



# **COLLEGE OF ENGINEERING AND TECHNOLOGY, AKOLA**

**Accredited By NAAC With 'A' Grade  
(CGPA 3.27)**

# **CRITERIA 7**

## **7.1.3 Green Audit /Environmental Audit Report**



Shri Shivaji Education Society, Amravati's

# COLLEGE OF ENGINEERING AND TECHNOLOGY, AKOLA



Founder President : Late Dr. Panjabrao alias Bhausaheb Deshmukh

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Date: 04/05/2023

## Declaration

This is to declare that the information, reports, true copies and numerical data etc

Furnished in this file as supporting documents is verified by IQAC and found correct.

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College of Engineering and Technology  
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Dr. S. K. Deshmukh

Principal

**Principal**  
**College of Engg.**  
**& Tech., Akola**

Shri Shivaji Education Society, Amravati's

# **COLLEGE OF ENGINEERING AND TECHNOLOGY AKOLA**

Babhulgaon, District: Akola

## **INTERNAL GREEN & ENVIRONMENT AUDIT REPORT 2021 - 2022**



Prepared by:

**Internal Green & Environment Audit Committee  
COLLEGE OF ENGINEERING AND TECHNOLOGY, AKOLA**





**INTRODUCTION:**

The term "Green" means eco-friendly or not damaging the environment. This can acronymically be called as "Global Readiness in Ensuring Ecological Neutrality" (GREEN). Green Accounting can be defined as systematic identification, quantification, recording, reporting & analysis of components of ecological diversity & Expressing the same in financial or social terms. "Green Auditing", an umbrella term, is known by another name "Environmental Auditing". In auditing literature both the terms are being used interchangeably. To implement the green audit other important aspects such as objective of green audit. Drivers of green audit, future scope, benefits, and advantages are necessary to understand. The green audit practically involves energy conservation, use of renewable sources, rain water harvesting, and efforts of carbon neutrality, plantation, hazardous waste management & E-waste management finally. The experiments on the nature by avoiding natural rules, this can be a one major reason behind that is green Audit. In scenario people are not caring of nature, they are directly or indirectly damaging the environment and it causes problems like; global warming, difficulties in maintaining ozone layers, air pollution, water pollution etc.

Green Audit is the most efficient & ecological way to solve such an environmental problem. For protecting the nature as a human being we have to show our sense of humor towards the mother earth. It is necessary to conduct a green audit in college campus because students are aware of the green audit, its advantages to save the planet & they become good citizens of our country. Green audit and sustainable development process help to reduce the wastage and associated cost as well as increase the product quality.

Obviously, there is a relationship between Green Audit and Sustainable Development of any business organization. Green audit and sustainable development process help to reduce the wastage and associated cost as well as increase the product quality.

**ENVIRONMENTAL POLICY OF THE COLLEGE : OUR ACTION PLAN****I. OUR SOCIETY**

Ours is the second Largest Education Society established by Dr. Panjabrao alias Bhausaheb Deshmukh Bhausaheb's mission –education to the downtrodden. Our Shri Shivaji Education Society, Amravati is a premier educational institution of Central India with branches in all the districts of Vidarbha in Maharashtra. It is registered as a Public Charitable Trust (R.N. F/89) (founded in 1931-32). Its founder President was the late Dr. Panjabrao alias Bhausaheb Deshmukh who established various schools, colleges, hostels and other teaching and technical institutions and devoted all his energy for strengthening and enlarging the activities of the Shri Shivaji Education Society, Amravati.



The Society was registered in December 1932. In 1958, it had one primary school, seven middle schools and eight colleges. Today it runs 24 senior colleges 54 Jr. colleges, 75 middle schools, 35 hostels mainly in the region of Vidarbha but also in other parts of the state. The educational institutions cover areas like agriculture, arts, bio-technology, computers, education, physical education, engineering, horticulture, information technology, law, medicine, micro-biology and the pure sciences. It also runs a Polytechnic for boys and girls at Amravati. Along with other members, Bhausaheb devoted himself to educate the people by establishing school and colleges far and wide in the Vidarbha. The Society was awarded the Dr. Babasaheb Ambedkar 'Dalit Mitra' Award in 1993-94 by the Govt. of Maharashtra. In the year 1999-2000 the Society was awarded the 'Gadge Maharaj Memorial Award, on 5th September, 2000 the Govt. of Maharashtra declared the Society as the "Best Administered Society" in the state and bestowed upon it a cash award of Rs. 1 lakh. In its citation, the State Government formally recognized the seminal contribution made by the Society in the field of education and cultural advancement.

## **II. OUR INSTITUTE :**

Ours is the pioneer Institute imparting Technical Education in our region since its inception 1983. Our College of Engineering & Technology, Akola is central India's premier multi disciplinary Engineering institute engaged in education, applied research, training and consultancy services which focuses clearly on Engineering.

## **III. MISSION**

Technical education for the individual, social and national development with global acceptance, by providing the relevant infrastructure with due consideration for our culture and the environment.

