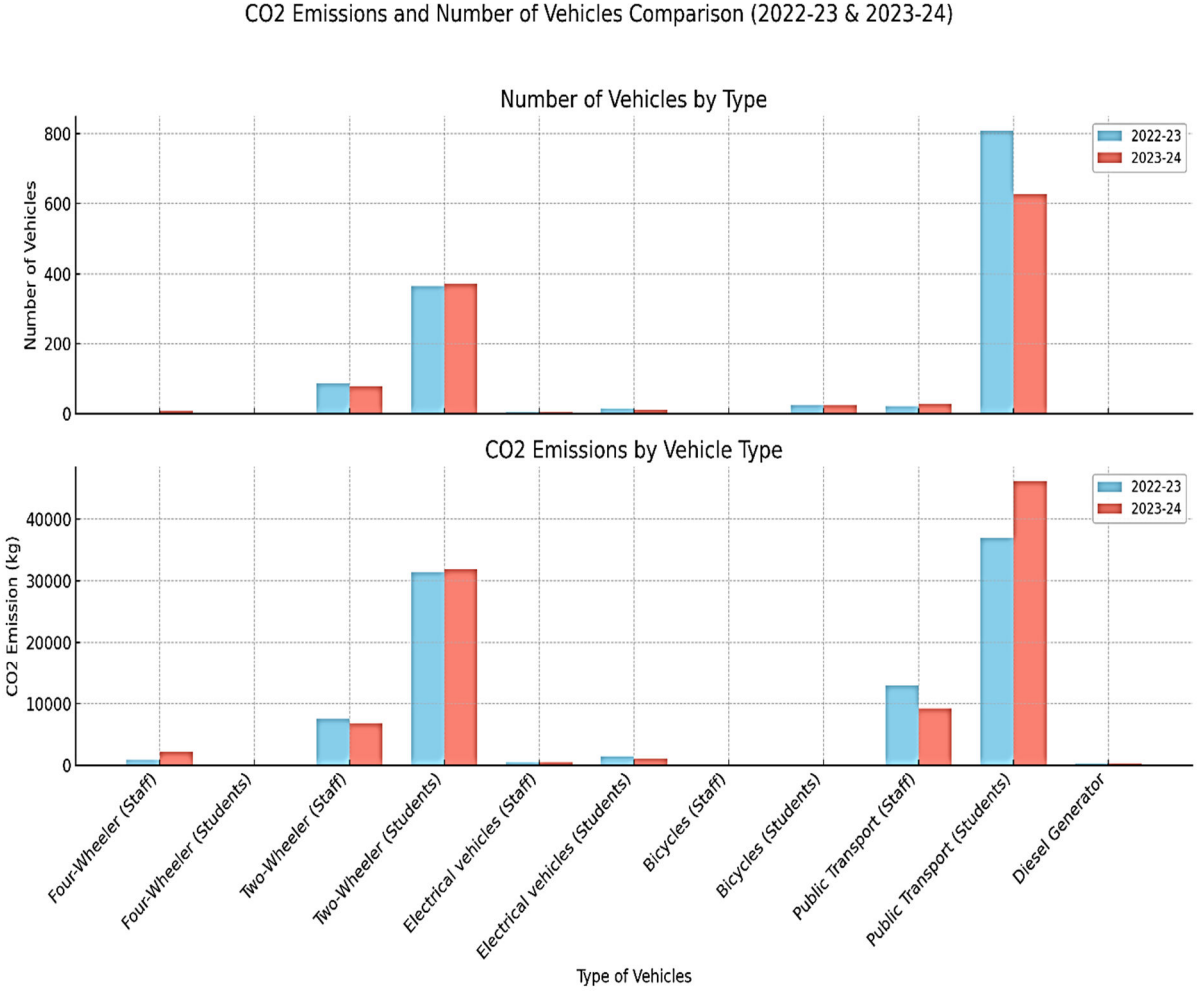

Figure 1 Number of Vehicles and Total CO_2 Emission by Vehicles in A.Y. 2022-23 & 2023-24

BIODIVERSITY CONSERVATION

The campus area of 55675 m^2 (5.56 hectare) consists of the following regions as stated below for land consumption in the built-up area of the college. The west and south region of campus is densely built-up having Main Administrative Block, departments and lecture rooms. The northern and central region comprises Sports ground and bare land. The periphery boundary of the campus has various types of trees observed. Approximately 16192.490 and 18517.340 sq. m of the region is occupied by trees and forms the part of green cover of the campus in the A.Y 2022-23 and 2023-24 respectively. Vegetation area has been reported good in the both academic years. The vegetation on campus has carbon sequestration of approximately 64769.96 kg and 74069.36 kg CO_2 in the years 2022–23 and 2023–24 respectively.

Table 2 Land-Use of the College campus

Academic Year	**2022-23**		**2023-24**	
Land Use	**Area (m^2)**	**Area (acre)**	**Area (m^2)**	**Area (acre)**
Built-up	9272.725	2.30	9272.725	2.30
Vegetation	16192.490	4.01	18517.340	4.58
Play Ground	15112.879	2.73	15112.879	2.73
Bare land	31289.396	7.73	31289.396	7.73

(Source: GeoEye-4 Satellite Imagery)

The college campus geo-position is at 18° 06' 59.25" N latitude and 75° 01' 49.57" E longitude in Indapur, District Pune, Maharashtra, India. It encompasses an area of about 5.56 acres. The area is enormously diverse with a variety of tree species performing a variety of functions. Most of these tree species are planted in different periods through various plantation programmes organised by the college and have become an integral part of the college. The trees of the college have increased the quality of life, not only for the college society but also for the people around the college in terms of contributing to our environment by providing oxygen, improving air quality, climate improvement, conservation of water, preserving of soil, and supporting wildlife, controlling climate by moderating the effects of the sun, rain and wind. Leaves absorb and filter the sun's radiant energy, keeping things cool in the summer months. Many species of birds are dependent on these trees mainly for food and shelter. The fluid of flowers and plants is a favourite of birds and many insects. Leaf-covered branches keep many animals, such as birds and squirrels, out of reach of predators. Different species show an endless variety of shapes, forms, textures and vibrant colours. Even individual trees vary their

appearance throughout the year as the seasons change. The strength, long lifespan and imperial stature of trees give them a monument–like quality. They also remind us of the glorious history of our institution in particular. We often make an emotional connection with these trees and sometimes become personally attached to the ones that we see every day. A thick belt of large shady trees in the periphery and near building of the college is bringing down the noise and cutting down dust and storms. Thus, the college has been playing a significant role in maintaining the environment of Imdapur city in its surrounding areas. Various types of Fauna were observed at the college campus, table 3, 4, 5 & 6 show Flora and Fauna at the college campus.

Table 3 Birds observed at the college campus

Sr. no	*Common name*	*Scientific name*
1	Parrot	Psittacula krameri
2	Sparrow	Passer domesticus
3	Crow	Corvus splendens
4	Pigeon	Columba livia
5	Koel	Eudynamys scolopaceus
6	King fisher	Halcyon smyrnensis
7	Owl	Bubo bengalensis
8	Hawk	Nisaetus cirrhatus
9	Nilpankh (Indian roller)	Coracias benghalensis
10	Lavri (Indian teetar)	Ortygornis pondicerianus
11	Titodi (Red wattle lapwing)	Vanellus indicus
12	Indian white Egret	Egretta Ardea alba
13	Bulbul	Pycnonotus barbatus
14	Jungle babbler	Turdoides striata

Table 4 Reptiles observed at the college campus

Sr. no	*Common name*	*Scientific name*
1	Garden lizard	Calotes versicolor
2	Wall lizard (Gecko)	Hemidactylus frenatus
3	Varanus Indian monitor	Varanus bengalensis

Table 5 Arthropods observed at the college campus

Sr. no	*Common name*	*Scientific name*
1	Butterfly	Papilla Machaon
2	Cockroach	Periplaneta americana
3	Lady bugs (ladybirds beetles)	Harmonia axyridis
4	Moths (brown house moth)	Hofmannophila pseudospretella
5	Termite	Isoptera brulle
6	Ants (black carpenter ants)	Camponotus pennsylvanicus
7	Honey bee	Apis dorsata, Apis indica
8	Dragon fly	Pantala flavescens, Anax imperator

(Source: Field visit and Survey)

Table 6 List of plant species observed in the campus.

Sr. No.	Botanical Name	Local Name	Family	Uses
1	*Acacia Catechu*	Khair	Mimosaceae	Traditional Medicine
2	*Abrus precatorius*	Gunj	Leguminosae	
3	*Aloe vera* L.	Korphad	Liliaceae	
4	*Annona squamosa* L.	Sitaphal	Annonaceae	
5	*Azadirachta indica* L.	Neem	Meliaceae	
6	*Bambusa tulda* Roxb.	Bamboo	Poaceae	
7	*Cocos nucifera L.*	Coconut	Arecaceae	
8	*Delonix regia*	Gulmohar	Caesalpiniaceae	Avenue Tree, Ornamental
9	*Ficus benghalensis*	Vad	Moraceae	Avenue Tree, Aesthetic
10	*Ficus racemose*	Umber	Moraceae	
11	*Ficus religiosa*	Peepal	Moraceae	
12	*Polyanthia Longifolia*	Ashok	Annonaceae	Avenue Tree

(Source: Field visit and Survey)

Table 7 List of plant species observed in the campus.