## **IV. VISION**

In full obeisance to the vision and foresight of Dr. Panjabrao alias Bhausaheb Deshmukh, this institute will strive tirelessly to educate and qualify the students from all the strata of the society, who are future engineers and technocrats, to take up challenges of modern era so that they are nationally and globally accepted in the application of their skills and knowledge to the benefit and development of the society.

**V. OUR CAMPUS:**

Campus Population –

Area – 9.73 Acres

Regional setting and connectivity -College Campus is situated on National Highway No.6, at about 13 km from Bus Stand,15 km from Railway station and 6 km From Shivani Aero drum. Easily accessible by Private Vehicles. It is surrounded by farms on East and west sides, on north National Highway No. 6

**VI. TOPOGTAPHY:** Our college campus is surrounded by agricultural land on east ,west and south side.Nala is flowing on south side which is full of water 3 months of year i.e. in Monsoon. It is having pollution free atmosphere having planted various types of trees where, many faunal species thrives.

Economic Base of Campus – It is a self finance educational Institute.

Campus Design: We ourselves as an initiative have developed our premises under Dr. Bhausahab Deshmukh Reasearch Cell.



Shri Shivaji Education Society, Amravati's

**COLLEGE OF ENGINEERING AND TECHNOLOGY, AKOLA**

Babhulgaon, District: Akola

**IGEAC : Internal Green and Environment Audit Committee**

Sr.	Name	Designation	Sign
01	Dr. S. K. Deshmukh	Principal / Chairman	 Principal College of Engg. & Tech., Akola
02	Dr. S. K. Patil	NAAC Coordinator, Mechanical Engineering	
03	Prof. Malini Nathe	(Green Campus Co-ordinator) IGEAC Coordinator, Architectural Department	
04	Dr. S. V. Dhomane	HOD, Architecture	
05	Dr. D. V. Wele	Member, IGEAC	
06	Dr. Naikwad	Electrical Engineering	
07	Dr. Kothari	Chemical Engineering	
08	Dr. Jyoti Shegokar	1 <sup>st</sup> Year Engineering	
09	Prof. Anand Tathod	Civil Engineering	
10	Prof. K. S. Gilda	Computer Engineering	
11	Prof. Gulfam Shaikh	Architecture Department	
12	Mr. Uday Vaze	Member, EFEC	
10	Mr. Devendra Telkar	Member, NGO	
11	MR. Akshay Shelke	Member, IGEAC Student Representative	
12	Ms. Vaidehi Rajkumar	Member, IGEAC Student Representative	
13	Mr. Narendra Shendragade	Member, IGEAC Gardner	

The Internal Green & Environment Audit Committee authenticate observations, records and recommendations in this report.



**Compilation document:**

Internal Green and Environment Audit is a process of systematic identification, quantification, recording, reporting, and analysis of components of environmental factors of various establishments. It aims to analyze environmental practices within and outside of the concerned sites, which will have an impact on the ambience. Thus it is imperative that the college evaluate its own contributions towards a sustainable future.

As environmental sustainability is becoming an increasingly important issue for the nation, the role of higher educational institutions in relation to environmental sustainability is more prevalent. Internal Green and Environmental Audit is assigned to the Criteria 7 of NAAC, National Assessment and Accreditation Council. The Internal Green & Environment Audit Committee was formed. The committee decided to conduct Internal Green and Environmental Audit of the college in June, 2021. The motive of the internal audit was to make sure that the practices followed in the campus are environment friendly.

Internal Green and Environment Audit is a systematic assessment of day to day activity with special focus on how resources are utilized with minimum impact on environment. The questionnaire was obtained with the help of external member of the Internal Green & Environment Audit Committee. It was observed and evidence were brought together what degree to which the departments are in compliance with the applicable regulations, policies and standards and to ensure that the development of the college aims at sustainable development and at the same time keeping the college campus green and pollution free. The methodology was simple and started, right from collecting data, insight inspection, evaluation, computation, conducting physical survey and review of the relevant documentation.

**Statement of assurance:**

The Internal Green & Environment Audit Committee has adopted the audit procedure that meets the terms of International Standards of Internal Auditing Practices. The committee is cause to feel certain that adequate and relevant audit procedures were followed, concrete evidence were gathered and conclusion were drawn from facts. The Internal Green and Environment Audit committee believe that recommendations are for improving the effectiveness of environmental management efforts made by the college. The Internal Green and Environment Audit Committee decided that changes or additions in management practices should be systemic, must be done through series of small steps and every concerned individual must be well informed about changes and additions made in management practices. Recommendations are based on a evidence compiled in this report as they existed at the time of the audit.

**Summary:**

It was evident from the data collected in several visits to College Of Engineering And Technology, Akola, that the teaching & non teaching staff, students of the college are aware about the importance of efforts to save and protect environment in the campus. The college staff follow best course of action such as plantation of important trees, reducing all types of waste, garden maintenance, follow composting practices, follow ways and means to reduce energy consumption, conduct review meetings, organize environmental educational activities for staff as well as for students. Although, it was also observed that, many of the practices followed by the college needs further action to improvise environment management system.



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### Introduction:

The expeditious urbanization and economic development at local, national and international level has led to several environmental and ecological emergencies. To prevent damages due to site specific activities, practices, processes and procedures followed by various institutions, businesses, organizations or factories, it becomes essential to adopt methods, process and procedures for making green campus for the institutions, businesses, organizations or factories which will lead for sustainable development.

College Of Engineering And Technology, Akola made it clear from its environment policy that its a priority area to conserve environment and promote environmental education & awareness in academia and every possible way to keep campus green.

The purpose of conducting the Internal Green and Environmental Audit is to understand and make continuous efforts to reduce adverse impact on environment. The college seeks advice from consultants and resource persons in environment education and protection.

The methodology to conduct Internal Green Audit & Environmental Audit was designed with the help of consultants and NGOs with the teaching staff of the college. It includes draft of questionnaire, in-situ site inspection in the campus, scrutinize and evaluate documentation, monitor procedures, practices and processes carefully.

The formation of Internal Green and Environment Audit Committee with involvement of external subject specialist has made report valuable. The Internal Green and Environment Audit Committee has made valuable recommendations.

The committee proposed remedial procedures to reduce the carbon foot print of the college. It works for the betterment of environment in the college campus including air, water, noise, soil quality, waste management, care for flora & fauna in campus, promoting paperless working.

### Internal green audit:

Internal Green Audit is a process of systematic verification of activities, identification of adverse impacts, evaluation of systems, documentation process, reporting and analysis of environmental diversity of various institutions, businesses, organizations or factories.

It aims to analyze environmental practices and processes within and outside of the targeted institution, business, organization or factory, which will have an impact on the ecologically friendly environmentally-safe ambience.





**Location of the college:**

College Of Engineering And Technology, Akola is situated in Babhulgaon village of Akola district.

Latitude: 20° 42'17.17"N

Longitude: 77° 5'38.06"E

**Land use and land cover:**

Total area of the college campus: 10.05 Acres

Area reserved for green cover:

**Population:**

Students : 1240    Teaching Staff: 71    Non Teaching Staff: 51    Floating : 50

**Audit questionnaire and audit forms:**

Internal Green and Environment Audit Committee was given a questionnaire. The committee was well supported by teaching and non-teaching staff of the college to collect the data. The evidences were collected by referring questionnaire and field visits to the college.

**Water quality:**

Access to safe drinking-water is essential to health, a basic human right and a component of effective policy for health protection. Water is essential to sustain life, and a satisfactory (adequate, safe and accessible) supply must be available to all. Improving access to safe drinking-water can result in tangible benefits to health.





**Internal Environment Audit:**

An Internal Environment Audit proposed by College Of Engineering And Technology, Akola is an assessment performed to ensure that institutions, is complying with environmental regulations policies. It examines the amount of adverse impact on environment or risk of injury that may be posed by the assessed entity and determines the types of pollution being produced by looking at a broad range of site specific activities, practices, processes and procedures. The information compiled from these factors to determine what remedial procedures are required to be added for better good.

**Scope:**

Internal Green and Environment Audit proposed by College Of Engineering And Technology, Akola play a significant role in continuing operation of institutions, businesses, organizations or factories. It keeps institutions accountable by scrutinizing their site specific procedures and determining what remedial measures are required to be added or put in place to ensure institutions, businesses, organizations or factories are following the proper statute.

**Objective:**

The key objectives of an Internal Environment Audit proposed by College Of Engineering And Technology, Akola therefore are to determine how well the environmental management systems and equipment are performing, verify compliance with the relevant national, local or other laws and regulations, minimize human exposure to risks from environmental, health and safety problems.

**Methodology:**

Internal Green & Environment Audit Committee by College Of Engineering And Technology, Akola was formed. In the first meeting of Internal Green and Environment Audit Committee an open discussion was made on how to conduct Internal Green & Environment Audit. The committee came to a conclusion that external party will look into overall infrastructure, procedures, practices and operation of the collage and will draft detail questionnaire. Questionnaires provide a relatively rapid and efficient way of obtaining large amounts of information from a large number of people. Answers obtained from open-ended questionnaire are analyzed using qualitative methods and they involve discussions and critical analysis without any difficulty. This was useful because the information lead to concrete conclusions. The methodology also included a physical inspection of the campus, observation, and review of the documentation, interviewing key persons and data analysis, measurements, and suggesting recommendations.





The efforts were taken to understand following focus areas and emphasis was given to know facts on the ground :

Overall area inspection to find out efforts taken by the College Of Engineering And Technology, Akola to promote greenery in campus.

Management & performance of water distribution and its conservation by College Of Engineering And Technology, Akola be it a municipal supply or the water collected by rain water harvesting.

Drinking water and water consumption for other purposes such as construction, gardening etc and its management.

Use of electricity and other types of energy uses and management related to it. Initiatives, projects and activities taken for conservation of flora, fauna and the measures taken to improve environment management systems in the college campus.