Sr. No.	*Botanical Name*	*Local Name*	*Family*
1	Rauvolfia serpentina	Sarpagandha	Apocynaceae
2	Kigelia africana	Sausage Tree	Bignoniaceae
3	Melia azadirachta	Bakam neem	Meliaceae
4	Delonix regia	Gulmohar	Fabaceae
5	Ficus glomerata	Umber	Moraceae
6	Carissa carandas	Karvand	Apocynaceae
7	Couroupita guianensis	Kailaspati	Lecythidaceae
8	Terminalia chebula	Hirda	Combretaceae
9	Terminalia bellirica	Behada	Combretaceae
10	Terminalia arjuna	Arjun	Combretaceae
11	Terminalia tomentosa	Ain	Combretaceae
12	Putranjiva roxburghii	Jivanti	Putranjivaceae
13	Pterospermum acerifolium	Muchkunda	Malvaceae
14	Aegle marmelos	Bel	Rutaceae
15	Samanea saman	Vilayati Chinch	Fabaceae
16	Artocarpus heterophyllus	Phanas	Moraceae
17	Cycas circinalis	Salfi	Cycadaceae
18	Zamia sp.	Zamia	Zamiaceae
19	Acacia arabica	Babhul	Fabaceae
20	Syzygium cumini (Eugenia jambolana)	Jambhul	Myrtaceae

(Source: Field visit and Survey)

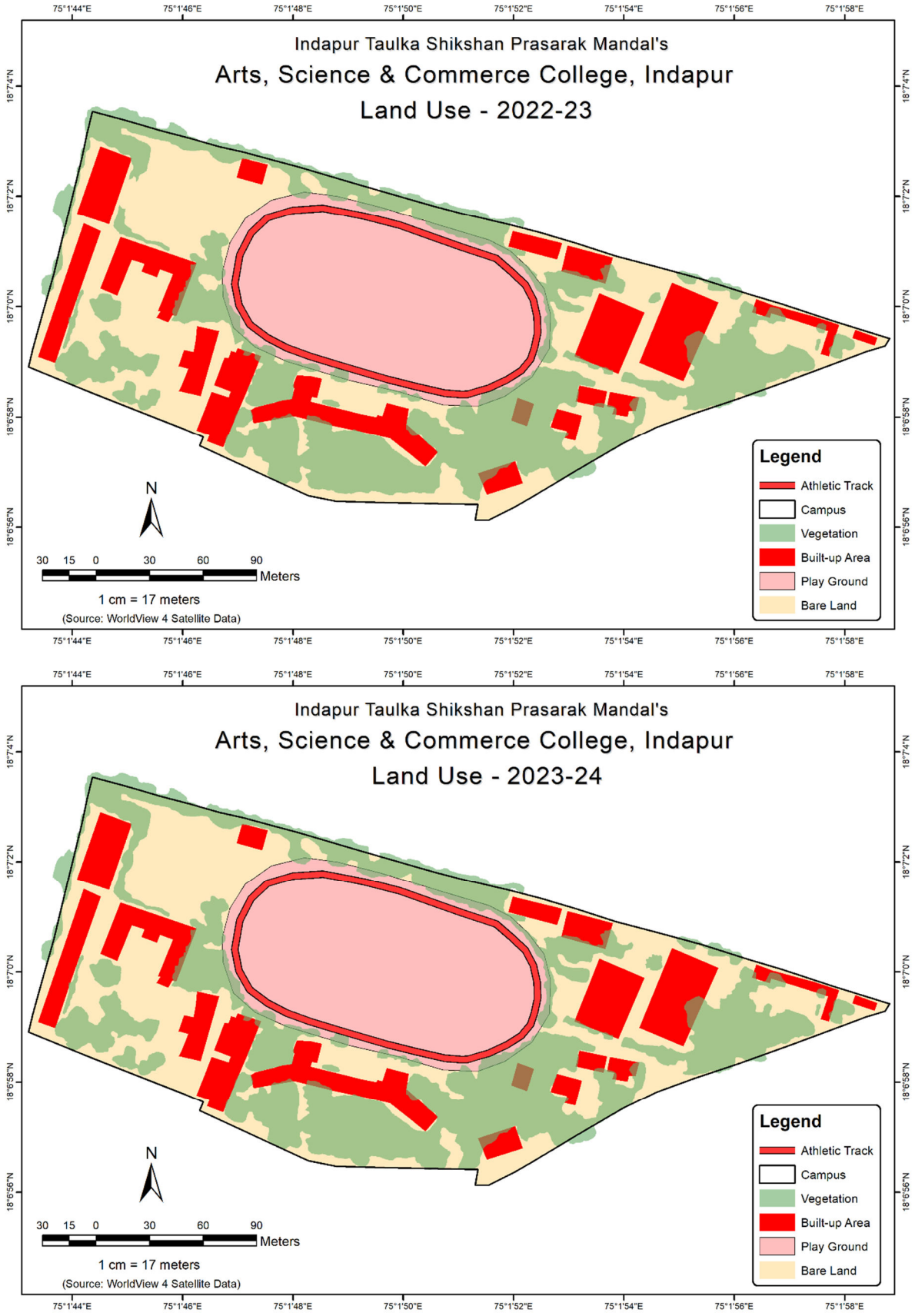

Figure 3 College Campus Land Use Map

AIR EMISSIONS

Air Emissions is the term used to describe the gases and particles which are put into the air or emitted by various sources. Ambient air quality mentions to the condition or quality of air surrounding us outdoors. Exhaust fans are not provided in the washroom. No vehicle entry is allowed on the College campus except for dignities & differently-abled students. A separate parking area for vehicles is available at the entry of the college campus. **Classrooms on the college Campus are Well Ventilated**, while the Window Floor ratio of the classroom is very good. This fact proves that there is no need for Exhaust fans in classrooms.

INDOOR AIR QUALITY

Indoor Air Quality (IAQ) refers to the air quality within and around buildings and structures, as it relates to the health and comfort of building occupants. Common indoor pollutants are;

- Carbon monoxide – Sources of carbon monoxide are incomplete combustion of fossil fuels
- Volatile organic compounds (VOCs) – VOCs are emitted by paints and lacquers, paint strippers, pesticides, office equipment such as copiers and printers, correction fluids and carbonless copy paper, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions etc.
- Carbon dioxide – Due to human respiration
- Particulate matter (PM) – Due to construction and maintenance activities, vehicular pollution
- Nitrogen Oxides- Due to vehicular pollution

In the Canteen area, parameters responsible for affecting indoor air quality are,

- Type and quantity of fuel used
- Medium of cooking
- Type of cooking e.g., roasting, frying, steaming etc.
- Duration of cooking, the quantity of food being cooked
- Efficiency of ventilation

Indoor air quality should be monitored at least once a year and results should be compared with The Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE) standards for indoor air quality.

In classrooms, ventilation is a natural draft through windows and is enhanced by fans. In corridors, cross-ventilation is observed. **Green belts** have been set up in the campus area, plants are present near the College building **which helps in maintaining ambient air quality**. In the canteen used LPG fuel, which is less pollutant.

LIGHTS AND ACOUSTICS

The human ear is constantly being beset by man-made sounds from all sides, and there remain few places in crowded areas where relative quiet prevails. There are two basic properties of sound Loudness and Frequency. Loudness is the strength of sensation of sound apparent by the individual. It is measured in terms of Decibels. Just audible sound is about 10 dB, a whisper about 20 dB, library place 30 dB, normal conversation about 35-60 dB, heavy street traffic 60-100 dB, boiler factories 120 dB, jet planes during take-off is about 150 dB, rocket engine about 180 dB. The loudest sound a person can stand without much discomfort is about 80 dB. Sounds beyond 80 dB can be safely regarded as Pollutants as it harms the hearing system. According to WHO, 45 dB is the safe noise level for a city. For international standards, a noise level of up to 65 dB is considered tolerated. Loudness is also expressed in sones. One sone equals the loudness of 40 dB sound pressure at 1000 Hz. Frequency is defined as the number of vibrations per second. It is denoted as Hertz (Hz).

As per the Occupational Safety and Health Administration (OSHA) standards, permissible noise exposure for 8 hours/day is 90 dB(A). Colleges, schools, hospitals and courts come under the silent zone. Permissible noise limits in and near the College are 35 dB during day time. Noise levels monitored during the audit are the near about permissible limits at all locations. The illumination (Lux) levels were adequate or less in a few areas that are because lights are kept switched off in rooms, and laboratories which are occupied and receive diffuse natural sunlight. High noise was reported in the playground premises.

The college campus is located in the Idapur city area; vehicular noise pollution is minimum on the premises probably due to tree cover on the campus. Noise levels are between 30 - 55 dB on the premises. Light intensity has been between 1000 - 4000 Lux. Light intensity and noise levels were monitored at nine30 different locations within academic years 2022-23 and 2023-24 and the results are presented in Table 7. The noise level is permissible value, while the light intensity is sufficient.

Table 7 Light intensity and noise levels monitoring results

Department / Section	*Noise level (dB)*	*Light Intensity (Lux)*
Physics	40	1000
Chemistry	40	1000
Zoology	40	1000
Mathematics	40	1000
Botany	40	1000
Microbiology	40	1000
Statistics	40	1000
Geography	40	1000
Psychology	40	1000
History	40	1000
Economics	40	1000
Political Science	40	1000
English	40	1000
Hindi	40	1000
Marathi	40	1000
Commerce	40	1000
Library	30	1000
Sports Complex	55	4000
BCA	40	1200
NSS	40	1000
NCC	40	1000
Research Lab	40	1000
Class Room	40	1000
Main Office	45	1000
Trust Office	35	1000
Ladies Room	35	1000
Ladies Hostel	35	1000
Staff Room	40	1000
Toilets	35	1000
Canteen	55	1200

WATER MANAGEMENT

A major water source for the college is 2 borewells on the campus and two municipal water supply connections. Data related to the water audit was collected by circulating a proforma based on water user profiles. In the A.Y. 2022-23 and 2023-24, there are 99 and 98 teaching staff and 29 and 24 non-teaching staff respectively, while 2063 and 2166 students are enrolled in the college. The assessment of water requirements comprises sanitation, laboratory, kitchen, drinking, washing, hostels, etc. For assessment of water management, the college has been divided into six blocks: Departments, Canteen, Garden, Common Toilet, Hostels, and office.