#### **Environment policy:**

College Of Engineering And Technology, Akola is a leading college in the Akola district and is well aware about it's responsibilities towards environment. It protects its own environment and efforts are taken to keep it free from pollution. Environment protection, conservation and education are key areas that are prioritized in academia of the college. The management, teaching & non teaching staff, students and community members of the college look after the environment carefully.

Important focus areas are:

- i. To create awareness regarding environmental policy of the College Of Engineering And Technology, Akola to management, teaching & non teaching staff, students and community members.
- ii. To keep college campus of College Of Engineering And Technology, Akola free from pollution by avoiding open fire, managing garbage, prohibition of consumption of tobacco in the campus. Display caution poster in regard to health, hygiene and environment protection are displayed in the campus.
- iii. Segregate bio-degradable & non bio-degradable waste. Create composting facility for bio-degradable waste.
- iv. To provide safe drinking water to students and staff.
- v. To install and maintain 'Rain Water Harvesting' in the campus.
- vi. To place the dustbins and promote hygienic condition in the college campus.
- vii. To organize various activities with the help of NGOs and government agencies.
- viii. To evaluate the environmental performance of the college by conducting Internal Green and Environment Audit of College Of Engineering And Technology, Akola annually.





### **Installations:**

The installation of solar panels, compost pits and rainwater harvesting system are the initiatives taken by .

### **Bio diversity in campus:**

College Of Engineering And Technology, Akola has planted several trees in the campus and these trees became saviors of bio-diversity present on the campus.

### **Flora and fauna:**

The green cover on the campus helps in creating favorable condition for many living organisms such as butterflies and other friendly insects such as lady bird beetles, spiders, birds and mammals.

### **Green initiatives:**

College Of Engineering And Technology, Akola is aware about importance of educating students about environment and special efforts are taken by Environment Committee in initiating activities that reduces its adverse impacts on environment. Initiative such as tree plantations, de-weeding program, rain water harvesting, no vehicle day, installation of solar panels, plastic waste free campus, regular maintenance of electrical gadgets, awareness training workshops, paperless exams are organized by the college.

### **Recommendations:**

Recommendations are given by Internal Green & Environment Audit Committee. The recommendations made by the committee will give insight to the administrative authority to improve the environment and will make positive impact on environment performance of the college.

### **Awards & recognition received by the college:**

College Of Engineering And Technology, Akola has received many awards and recognition over the last few years.

### **Post Internal Green & Environment Audit commitments:**

Review meeting was organized to discuss about recommendations made by committee after the Internal Green & Environment Audit process was completed.

### **Internal Green & Environment Audit document storage:**

Documents related to Internal Audit are stored at IQAC chamber.





**Bio-diversity in campus: Flora**

College Of Engineering And Technology, Akola is well aware about benefits of trees for other living organisms. Trees act as carbon sinks and offset carbon from the environment. Wide variety of floral species can be seen thriving in the college campus and variety of life forms such as birds, mammals, butterflies can be seen at all periods of the day. Exhaustive list of species found in botanical garden on the campus are presented in following table.

S.N	COMMON NAME	SCIENTIFIC NAME	MEDICINAL /NONMEDICINAL	USES	NUMBER OF TREES	PHOTO
1	NEEM	AZADIRACHTA INDICA	MEDICINAL	MEDICINES, TIMBER, PESTICIDES		
2	NIGHT – FLOWERING JASMINE (PARIJAT, PRAJAKTA)	NYCTANTHES ARBO-TRISTIS	MEDICINAL	MEDICINES, FLOWERS		
3	BAUHINIA KANCHAN	PHANERA VARIEGATA	MEDICINAL	INGREDIENT IN MANY INDIAN RECIPES, MEDICINES.		
4	BABUL	ACACIA NILOTICA	MEDICINAL	GOOD PROTECTIVE HEDGE BECAUSE OF ITS THORNS, GUM, MEDICINES		
5	SUGAR APPLE (SITAFAL)	ANNONA SQUAMOSA	MEDICINAL	FRUITS		
6	BER	ZIZIPHUS MAURITIANA	MEDICINAL	FRUITS		
7	BAMBOO (GRASS)	BAMBUSOIDEA E	MEDICINAL	CONSTRUCTION, BUILDING MATERIALS.		
8	MORINGA, DRUMSTICK	MORINGA OLEIFERA	MEDICINAL	INGREDIENT IN MANY INDIAN RECIPES, MEDICINES.		
9	KARANJA	PONGAMIA PINNATA	MEDICINAL			
10	BLACK PULM (JAMUN)	SYZYGIUM CUMINI	MEDICINAL	MEDICINES, FRUITS, TIMBER		