As can be seen, the average consumption of water by the Trees and Garden is 25.83 % and 32.75 % as compared to 25 % and 24.51 % for the Drinking water for students and common toilet block respectively within year 2022-23 and 2023-24. The collective average consumption of water by overall college has been 24000 and 29010 litres / Day in year 2022-23 and 2023-24. In the college, the major consumers of water by Trees and Garden (6200 and 9500 litres / Day). Highest utilisation of water in the Drinking water for students and for Trees and Garden. Water consumption of the College works out to be 8 Litre /Person/Day. As per IS 1172 standards for non-residential institutions, water consumption should be a maximum of 45 Litre /Person/Day. Water Where the Roots Are, Water in the Morning and avoid overwater-to-tree methods have been used to water the trees on the college premises. A proper and systematic rainwater harvesting pit has been established on the college campus. **Thus, water consumption is well under the limit.**

Table 10 Utilizations of water per day in liters.

Academic Years	*2022-23*		*2023-24*	
Particulars	***(litres / Day)***	***(%)***	***(litres / Day)***	***(%)***
Canteen	1000	4.17	1000	3.45
Common Toilet block	1000	4.17	1000	3.45
Trees and Garden	6200	25.83	9500	32.75
Drinking Water for Students	5000	20.83	6110	21.06
Hostel	5000	20.83	5000	17.24
Departments	5800	24.17	6400	22.06

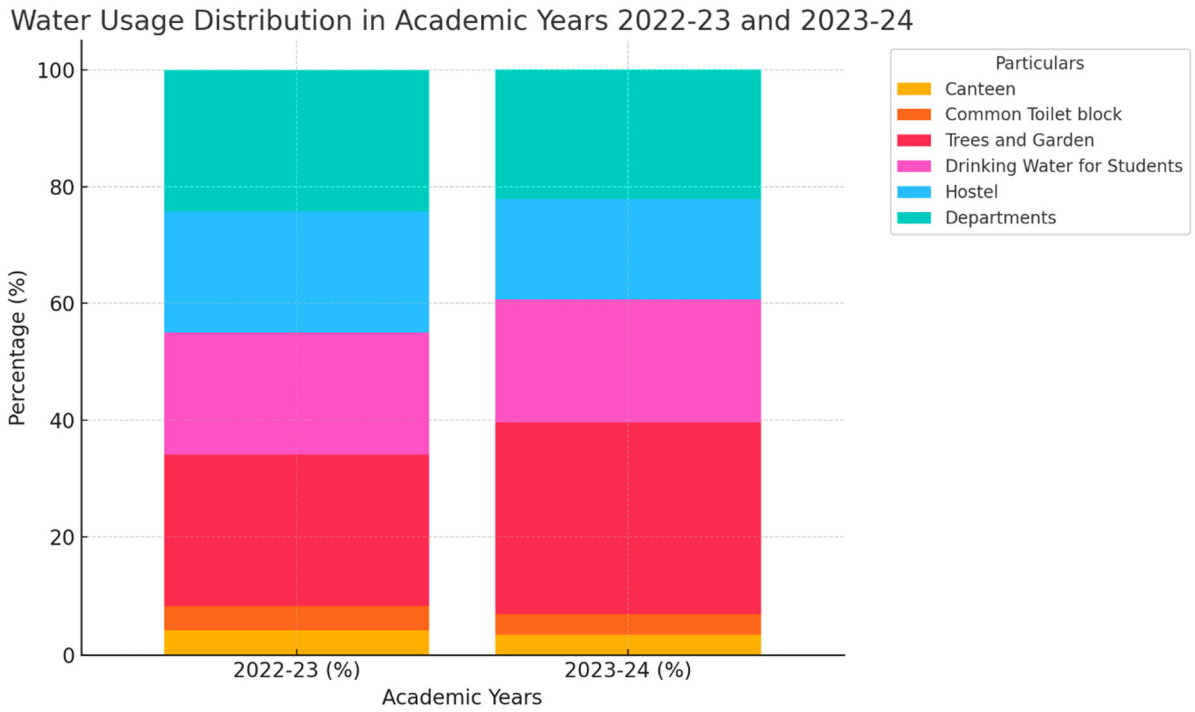

Figure 4 Daily water consumption for A.Y. 2022-23 and 2023-24

A considerable water usage pattern for the academic years 2022-23 and 2023-24 was analyzed, analyzing shifts in water allocation between several areas of the institution. Despite the canteens and common toilet blocks' percentage contribution reducing slightly from 4.17% to 3.45% during the period 2022 to 2023, overall canteens and common toilet blocks used the same amount of water at 1000 liters per day for both years. Absolute usage was flat in 2023 and 2024, but this drop in the percentage point indicates, rather, that these areas were using a lower share of total water usage, possibly because of increased efficiency or other changes elsewhere.

The use of water for trees and gardens was also going up, jumping from 6200 liters per day (25.83%) in 2022-23 to 9500 liters per day (32.75%) in 2023-24. This rise could signal an effort to bolster green cover or keep landscaping, or represent a more institutional push to improve environmental sustainability and campus appeal.

In 2023-24 the demand for drinking water for students increased from 5000 liters per day (20.83%) to 6110 liters per day (21.06%). The amount might be increasing due to an increasing student population, and in order to meet higher water quality standards. Though, the percentage share of hostel area consumption went down from 20.83% to 17.24% suggesting that the water efficiency has swung in favour of hostel area as opposed to other areas.

- **Flora and fauna conservation**

The college has a lush green campus which provides habitat to various species. Recently conducted Flora and fauna survey reports Parrot, Sparrow, Crow, Pigeon, Koel, Kingfisher, Owl, Hawk, Nilpankh, Indian Teetar, Red wattle lapwing, Indian white Egret, Bulbul, Jungle babbler, Garden lizard, Wall lizard, Varanus Indian monitor, Butterfly, Cockroach, ladybird's beetles, Moths, Termite, black carpenter ants, Honey bee and Dragonfly.

- **Tree Plantation Drives**

Every Guest is honoured by Tree Plantation on Campus. Periodically the plantation drove by students and staff of the campus. The dignitaries and staff have presented guests with plants as a gesture of goodwill.

- **Pollution Reduction**

Personal Vehicles of Students are not allowed at the campus. In this way reduction in Air Pollution through vehicular emission. Most of the students prefer bicycles and public transportation to reduce CO_2 emissions.

- **Solid Waste Management**

Lifting of garbage from campus on an alternate day by municipal corporations and leaves and food scraps has been Vermicomposting at college premises.

- **Water Management**

For water resource conservation a proper and systematic rainwater harvesting pit has been established on the college campus.

- **Environment Awareness**

Various activities like cleanliness drives, tree plantation, seminars and workshops are organised by college to increase awareness and sensitivity among students and faculty. Students participate in field visits to biodiversity parks and other places of ecological importance are also being arranged by college various departments.

CONCLUSION

The GREEN and Environmental audit thoroughly examined all the indicators, collecting, analysing, and summarizing information about them. This comprehensive Environmental and biodiversity conservation audit involved extensive collaboration with the campus team and interactions with key personnel, covering a wide range of environmental issues. As a result of the audit, several actionable insights were identified to enhance the campus's eco-friendliness. Certain sections with instruments exhibit higher electricity consumption, while other departments have minimal usage. The college boasts an abundance of diverse trees and plants, contributing to its lush greenery. To reduce fuel energy consumption for daily tasks, both students and staff are encouraged to utilize public transportation, bicycles and carpooling options. Notably, the majority of students prefer traveling by buses. Additionally, staff members traveling long distances also show a preference for public transportation. Furthermore, the campus maintains good air quality.

The recommendations are also mentioned with observations for the campus team to initiate actions. The audit team opines that the overall site is maintained well from an environmental perspective. There are no major observations but a few things that are important to initiate urgently are e-waste management records by the monthly inventory of hazardous waste, rainwater harvesting recharge; water balance cycle and periodic inspection of buildings housekeeping and environment policy.

RECOMMENDATIONS

1) Adopt an environmentally responsible purchasing policy and work towards creating and implementing a strategy to reduce environmental impact.
2) Drips and sprinklers can be used for watering the gardens and trees.
3) E-waste and solid waste segregation, handling and disposal can be deployed at the campus.
4) Reduction in use of paperwork by goes digital system.
5) Water meters should be installed at the college for monitoring water consumption for gardening and landscape.
6) Exhaust fans will be provided in the canteen kitchen.
7) It is recommended to measure emissions from every vehicle of staff and students & ambient air quality at least once a year and results should be compared with Indian Ambient Air Quality Standards.
8) Encourage staff and students who regularly use sustainable modes of transportation, such as walking, cycling, or public transportation, by offering them prizes or recognition for their green commuting efforts.
9) Encouraging the adoption of electric vehicles through incentives and infrastructure development.
10) Implementing measures to reduce reliance on conventional vehicles, such as carpooling initiatives and improving public transportation services.
11) Exploring renewable energy options to replace or supplement diesel generators for power generation.

REFERENCES

- The Environment [Protection] Act – 1986 (Amended 1991) & Rules-1986 (Amended 2010)
- The Petroleum Act: 1934 – The Petroleum Rules: 2002
- The Central Motor Vehicle Act: 1988 (Amended 2011) and The Central Motor Vehicle Rules:1989 (Amended in 2005)
- Energy Conservation Act 2010.
- The Water [Prevention & Control of Pollution] Act – 1974 (Amended 1988) & the Water (Prevention & Control of Pollution) Rules – 1975
- The Air [Prevention & Control of Pollution] Act – 1981 (Amended 1987) The Air (Prevention & Control of Pollution) Rules – 1982
- The Gas Cylinders Rules – 2016 (Replaces the Gas Cylinder Rules – 1981
- E-waste management rules 2016
- Electrical Act 2003 (Amended 2001) / Rules 1956 (Amended 2006)
- The Hazardous Waste (Management and Handling and Trans-boundary Movement) Rules, 2008 (Amended 2016)
- The Noise Pollution Regulation & Control rules, 2000 (Amended 2010)
- The Batteries (Management and Handling) Rules, 2001 (Amended 2010)
- Relevant Indian Standard Code practices
- Internal Records of the Campus, (A.Y.2022-23 and 2023-24)

PHOTO PLATES

Photo 1 Tree plantation by Minister of Maharashtra Hon. Harshawardanji Patil Saheb

Photo 2 Tree plantation by college staff and students

Photo 3 Tree plantation by college staff

Photo 4 Tree plantation by NCC and NSS students

Photo 5 Tree plantation by college staff

Photo 6 A plant is gifted to each guest as a living symbol of growth and goodwill by Minister of Maharashtra Hon. Harshawardanji Patil Saheb to guest.