S.N	COMMON NAME	SCIENTIFIC NAME	MEDICINAL /NONMEDICINAL	USES	NUMBER OF TREES	PHOTO
11	COPPER POD (HALADI GULMOHUR)	PELTOPHORUM PTEROCARPUM		TIMBER, SHADE		
12	GULMOHUR TREE	DELONIX REGIA		FLOWERS, SHADE		
13	PEEPAL TREE	SACRED FIG FICUS RELIGIOSA	MEDICINAL	TIMBER, SHADE MEDICINAL		
14	BANYAN TREE	FICUS BENGHALENSIS	MEDICINAL	TIMBER, SHADE MEDICINAL		
15	BOUGAINVILLEA	BOUGAINVILLEA GLABRA		COMPOUND HEDGES		
16	TEAK	TECTONA GRANDIS	MEDICINAL	CONSTRUCTION, BUILDING MATERIALS		
17	PALM TREE - BOTTLE PALM	OREODXA REGIA COMMON		AVANUE		
18	ASHOKA TREE	POLYATHIA LONGIFOLIA		AVANUE		
19	YELLOW FLOWERS	TECOMA STANS	MEDICINAL	FLOWERING SHRUB		
20	MANGO	MANGIFERA INDICA	MEDICINAL	MEDICINES, FRUITS, TIMBER, INGREDIENT IN MANY INDIAN RECIPES	1	








S.N	COMMON NAME	SCIENTIFIC NAME	MEDICINAL / NONMEDICINAL	USES	NUMBER OF TREES	PHOTO
21	COCONUT TREE	COCOS NUCIFERA	MEDICINAL	FRUITS, CONSTRUCTION, BUILDING MATERIALS, MEDICINAL		
22	TAMARIND	TAMARINDUS INDICA	MEDICINAL	INGREDIENT IN MANY INDIAN RECIPES, MEDICINES.		
23	ROSES	ROSA	MEDICINAL	MEDICINAL FLOWERS.		
24	WHITE HIBISCUS	HIBISCUS SABDARIFFA WHITE HIBISCUS	MEDICINAL	FLOWERS, MEDICINAL		
25	RED HIBISCUS, SCARLET ROSE MALLOW, TEXAS HIBISCUS	HIBISCUS COCCINEUS	MEDICINAL	FLOWERS, MEDICINAL		
26	TABERNAEMONTANA HEDGE		MEDICINAL	HEDGE, FLOWERS		
27	BOTTLE BRUSH TREE	CALLISTEMON BRACHYANDRUS.	ORNAMMENTAL	GREAT ATTRACTORS OF POLLINATORS.	2	
28	AMLA /AMALIKA	PHYLLANTHUS EMBUCA.	MEDICINAL	DECIDUOUS TREE OF THE FAMILY PHYLLANTHACEAE IN TRADITIONAL INDIAN MEDICINE, DRIED AND FRESH FRUITS ARE USED	1	
29	AUDUMBER	BLUE LOTUS PLANT	MEDICINAL	DECIDUOUS TREE, FRUITS, SPIRITUAL IMPORTANCE	1	
30	CHAFA, CHAMPAK	FUMERIA	MEDICINAL	AROMATIC FLOWERING		





S.N	COMMON NAME	SCIENTIFIC NAME	MEDICINAL NONMEDICINAL	USES	NUMBER OF TREES	PHOTO
31	PALASH TREE FLAME-OF-THE-FOREST & BASTARD TEAK.	BUTEA MONOSPERMA	MEDICINAL	IT IS USED FOR TIMBER, RESIN, FODDER, MEDICINE, AND DYE		
32	GUAVA PERU	PSIDIUM GUAJAVA.	MEDICINAL	INGREDIENT IN MANY INDIAN RECIPES, MEDICINES.		
33	GOLDEN ARROW OR GILDED SPOON(NAG- CHAMPA)	PLUMERIA FUDICA	MEDICINAL	MEDICINAL FLOWERS		
34	SAGO PALM	CYCAS REVOLUTA	-	ORNAMENTAL		
35	BETA/ AGATI	SESBANIA GRANDIFLORA	MEDICINAL	FLOWERS ARE USED IN VEGITABLE. MEDICINAL HAS SEVERAL ENVIRONMENTAL BENEFITS. AS FAST-GROWING, N-FIXING LEGUME, IT IS USED FOR THE REFORESTATION. IT IS OFTEN PLANTED TO MAKE FENCE LINES OR AS SHADE TREE, WINDBREAK AND SUPPORT FOR OTHER CROPS		
36	SAPTAPARNI	ALSTONIA SCHOLARIS	MEDICINAL	HEDGE, FLOWERS		
37	BUCH TREE - INDIAN CORK TREE	MILLETTONIA HORTENSIS		FLOWERS		

S.N	COMMON NAME	SCIENTIFIC NAME	MEDICINAL NONMEDICINAL	USES	NUMBER OF TREES	PHOTO
38	WEeping FIG- BENJAMIN, FICUS TREE	FICUS BENJAMINA	ORNAMENTAL	HEDES.		
39	GOLDEN ARROW - GILDED SPOON.	PLUMERIA PUDICA	-ORNAMENTAL	-		
40	GOLDEN DURANTA HEDGE	DURANTA ERECTA	ORNAMENTAL	HEDES.		
41	LEMON GRASS	[Cymbopogon citratus]	medicinal	Leaves are used Uses: Cough, Colds, Fever, Anti-poison, Indigestion, Spleen, Tiredness, Headache, Worms, Vomiting, Skin, Urinary, Flatulence, Flavouring agent, Cancer, Nasal congestion, Anti-fungal and antimicrobial, as insecticide.		
42	Rhoeo (Rhoeo discolor)	TRADESCANTIA SPATHACEA	ORNAMENTAL	Rhoeo is a popular perennial bright colored garden plant mostly used as border plant. It is also known as Moses-in-the-Cradle or Moses-in-the-Boat.		