Photo 7 A plant is gifted to each guest as a living symbol of growth and goodwill

Photo 8 A plant is gifted to each guest

Photo 9 A plant is gifted to each guest

Photo 10 A plant is gifted to each guest

Photo 11 Lush greenery in the college campus

Photo 12 The college campus features lush greenery surrounding the playground

Photo 13 Lush greenery in the college campus

Photo 14 Lush greenery in the college campus

Photo 15 Lush greenery near the college classrooms

Photo 16 Lush greenery and vermicompost in the college campus

Photo 17 Lush greenery in the college campus

Photo 18 Lush greenery and garden in the college campus

Photo 19 Lush greenery in the college campus

Photo 20 Lush greenery and garden in the college campus

Photo 21 Lush greenery and garden in the college campus

Energy Audit Certificate

Energy Audit

is awarded for the year **2022-23** & **2023-24** to the Esteemed Institution

Indapur Taulka Shikshan Prasarak Mandal's

Arts, Science & Commerce College, Indapur

Tal- Indapur, Dist.- Pune. 413106

We appreciate the immense efforts taken by Management, Staff and Students towards the Energy Management and Conservation.

Issued on 17 April 2024 valid till 16 April 2025.

Certificate ID: 0063

0063

Vikram Geoinfo Tech

Revealing Earth Information

(ISO 9001:2015 Certified)

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V. M. Agone

Dr. Vikram Agone

Lead Auditor

VIKRAM GEOINFO TECH

Energy Audit

Year 2022-23 and 2023-24

Energy Audit

Indapur Taulka Shikshan Prasarak Mandal's

Arts, Science & Commerce College, Indapur

Tal-Indapur, Pune-413106

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ACKNOWLEDGEMENT

Vikram Geoinfo Tech thanks the management of ***Indapur Taulka Shikshan Prasarak Mandal's Arts, Science & Commerce College, Indapur, Dist - Pune*** for assigning this important work of Energy Audit. Vikram Geoinfo Tech appreciates the cooperation in the completion of the study. Our special thanks are due to:

- Honourable Chairman
- Honourable Secretary
- Honourable Director Board Members of the college
- Honourable Principal
- IQAC Members
- Teaching & Supporting Staff of College

For giving us the necessary inputs to carry out this very vital exercise of Energy Audit. We are also thankful to other staff members who were actively involved while collecting the data and conducting field measurements.

(Dr. Vikram Agone)

Founder & Chairman

Vikram Geoinfo Tech

Vikram Geoinfo Tech

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DISCLAIMER

Vikram Geoinfo Tech has prepared this report for ***Indapur Taulka Shikshan Prasarak Mandal's Arts, Science & Commerce College, Indapur, Dist - Pune*** based on input data submitted by the representatives of the College complemented with the best judgment capacity of the expert team.

It is further informed that the conclusions have arrived following best estimates and no representation, warranty or undertaking, express or implied is made and no responsibility is accepted by Vikram Geoinfo Tech in this report or for any direct or consequential loss arising from any use of the information, statements or forecasts in the report.

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Report by: Lead Auditor

(Dr. Vikram Agone)

Founder & Chairman

Vikram Geoinfo Tech

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Revealing Earth Information

Auditor

NAME	POSITION	QUALIFICATION
Dr. Vikram Madhukar Agone	Lead Auditor	Ph.D. FRGS (UK)

Vikram Geoinfo Tech, ISO 9001:2015 certified (Reg. No.: UDYAM-MH-14-0037749 / ISO Cert. No.: 305023092154Q), specializes in GREEN, Environmental, and Energy Audits. Using scientific methodology, GIS, remote sensing, and geospatial tools, we deliver precise assessments and actionable recommendations. Our audits cover carbon footprint, water and waste management, biodiversity, air quality, and energy efficiency, providing institutions with sustainable, cost-saving strategies to reduce their environmental impact and align with global standards. Vikram GeoInfo Tech are ISO 9001:2015, Quality Research Organisation (QRO Certification LLP), EGAC, IAF certified Firm.

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INTRODUCTION

Indapur Taulka Shikshan Prasarak Mandal's Arts, Science & Commerce College, Indapur, Dist - Pune aims at creating awareness about energy conservation awareness. In an era where energy conservation and sustainability have become paramount, energy audits have emerged as a vital tool for individuals, businesses, and governments to assess, optimize, and reduce energy consumption. Energy is the lifeblood of modern society, powering our homes, industries, and economies. However, the indiscriminate use of energy resources has led to environmental concerns, rising costs, and a growing need for responsible energy management. Energy audits offer a systematic approach to address these challenges by evaluating energy usage patterns, identifying inefficiencies, and proposing actionable solutions to enhance energy performance.

An energy audit is a comprehensive assessment of an organization's or individual's energy consumption, focusing on both the supply and demand sides of energy utilization. It involves a detailed examination of energy systems, processes, and infrastructure to understand how energy is used and where improvements can be made.

Excessive energy consumption contributes to greenhouse gas emissions, climate change, and resource depletion. Energy audits help mitigate these impacts by reducing energy waste and optimizing resource utilization. Energy costs represent a significant portion of operating expenses for businesses and households. Energy audits can uncover cost-saving opportunities, making energy management a financially sound strategy. Many jurisdictions have implemented energy efficiency standards and mandates. Energy audits assist organizations in meeting these requirements and avoiding penalties. In a world increasingly focused on sustainability and responsible resource management, energy audits play a pivotal role in achieving these objectives. By uncovering energy inefficiencies, reducing costs, and lessening environmental impacts, energy audits empower individuals, businesses, and governments to make informed decisions and take meaningful steps towards a more sustainable and energy-efficient future.

One of the primary purposes of an energy audit is to identify opportunities for reducing energy consumption and, subsequently, energy costs. Educational institutions often have tight budgets, and energy expenses can be a significant portion of their operating costs. By identifying energy

efficiency measures, the institution can lower its utility bills and allocate more resources to educational programs and services.

Educational institutes have a responsibility to promote sustainability and environmental stewardship. Energy audits help identify ways to reduce energy consumption, lower greenhouse gas emissions, and minimize the institute's overall environmental footprint. This aligns with the institution's commitment to sustainability and can serve as an example for students and the community.

Educational institutes often have extensive facilities and equipment. Energy audits help in assessing the condition and efficiency of these assets, including HVAC systems, lighting, and electrical equipment. This information can inform maintenance and replacement strategies, ensuring that resources are used efficiently.

the purpose of an energy audit in an educational institute is multifaceted. It encompasses cost reduction, environmental responsibility, educational opportunities, regulatory compliance, asset management, and overall improvement in the institution's financial stability and sustainability efforts. Conducting energy audits aligns with the educational institution's mission to provide quality education while being socially and environmentally responsible.

The primary goal of an energy audit done by ***Indapur Taulka Shikshan Prasarak Mandal's Arts, Science & Commerce College, Indapur, Dist - Pune*** is to assess and analyze the energy consumption and utilization of a system, facility, or organization with the aim of identifying opportunities to improve energy efficiency, reduce energy costs, and minimize environmental impacts.

It helps in recognizing the necessity for colleges to figure around the academic years **2022-23** and **2023-24** for energy conservation. Thus, the Energy audit forms the baseline survey to decide on the **energy consumption policy**.

ENERGY AUDIT

An energy audit is a survey of a building or process to determine how much energy is being used and to identify ways to reduce energy consumption. An energy audit is an inspection, survey, and analysis of energy flows for energy conservation in a building, process, or system. It is an assessment of the current energy use of a facility and a proposal for measures to reduce energy consumption. The results of an energy audit are typically presented in a report that includes recommendations for energy efficiency improvements. The report may also include estimates of the cost savings and environmental benefits of the recommended improvements.

The purpose of an energy audit is to identify the sources and uses of energy, measure the energy consumption and efficiency, and recommend ways to reduce energy waste and improve energy savings. An energy audit can be conducted at different levels of detail and scope, depending on the objectives and resources of the auditee. Some of the benefits of an energy audit include:

- Lowering energy bills and operating costs
- Enhancing environmental performance and reducing greenhouse gas emissions
- Improving occupant comfort and productivity
- Increasing asset value and marketability
- Complying with regulatory requirements and standards

In this context it becomes essential to adopt the system of the energy efficient Campus for the college which will lead to sustainable development and at the same time decrease a sizable amount of atmospheric pollution from the environment, conserve energy and many more. The National Assessment and Accreditation Council, New Delhi (NAAC) has made it compulsory that all Higher Educational Institutions should submit an annual Energy Audit Report. Moreover, it is part of the Corporate Social Responsibility of Higher Educational Institutions to ensure that they contribute towards the reduction of global warming through energy uses reduction measures. The energy audit Report aims at summarising the college's contribution and its activeness in creating awareness and consciousness in practically applying environmentally friendly measures towards an institute in A.Y. **2022-23 and 2023-24.**

ENVIRONMENTAL SETTING OF THE COLLEGE

The college has a sprawling pollution-free campus on the northern part of Indapur city. Indapur is a city and taluka in Pune district of Pune Division, Maharashtra, and It is located on state Highway NH 65. The Bhima River flows near the city. College has been situated at 545 m MSL altitude. Indapur has a tropical climate with hot and humid summers and mild winters. The average temperature ranges from 28°C to 40°C in the summer and 10°C to 20°C in the winter. The city receives an average rainfall of 600 mm per year, most of which falls during the monsoon season (June to September). The vegetation in Indapur is mainly tropical deciduous forest. The city is home to a variety of trees and plants.

The college campus is spread over 55675 m^2 (5.56 hectare or 13.74 acres) which include about 2.73-acre sports ground. College is easily accessible by road for the rural area which is 25 km away. Although the campus is located near the residential area, the presence of a green belt considerably reduced noise pollution and provided fresh air on the campus. The College campus area has an academic building, library, parking, canteen and sports ground.