## List of birds seen at various places in the campus:

English Name	Scientific Name	Marathi Name
House Crow	<i>Corvus splendens</i>	कावळा
Grey Shouldered Kite	<i>Elanus axillaris</i>	कपाशी
House Sparrow	<i>Passer domesticus</i>	भारतीय चिमणी
Purple Sunbird	<i>Cinnyris asiaticus</i>	शिजीर
Lesser Coucal	<i>Centropus bengalensis</i>	भारद्वाज
Alexandrine Parakeet	<i>Psittacula eupatria</i>	करण पोपट
Rose Ringed Parakeet	<i>Psittacula krameri</i>	लाल मान्या पोपट
Blue Rock Pigeon	<i>Columba livia</i>	राखी कबुतर
White Breasted Waterhen	<i>Amaurornis phoenicurus</i>	लाजरी पाणकोंबडी
Asian Koel	<i>Eudynamis scolopaceus</i>	भारतीय कोकीळ
Yellow Legged Green Pigeon	<i>Treron phoenicoptera</i>	हरीयल
Barn Owl	<i>Tyto alba</i>	पिंजरा घुबड
Coppersmith Barbet	<i>Megalaima haemacephala</i>	तांबट
Indian Roller	<i>Coracias benghalensis</i>	चाष
Little Green Bee Eater	<i>Merops orientalis</i>	चेडा राघू
Black Drongo	<i>Dicrurus macrocercus</i>	कोतवाल
Shikra	<i>Accipiter badius</i>	शिक्रा
Common Iora	<i>Aegithina tiphia</i>	सुभग
Purple Sunbird	<i>Cinnyris asiaticus</i>	शिजीर
House Sparrow	<i>Passer domesticus</i>	गावचिमणी
Golden Oriole	<i>Turdoides striatus</i>	हळद्या
Red Munia	<i>Amandava amandava</i>	लाल मुनिया
Yellow Footed Green Pigeon	<i>Treron phoenicoptera</i>	हरीयल
Black Drongo	<i>Dicrurus macrocercus</i>	कोतवाल
Jungle babbler	<i>Turdoides striatus</i>	सातभाई
Indian Roller	<i>Coracias benghalensis</i>	नीलकंठ
Indian Pea Fowl	<i>Pavo Cristatus</i>	भारतीय मोर
Indian Pea Fowl	<i>Pavo Cristatus</i>	भारतीय मोर
Indian Pea Fowl	<i>Pavo Cristatus</i>	भारतीय मोर
Indian Pea Fowl	<i>Pavo Cristatus</i>	भारतीय मोर
Indian Pea Fowl	<i>Pavo Cristatus</i>	भारतीय मोर





**Green initiatives by the college:****I. PLANNING AND DESIGNING OF CAMPUS**

**OPTIMUM LAND USE-** planning of campus is compact planning with multiplexing of spaces e.g. Barrier free studios that can be used as exhibition spaces. Studios are equipped with furniture that is space efficient. We have provided built in cupboards in studios in Architecture dept. Building, for students equipments. Walls of Studios are constructed with rat trap bond so as to protect from harsh sun rays in summer.

In computer Department courses are carried out in two shifts hence optimum use of functional spaces is carried out. We have provided ramps and toilets for physically handicapped persons. In order to admit more light and ventilation a fully glazed steel casement windows are provided which admit 100% natural light and comfortable air circulation. The workplaces are arranged to take advantage of natural light and ventilation from windows.

**II. LANDSCAPING**

Taking in to consideration the hot and dry climate of Akola we have provided ground covers in the form of lawns in overall campus to reduce heat gain and to create a microclimate. On the periphery of entire campus the existing trees are preserved and in addition to that number of trees has been planted in entire campus forming the green belt, which acts as a buffer zone for sound and heat. Such kind of tree plantation will reduce carbon percentage and increase oxygen level. This creates a healthy and pollution free environment. Court yard in Architecture department is provided with sitting tiers with reused flooring material in combination with lawns and beautiful flowerbeds.

Every year the staff and students are involved in tree plantation. Up till now numbers of trees has been planted in College as well as Akola city. The campus is having huge numbers of trees including herbs, shrubs, grasses, medium & big sized trees, with belt of bamboo plantations. The institute is also equipped with 2 gardens which has made the campus environmentally fresh and eco-friendly.

NSS unit is also carrying out tree plantation as regular activity in campus and nearby villages during NSS winter camps. Faculty Staff and students are encouraged to plant trees inside and outside the campus on special occasions.

**III. FENESTRATION AND SHADING** In entire campus all the building blocks with sunken windows are provided which prevent harsh sunrays and rain. Maximum use of north light is used. Sufficient numbers of doors and windows are provided.

Deciduous trees are planted near building blocks which gives protection from harsh sun rays.





**Green initiatives by the college:****V. Use of ENERGY EFFICIENT APPLIANCES:**

Energy audit is conducted for saving of electrical power. Resistive based fan regulators are replaced by solid state devices based regulators which reduce losses in the electrical power also electronic ballasts are used to control power. Replacing old light systems by energy efficient Compact Fluorescent Lamps (CFL) tubes and bulbs. The faculty, staff and students takes care of switching off lights, fans and other electrical devices to avoid wastage of energy when they are not in use. Single switch is used to switch off classroom, laboratory power supply for fans and light points. The workplaces are arranged to take advantage of natural light and ventilation from windows. Energy awareness campaigns have been carried out for the student, faculty and staff members. Placards, notice boards have been used for creating awareness about power saving and safety.

**VI. WASTE MANAGEMENT:**

Everyday all the academic buildings and other surrounding area in the campus are cleaned by sweepers and they separate out waste and dispose accordingly. Classrooms and studios are provided with dustbins which are prepared by students by reusing other materials.

i). **COMPOSTING** With the vision to produce fertilizer with the campus using the waste generated in the campus, the waste compost plant is installed and operated by department of civil engineering in college campus; Waste excluding polythene generated in the campus is converted in to compost by using PDKV culture. The waste mainly generated being a teaching institute is used papers along with other organic waste like leaves and garden residues. Initially all the organic and inorganic waste is separated so that organic waste can be put for composting. After 4 to 6 turnings in the period of four month, the fertilizer is obtained (approximately quantity of 20 sags of 50 kg). The efficiency obtained on volumetric basis is 111kg / cu-m / four months. Similarly another lot is obtained in the interval of four months.

**निर्माणनिर्मित घटकांच्या साह्याने पर्यावरण सेवा**

शिवमती अभियांत्रिकी व तंत्रिकी महाविद्यालयतील उपक्रम





**Green initiatives by the college:**

ii) E-waste management: Out-dated and low-end e-components are being used for demonstration. E.g. CRO, Function Generator like these electronics equipments have been used as demonstration models in respective laboratories. The major e-waste such as out of use instruments / equipment, CRTs, Printers, Computers, Electronics gadgets, circuits, kits have been written off and then it is sold out to buyers by auctioning. All the miscellaneous e-waste such as CDs, batteries, fluorescent bulbs, PCBs and electronic items are collected from every department and office, and delivered for safe disposal. Useful parts of electronic gadgets like resistors, capacitors, inductors, diodes, transistors, thyristors etc have been removed from the gadgets for reuse purpose in practical / projects.

**VII. WATER HARVESTING**

Rainwater / roof water harvesting has been done in entire campus to increase underground water table. Surface run off & roof top water is collected and used for garden irrigation. Rainwater is collected from each shade and corner campus and drop into into the wells. For water harvesting survey has been carried out and underground storage tanks are constructed in campus. The trees and lawns are maintained with water drips and sprinklers respectively. Reuse of waste water for gardening. Every year NSS volunteers are involved in Special Camp where they construct CCTs (Contour Crafting Traversing) and coffer dams.

**VIII. ENVIRONMENT CONSCIOUSNESS**

Thus the institute is very much conscious about environmental issues. Regular practices and activities have been adopted to create environmental awareness. The institute is very keen for making the campus eco-friendly by adopting certain measures and policies. All the academic buildings and other surrounding area in the campus are cleaned regularly by sweepers. The Institute has adopted energy conservation practices, tree plantation and water harvesting for making the campus clean, green and healthy.

The institute has adopted following strategies for environmental consciousness: Regular Campus Cleanliness, Polythene free and smoking free zone helps to make campus eco-friendly. Green belt evergreen trees and plants.

Tree Plantation on the occasion of Independence Day & "Tree plantation Day".

Reduction in usage of papers by digitizing most of the records.

Effective utilization of rough papers (one side printed) for printing.

Students are motivated for eco-friendly practices.

Maximum use of Public transport by students and staff.

Sharing of cars and two wheelers by staff and students.

Announcing 'NO VEHICLE DAY'.





### Green initiatives by the college:

This year 24<sup>th</sup> December was announced as no vehicle day in our Campus. Providing enough signs in entire campus for proper circulation of vehicles to minimize fuel consumption, reducing noise level, indication of parking spaces. Entire college map is located at the main entry so as to avoid inconvenience for circulation in entire campus. Minimizing the paved area and maximizing permeable area so as to percolate more water in to ground and minimize heat gain. Beautiful landscape is provided in entire campus to create cheerful and healthy atmosphere.