OVERVIEW OF INSTITUTE

The Arts, Commerce, and Science College in Indapur is a renowned educational institution dedicated to providing quality education to students.

With a team of highly qualified faculty members, state-of-the-art infrastructure, and a focus on holistic development, the college has become a preferred choice for students aspiring for a well-rounded education.

The college campus is equipped with modern amenities, including a well-stocked library, laboratories, and sports facilities. It fosters a vibrant learning environment, encouraging students to excel in both academics and extracurricular activities.

The Arts, Commerce, and Science College in Indapur is a renowned educational institution. The college has a team of highly qualified faculty members, state-of-the-art infrastructure, and a focus on holistic development. The college campus is equipped with modern amenities, including a well-stocked library, laboratories, and sports facilities. The college fosters a vibrant learning environment, encouraging students to excel in both academics and extracurricular activities. The college has a strong focus on student development, with various events and activities like NSS camps, NCC, sports, and cultural programs. The college has a clear vision and mission to serve the rural population and uplift the rural youth. The college has received positive testimonials from students, management, university executives, parents, and employers.

VISION

विद्या परम् दैवतम्

We believe knowledge as a great power with divine quality.

MISSION

Our main goal is to serve the rural population & project every rural youth as the most competent individual with up-to-date knowledge.

Our dream is to uplift the rural youth in all respects.

AIMS AND OBJECTIVE

Indapur Taulka Shikshan Prasarak Mandal's Arts, Science & Commerce College, Indapur, Dist - Pune conducted an Energy auditing survey for the year 2022-23 and 2023-24. The primary aim of an energy audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. It serves to identify all the energy streams in a facility and quantifies energy usage according to its discrete functions. The following were the objectives:

- A baseline survey to recognize the real status of energy consumption.
- One of the main objectives is to identify where and how energy is being used in a facility. This includes understanding the energy consumption patterns and the efficiency of energy use.
- Energy audits aim to find opportunities to reduce energy usage without negatively impacting the operations. This could be through improved efficiency, process changes, or equipment upgrades.
- By identifying areas of energy waste and potential improvements, energy audits can help reduce operating costs.
- Energy audits can also help reduce the environmental impact of a facility by identifying ways to decrease energy consumption, which in turn reduces greenhouse gas emissions.
- The information gathered during an energy audit can be used to develop a comprehensive energy management plan, which includes strategies for ongoing energy efficiency and cost savings.
- Increasing and spreading the awareness for energy conservation and sustainable use of resources amongst the students, teaching and non-teaching staff members.
- Improving environmental standards of the institute.
- Financial savings through a reduction in energy use.

DATABASE AND METHODOLOGY

The present study is based on visits to the college, personal observations, and a primary database that was collected using sets of questionnaires and other survey tools.

- **Database**: The database refers to the collection of relevant data and information that are used to analyse the energy performance of a facility. The database may include:
    - Historical energy consumption and cost data
    - Energy bills and tariffs
    - Facility layout and floor plans
    - Equipment inventory and specifications
    - Operating schedules and conditions
    - Benchmarking data and industry standards
- **Methodology**: The methodology refers to the systematic approach and techniques that are used to conduct the energy audit. The methodology may include:
    - Defining the audit objectives and scope
    - Forming the audit team and assigning roles and responsibilities
    - Conducting a preliminary walk-through survey
    - Collecting and verifying data from various sources
    - Measuring and monitoring key energy parameters
    - Performing energy balance and analysis
    - Identifying energy saving opportunities and calculating savings potential
    - Evaluating the technical and economic feasibility of energy conservation measures
    - Preparing and presenting the audit report and recommendations

ANALYSIS OF THE DATABASE

The database has been prepared for statistical analysis for the energy audit using Minitab and IBM SPSS statistical software. The surveys from each group were tabulated in MS Excel spreadsheets. The tabulated data were further analyzed through statistical analysis and computing. For a better understanding of the results and to avoid complications, averages and percentages of the tables were taken. A graphical representation of these results was made to give a summarized picture of the status. The outcome was interpreted with the overall consequences, conclusion and plausible solutions or steps for them.

Energy Audit Report

ENERGY AUDIT

As per the Energy Conservation Act, 2001, Energy Audit is defined as "the verification, monitoring and analysis of the use of energy as well as submission of technical report containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce energy consumption". Effective management of energy-consuming systems can lead to significant cost and energy savings as well as increased comfort, lower maintenance costs, and extended equipment life. A successful energy management program begins with a thorough energy audit. The energy audit evaluates the efficiency of all building and process systems that use energy.

Energy use is an important aspect of campus sustainability and thus requires no explanation for its inclusion in the assessment. An old incandescent bulb uses approximately 60W to 100W while an energy-efficient light emitting diode (LED) uses only less than 10 W. Energy auditing deals with the conservation and methods to reduce its consumption related to environmental degradation. It is therefore essential that any environmentally responsible institution examine its energy use practices.

One electricity meter is provided for the entire campus. There is **total energy consumption** for the college has been **345.22 and 323.40 kWh/day** for the A.Y. 2022-23 and 2023-24 respectively. The major difference in Energy consumption of various departments is due to the usage of various electronic and electrical equipment. Data are shown in Tables below for a comparison of no. of electrical appliances and energy consumption (kwh) per day in each Department/ Sections. The difference in no. of electrical appliances and energy consumption (kwh) used is reflected in their respective energy consumption. The emissions per unit of electricity in India are estimated to be in the range of 0.91 to 0.95 kg/kWh, in this way **college contribute 321.054 and 300.762 kg per day of CO_2 emission** to the atmosphere by using electrical energy for the A.Y. 2022-23 and 2023-24 respectively.

Table 1 Department-wise number of electrical appliances A.Y. 2022-23

Department / Section	Tubes light	CFL or LED	Focus	Ceiling fans	Exhaust Fan	computers	Printers	Projectors	Freezer / Chiller	RO / Water filters	Invertor	CCTV	Electrical appliances
Physics	26	5	0	11	3	8	1	2	0	1	1	7	10
Chemistry	31	3	0	12	4	2	1	1	1	1	1	6	3
Zoology	17	0	0	12	0	2	1	1	1	0	0	6	0
Mathematics	3	0	0	2	0	1	0	0	0	0	0	2	0
Botany	7	0	0	2	1	1	1	1	0	0	0	3	0
Microbiology	6	0	0	2	1	1	0	0	1	0	0	4	1
Statistics	2	0	0	2	0	1	0	0	0	0	0	2	0
Geography	6	0	0	5	0	2	1	1	0	0	0	2	0
Psychology	5	0	0	3	0	1	0	1	0	0	0	1	0
History	3	0	0	2	0	1	1	1	0	0	0	0	0
Economics	5	0	0	3	0	1	1	1	0	0	0	2	0
Political science	4	0	1	2	0	1	1	1	0	0	0	3	0
English	2	0	0	2	0	1	0	0	0	0	0	2	0
Hindi	3	0	0	2	0	1	1	0	0	0	0	1	0
Marathi	2	0	0	2	0	1	1	0	0	0	0	1	0
Commerce	10	0	0	4	0	1	1	1	0	0	0	3	0
Library	27	0	0	16	3	10	2	1	0	2	0	10	0
Sports complex	13	0	4	10	3	1	1	0	0	0	0	6	0
BCA	11	0	0	7	0	100	2	1	0	0	0	5	0
NSS	2	0	0	1	0	1	1	0	0	0	0	2	0
NCC	3	0	0	2	3	1	1	0	0	0	0	2	0
Research lab	6	0	0	4	2	2	1	0	0	0	0	3	0
Class Room 1-19	46	0	0	40	0	0	0	0	0	0	0	23	0
Main Office	6	0	0	6	1	10	1	0	0	0	0	4	0
trust office	4	0	0	0	0	3	1	0	0	0	0	2	0
ladies room	10	0	0	5	2	0	0	0	0	0	0	2	0
ladies hostel	20	10	1	20	2	0	0	0	0	0	0	10	0
Staff room	4	0	0	3	1	0	0	0	0	1	0	1	0
Toilets	4	0	0	0	2	0	0	0	0	0	0	0	0
Canteen	4	0	0	0	0	0	0	0	0	0	0	2	0

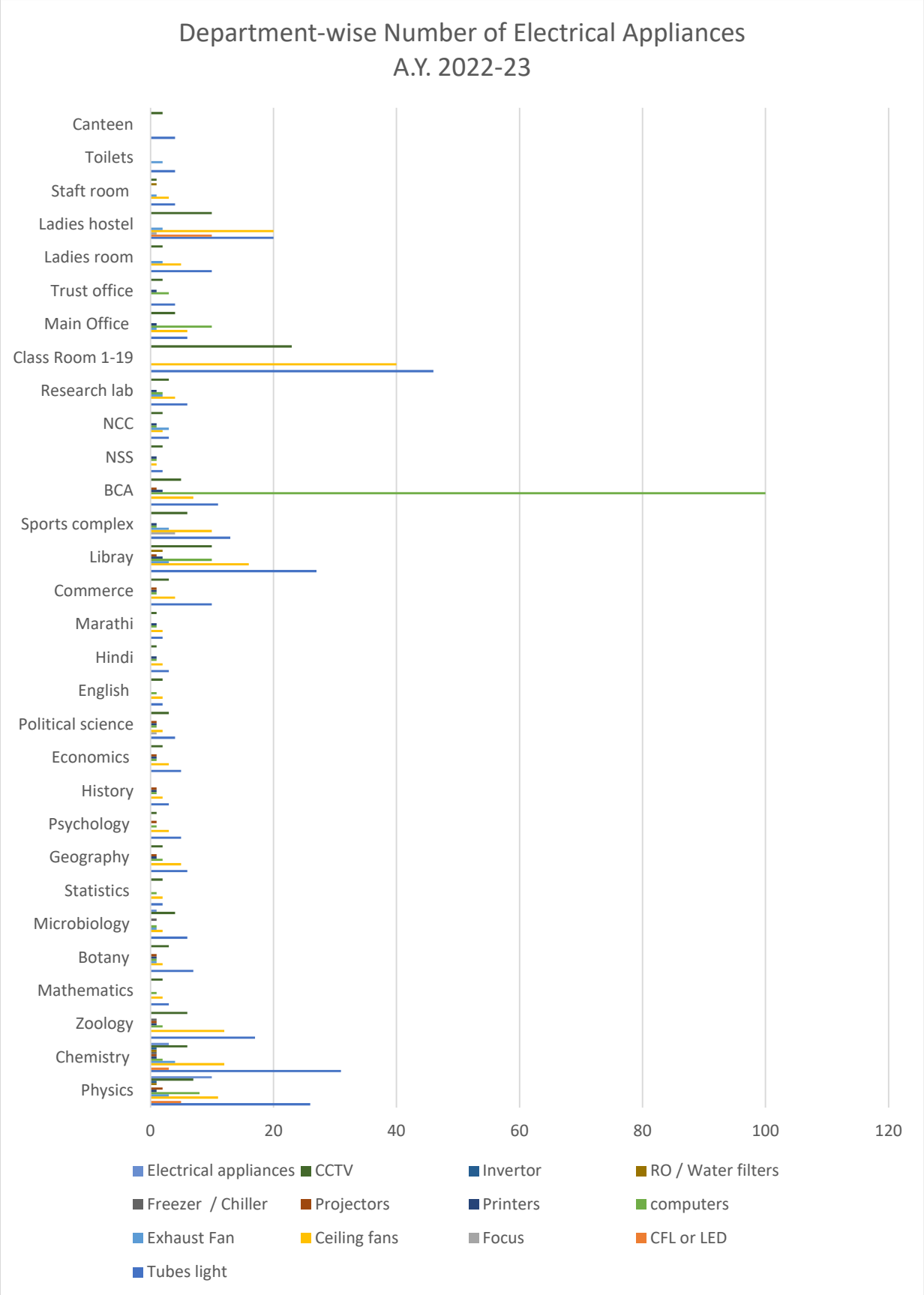

Figure 1 Department-wise Number of Electrical Appliances A.Y. 2022-23

Table 2 Department-wise Energy Consumption per day (kwh) A.Y. 2022-23

Department / Section	Tubes light	CFL or LED	Focus	Ceiling fans	Exhaust Fan	computers	Printers	Projectors	Freezer / Chiller	RO / Water filters	Invertor	CCTV	Electrical appliances
Physics	7.28	0.1	0	2.475	7.56	6.4	0.3	4.8	0	0.175	6.96	2.52	0.2
Chemistry	8.68	0.06	0	1.8	13.44	0.8	0.3	0.8	1.0	0.125	1.45	2.16	0.12
Zoology	0.68	0	0	2.7	0	0.8	0.3	1.6	1.0	0	0	2.16	0
Mathematics	0.3	0	0	0.45	0	0.2	0	0	0	0	0	0.72	0
Botany	0.28	0	0	0.3	1.68	0.2	0.3	0.8	0	0	0	1.08	0
Microbiology	0.24	0	0	0.15	1.68	0.2	0	0	1.0	0	0	1.44	0.04
Statistics	0.08	0	0	0.3	0	0.2	0	0	0	0	0	0.72	0
Geography	0.6	0	0	0.75	0	0.8	0.6	0.8	0	0	0	0.72	0
Psychology	0.4	0	0	0.45	0	0.2	0	0.8	0	0	0	0.36	0
History	0.12	0	0	0.45	0	0.4	0.3	0.8	0	0	0	0	0
Economics	0.4	0	0	0.675	0	0.2	0.3	0.8	0	0	0	0.72	0
Political science	0.32	0	0	0.3	0	0	0.3	0.8	0	0	0	1.08	0
English	0.04	0	0	0.6	0	0.2	0	0	0	0	0	0.72	0
Hindi	0.18	0	0	0.3	0	0.4	0.3	0	0	0	0	0.36	0
Marathi	0.04	0	0	0.45	0	0.4	0.3	0	0	0	0	0.36	0
Commerce	0.2	0	0	1.2	0	0.2	0.3	0.8	0	0	0	1.08	0
Library	2.16	0	0	6	7.56	6	1.2	0.8	0	0.25	0	3.6	0
Sports complex	0.52	0	7	2.25	7.56	0.2	0.3	0	0	0	0	2.16	0
BCA	0.66	0	0	2.625	0	60	1.2	0.8	0	0	0	1.8	0
NSS	0.08	0	0	0.075	0	0.4	0.3	0	0	0	0	0.72	0
NCC	0.18	0	0	0	0	0.4	0.3	0	0	0	0	0.72	0
Research lab	0.6	0	0	1.2	6.72	1.2	0.3	0	0	0	0	1.08	0
Class Room 1-19	1.84	0	0	9	0	0	0	0	0	0	0	8.28	0
Main Office	0.72	0	0	2.7	2.52	12	0.9	0	0	0	0	1.44	0
trust office	0.4	0	0	0	0	3	0.3	0	0	0	0	0.72	0
ladies room	1	0	0	1.875	8.4	0	0	0	0	0	0	0.72	0
ladies hostel	3.6	0.2	1.25	9	8.4	0	0	0	0	0	0	3.6	0
Staff room	0.16	0	0	1.125	0.84	0	0	0	0	0.125	0	0.36	0
Toilets	0.24	0	0	0	16.8	0	0	0	0	0	0	0	0
Canteen	0.08	0	0	0	0	0	0	0	0	0	0	0.72	0

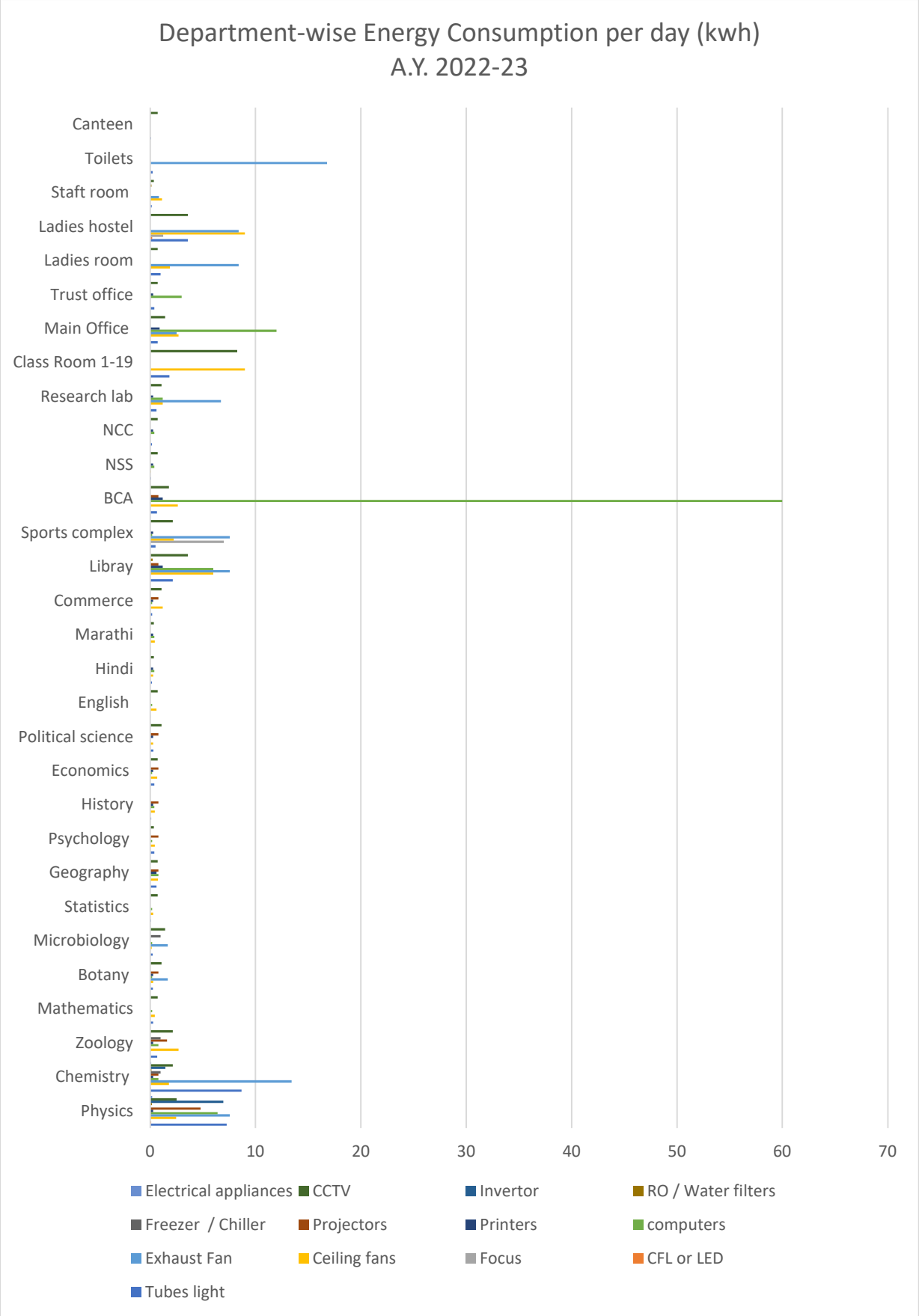

Figure 2 Department-wise Energy Consumption per day (kwh) A.Y. 2022-23

Table 3 Department-wise number of electrical appliances A.Y. 2023-24

Department / Section	Tubes light	CFL or LED	Focus	Ceiling fans	Exhaust Fan	computers	Printers	Projectors	Freezer / Chiller	RO / Water filters	Invertor	CCTV	Electrical appliances	AC	Cooler	Sound Systems	Photocopier
Physics	27	5	0	11	3	8	1	2	0	1	1	7	2	0	0	1	0
Chemistry	32	5	0	12	3	2	1	1	1	1	0	6	3	0	0	0	0
Zoology	19	0	0	12	0	2	1	1	1	0	0	6	2	0	0	0	0
Mathematics	3	0	0	2	0	1	0	0	0	0	0	3	0	0	0	0	0
Botany	4	0	0	3	0	0	1	1	0	0	0	3	0	0	0	0	0
Microbiology	6	0	0	2	1	1	0	0	1	0	0	4	1	0	0	0	0
Statistics	2	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0
Geography	6	0	0	5	0	2	1	1	0	0	1	2	0	0	0	0	0
Psychology	4	0	0	3	0	1	0	1	0	0	0	1	0	0	0	0	0
History	2	0	0	2	0	1	1	0	0	0	0	2	0	0	0	0	0
Economics	4	0	0	3	0	1	1	0	0	0	0	3	0	0	0	0	0
Political science	3	0	0	2	0	1	1	1	0	0	0	2	0	0	0	0	0
English	3	0	0	2	0	1	0	0	0	0	0	2	0	0	0	0	0
Hindi	2	0	0	2	0	1	1	0	0	0	0	2	0	0	0	0	0
Marathi	3	0	0	2	0	1	0	0	0	0	0	2	0	0	0	0	0
Commerce	6	0	0	0	0	2	1	1	0	0	0	3	0	0	0	0	0
library	29	0	0	16	3	10	2	1	0	1	0	10	0	0	0	0	0
Sports complex	13	0	0	10	3	1	1	0	0	0	0	6	0	0	0	0	0
BCA	11	0	0	7	0	100	2	0	1	1	1	5	0	1	1	1	1
NSS	2	0	0	2	0	1	1	0	0	0	0	2	0	0	0	0	0
NCC	2	0	0	2	0	1	1	0	0	0	0	2	0	0	0	0	0
Research lab	9	0	0	0	3	2	1	1	1	0	0	3	3	0	0	0	0
Class Room 1-19	46	0	0	40	0	0	0	0	0	0	0	24	0	0	0	0	0
Main Office	15	0	0	9	0	12	3	1	0	0	0	10	0	0	0	0	0
trust office	4	0	0	0	0	3	1	0	0	0	0	2	0	0	0	0	0
ladies room	10	0	0	5	3	0	0	0	0	0	0	2	0	0	0	0	0
ladies hostel	25	5	2	16	3	0	0	0	0	0	0	10	0	0	0	0	0
Staff room	4	0	0	4	0	0	0	0	0	1	0	1	0	0	0	0	0
Toilets	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Canteen	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0

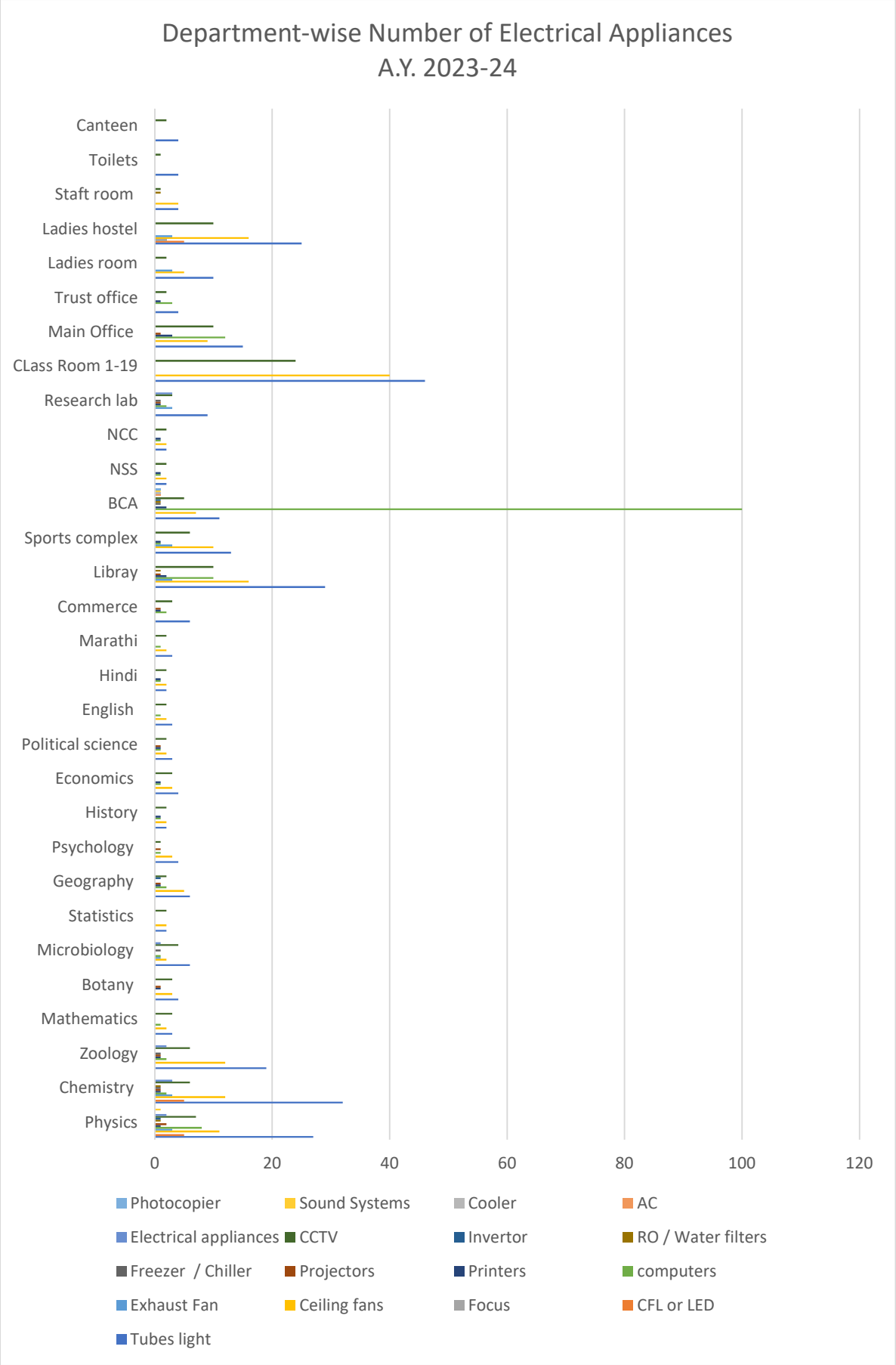

Figure 3 Department-wise Number of Electrical Appliances A.Y. 2023-24

Table 4 Department-wise Energy Consumption per day (kwh) A.Y. 2023-24

Department / Section	Tubes light	CFL or LED	Focus	Ceiling fans	Exhaust Fan	computers	Printers	Projectors	Freezer / Chiller	RO / Water filters	Invertor	CCTV	Electrical appliances	AC	Cooler	Sound Systems	Photocopier
Physics	7.56	0.1	0	1.65	7.56	1.6	0.3	3.2	0	0.3	0.58	2.52	0.04	0	0	0.1	0
Chemistry	7.04	0.1	0	0.9	10.08	0.4	0.3	1.6	1.0	0.175	0	2.16	0.12	0	0	0	0
Zoology	4.18	0	0	2.7	0	0.4	0.3	1.6	1.0	0	0	2.16	0.04	0	0	0	0
Mathematics	0.3	0	0	0.3	0	0.2	0	0	0	0	0	1.08	0	0	0	0	0
Botany	0.24	0	0	0.225	0	0	0.3	0	0	0	0	1.08	0	0	0	0	0
Microbiology	0.24	0	0	0.15	1.68	0.2	0	0	1.0	0	0	1.44	0.04	0	0	0	0
Statistics	0.08	0	0	0.3	0	0	0	0	0	0	0	0.72	0	0	0	0	0
Geography	0.48	0	0	0.75	0	0.8	0.3	1.6	0	0	0	0.72	0	0	0	0	0
Psychology	0.24	0	0	0.675	0	0.2	0	0.8	0	0	0	0.36	0	0	0	0	0
History	0.16	0	0	0.45	0	0.2	0.3	0	0	0	0	0.72	0	0	0	0	0
Economics	0.24	0	0	0.675	0	0.2	0.3	0	0	0	0	1.08	0	0	0	0	0
Political science	0.18	0	0	0.45	0	0.2	0.3	0.8	0	0	0	0.72	0	0	0	0	0
English	0.3	0	0	0.6	0	0.2	0	0	0	0	0	0.72	0	0	0	0	0
Hindi	0.08	0	0	0.3	0	0.2	0.3	0	0	0	0	0.72	0	0	0	0	0
Marathi	0.18	0	0	0.45	0	0	0	0	0	0	0	0.72	0	0	0	0	0
Commerce	0.24	0	0	0	0	0.4	0.3	0.8	0	0	0	1.08	0	0	0	0	0
library	3.48	0	0	6	12.6	4	0.6	0.8	0	0.125	0	3.6	0	0	0	0	0
Sports complex	1.3	0	0	2.25	7.56	0.2	0.3	0	0	0	0	2.16	0	0	0	0	0
BCA	0.88	0	0	2.625	0	60	0.6	0	0.04	0.025	0.29	1.8	0	1.5	0.84	0.1	1.1
NSS	0.08	0	0	0.3	0	0.2	0	0	0	0	0	0.72	0	0	0	0	0
NCC	0.08	0	0	0.3	0	0.2	0.3	0	0	0	0	0.72	0	0	0	0	0
Research lab	0.9	0	0	0	12.6	0.8	0.3	0	1.0	0	0	1.08	0.24	0	0	0	0
Class Room 1-19	2.76	0	0	15	0	0	0	0	0	0	0	8.64	0	0	0	0	0
Main Office	1.5	0	0	3.375	0	12	2.7	0.8	0	0	0	3.6	0	0	0	0	0
trust office	0.4	0	0	0	0	3	0.3	0	0	0	0	0.72	0	0	0	0	0
ladies room	1	0	0	1.875	7.56	0	0	0	0	0	0	0.72	0	0	0	0	0
ladies hostel	2.5	0.1	2.5	6	12.6	0	0	0	0	0	0	3.6	0	0	0	0	0
Staff room	0.08	0	0	0.6	0	0	0	0	0	0.125	0	0.36	0	0	0	0	0
Toilets	0.4	0	0	0	0	0	0	0	0	0	0	0.36	0	0	0	0	0
Canteen	0.08	0	0	0	0	0	0	0	0	0	0	0.72	0	0	0	0	0

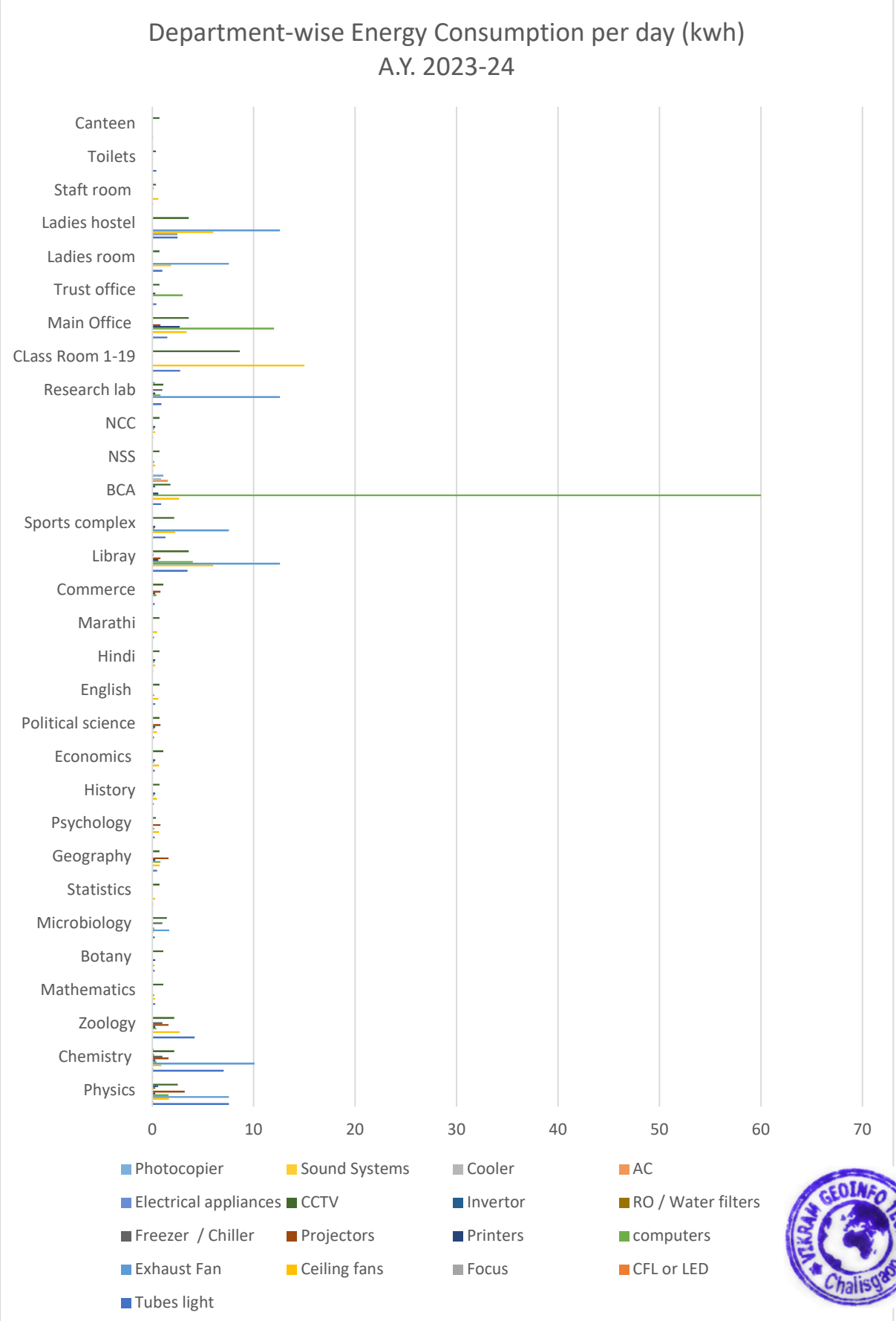

Figure 4 Department-wise Energy Consumption per day (kwh) A.Y. 2023-24

The energy audit of Indapur Taulka Shikshan Prasarak Mandal's Arts, Science & Commerce College, Indapur conducted for the academic years 2022-23 and 2023-24, provides a detailed assessment of the institution's energy usage patterns, highlighting areas of high consumption and opportunities for efficiency improvements. Key findings reveal that total energy consumption was 345.22 kWh/day in 2022-23, which decreased to 323.40 kWh/day in 2023-24, reflecting a modest reduction. This decline indicates that some initial energy-saving measures may have been effective, although significant consumption remains in specific areas such as laboratories, administrative offices, and common spaces like the library. Notably, departments like Physics, Chemistry, and Zoology demonstrated the highest energy usage due to equipment demands, such as HVAC systems, lighting, computers, and specialized laboratory devices, underscoring the challenge of reducing energy use in resource-intensive environments.

One of the primary observations is the shift from traditional incandescent lighting to energy-efficient LEDs, which, according to empirical data, can reduce lighting energy use by up to 80%. The audit notes that LEDs are installed in many areas, but further adoption is needed across the campus to maximize potential savings. Additionally, the audit identifies the need for consistent maintenance of HVAC systems and the integration of inverter technology, which can lead to smoother, more efficient air conditioning operations and lower power demand. This shift is particularly relevant in areas where temperature-sensitive equipment and comfort are essential, such as laboratories and administrative offices.

A critical aspect of the audit's findings is the environmental impact of energy use on campus. With India’s emission factor ranging between 0.91 to 0.95 kg CO_2/kWh, the college’s daily CO_2 emissions totaled approximately 321.05 kg in 2022-23, which was slightly reduced to 300.76 kg in 2023-24. This reduction aligns with the modest decrease in energy consumption but underscores the potential for further environmental benefits through additional energy-saving measures.

The analysis also highlights disparities in energy usage among departments, largely attributable to the varying number of electrical appliances and equipment required for each area. The Physics and Chemistry labs, for example, require specialized equipment that contributes significantly to overall power demands, while general classrooms and administrative areas show relatively lower energy consumption. A targeted approach is thus recommended, focusing on energy-intensive departments where even minor efficiency upgrades can yield significant savings.

Further scientific analysis suggests that implementing a centralized energy management system could enhance the college's ability to monitor real-time consumption patterns and adjust usage accordingly. Advanced systems utilizing smart metering and automated controls have shown promise in educational institutions globally, as they allow for granular data analysis and real-time adjustments, which can contribute to substantial long-term savings.

The energy audit's results highlight the need for a multi-faceted approach to energy efficiency at the college, combining technology upgrades with strategic maintenance and ongoing monitoring. The findings suggest that continued efforts in transitioning to LED lighting, upgrading HVAC systems, and implementing a centralized energy management system would not only reduce operational costs but also decrease the college's carbon footprint, thereby supporting its commitment to sustainable practices and environmental stewardship.

CONCLUSION

In conclusion, the energy audit of Indapur Taulka Shikshan Prasarak Mandal's Arts, Science & Commerce College for the academic years 2022-23 and 2023-24 reveals a significant opportunity for the institution to improve its energy efficiency and reduce its environmental impact. Although a reduction in daily energy consumption was observed between the two years, from 345.22 kWh to 323.40 kWh, substantial energy usage persists in key areas like laboratories, administrative offices, and the library. This continued high demand underlines the importance of further optimizing energy-intensive operations and enhancing equipment efficiency. The audit's findings suggest that by implementing additional measures—such as more widespread adoption of LED lighting, regular HVAC maintenance, and a centralized energy monitoring system—the college can achieve considerable cost savings, reduced greenhouse gas emissions, and align with sustainable energy practices. Ultimately, continued energy audits, combined with campus-wide awareness and proactive energy management strategies, will enable the college to fulfill its sustainability goals while setting a valuable example for its community.

RECOMMENDATIONS

1. Tubes lights and bulbs: The majority of departments are still using tubes lights and bulbs, which are less energy-efficient than CFLs or LEDs. Replacing tubes lights and bulbs with CFLs or LEDs can significantly reduce energy consumption.
2. Ceiling fans: Ceiling fans are the largest energy consumer in most departments. Installing energy-efficient ceiling fans can reduce energy consumption by up to 50%.
3. Computers and monitors: Computers and monitors are also major energy consumers. Encouraging users to turn off their computers and monitors when they are not in use can help to reduce energy consumption.
4. Printers and copiers: Printers and copiers can also consume a significant amount of energy. Using duplex printing and copying can help to reduce paper consumption and energy use.
5. Projectors: Projectors can be energy-intensive. Using projectors in eco-mode can help to reduce energy consumption.
6. Air conditioners: Air conditioners are major energy consumers. Setting thermostats to a higher temperature in the summer and a lower temperature in the winter can help to reduce energy consumption.
7. Lighting controls: Installing lighting controls, such as occupancy sensors and timers, can help to ensure that lights are only turned on when they are needed.
8. Power management software: Installing power management software on computers can help to reduce energy consumption by putting computers into sleep mode when they are not in use.
9. The college should continue to invest in and maintain its solar panel system. Exploring additional energy-saving measures could further reduce reliance on imported energy and increase exported energy.

REFERENCES

- The Environment [Protection] Act – 1986 (Amended 1991) & Rules-1986 (Amended 2010)
- The Petroleum Act: 1934 – The Petroleum Rules: 2002
- The Central Motor Vehicle Act: 1988 (Amended 2011) and The Central Motor Vehicle Rules:1989 (Amended in 2005)
- Energy Conservation Act 2010.
- The Air [Prevention & Control Of Pollution] Act – 1981 (Amended 1987) The Air (Prevention & Control of Pollution) Rules – 1982
- Electrical Act 2003 (Amended 2001) / Rules 1956 (Amended 2006)
- The Hazardous Waste (Management and Handling and Trans-boundary Movement) Rules, 2008 (Amended 2016)
- The Batteries (Management and Handling) Rules, 2001 (Amended 2010)
- Relevant Indian Standard Code practices
- Internal Records of the Campus, (A.Y.2022-23 and 2023-24)