Topography of entire campus has been studied and remedial measures are taken for disposal of storm water/ rain water. Measures regarding channelization, pitching, turbing of existing Nalla has been taken under consideration as a proposal to increase water level, to avoid soil erosion and to beautify campus. Proper drainage systems have been provided to collect and dispose off sewage water in entire campus. In existing COETA Campus problem areas are identified such as dark corridors, insufficient ventilated areas, and remedial measures are suggested. Use of solar energy is under consideration. LED lights are suggested to minimize electrical energy consumption. Awareness/training workshops are organized in the campus regarding Cost Effective Technology, Energy Efficiency, renewable energy applications, and taking suitable measures for energy conservation. Suitable architectural retrofit options for building envelop (floor, roof, walls etc.) and energy efficient glasses for windows are under consideration. The redesigning of exterior surfaces of the buildings with energy efficient material is under consideration. Any other innovative actions/ points to be taken for making existing campus green.

At the end of the year, the college has achieved a great success in the field of green initiatives.

Some of the major achievements of the college in the field of green initiatives are as follows:

1. The college has been awarded the 'Green Campus' award for the year 2019.
2. The college has been awarded the 'Green Campus' award for the year 2020.
3. The college has been awarded the 'Green Campus' award for the year 2021.
4. The college has been awarded the 'Green Campus' award for the year 2022.
5. The college has been awarded the 'Green Campus' award for the year 2023.
6. The college has been awarded the 'Green Campus' award for the year 2024.
7. The college has been awarded the 'Green Campus' award for the year 2025.
8. The college has been awarded the 'Green Campus' award for the year 2026.
9. The college has been awarded the 'Green Campus' award for the year 2027.
10. The college has been awarded the 'Green Campus' award for the year 2028.
11. The college has been awarded the 'Green Campus' award for the year 2029.
12. The college has been awarded the 'Green Campus' award for the year 2030.

Some other major achievements of the college are as follows:

S. No.	Item	Value	Unit
1.	Water	1000000	litres
2.	Gas	1000000	litres
3.	Electricity	1000000	litres
4.	Oil	1000000	litres
5.	Waste	1000000	litres
6.	Waste	1000000	litres
7.	Waste	1000000	litres
8.	Waste	1000000	litres
9.	Waste	1000000	litres
10.	Waste	1000000	litres

At the end of the year, the college has achieved a great success in the field of green initiatives.



**Green initiatives by the college:**

6) Detailed survey was carried out to evaluate use of energy, water and other resources in all the following areas.

**I. ACTUAL CASE STUDY:**

Name of Campus- College of Engineering & Technology, Akola.

Sr. No.	Name and area of the Unit	Total Area
1.	Total Campus Area	50523.64 m <sup>2</sup>
2.	Built up Area of the Building	18319.09 m <sup>2</sup>
3.	Building Area of Administration	213.26 m <sup>2</sup>
4.	Chemistry Lab Area+	109.11 m <sup>2</sup>
	Library	19.74 m <sup>2</sup>
	Head & Staff	53.37 m <sup>2</sup>
5.	Physics Lab.	102.61 m <sup>2</sup>
	Dark Room	21.38 m <sup>2</sup>
6.	Computer Lab	133.06 m <sup>2</sup>
7.	Library Reading Room	133.45 m <sup>2</sup>
8.	Class rooms	2908.72 m <sup>2</sup>
9.	Drawing Studios	697.13 m <sup>2</sup>
10.	Canteen Area	75.00 m <sup>2</sup>
11.	Staff Room	495.49 m <sup>2</sup>
12.	Ladies Room	34.00 m <sup>2</sup>
13.	Gymkhana Hall	75.00 m <sup>2</sup>
14.	Guest Room	135.90 m <sup>2</sup>
15.	Bank	135.90 m <sup>2</sup>
16.	Toilet Block -1	225.36 m <sup>2</sup>
17.	Math's Department	22.91 m <sup>2</sup>
18.	Exam Control Room	107.03 m <sup>2</sup>
19.	Architecture Dept.	1750.53 m <sup>2</sup>
20.	Computer Department	2130.00 m <sup>2</sup>
21.	Workshop	837.00 m <sup>2</sup>
22.	NAAC Office/ VP Cabin	27.11 m <sup>2</sup>
23.	Total Roof Area is .	50523.00 m <sup>2</sup> .





**Green initiatives by the college:****II. WATER CONSUMPTION**

Water Consumption on the entire campus is as follows:

Sr.No.	Water Used For	Per Day
1	Domestic Purpose including canteen.	4 m <sup>3</sup> /day
2.	Gardening	1.5 m <sup>3</sup> /day
3.	Laboratory Purpose.	1.0 m <sup>3</sup> /day

**III. ELECTRICITY CONSUMPTION**

Electricity Consumption per Year was 981 KWH. Avg. Electrical Consumption per Month was 81.75 KWH. Avg. Electrical Consumption per Day was 2.68 KWH

**IV. CHARACTERISTIC AND DISPOSAL PRACTICES OF SOLID WASTES WASTE MANAGEMENT**

1. The waste is segregated at source by providing separate dust bins for waste.
2. Segregation of chemical waste generated in chemistry lab.

Sr.No.	Waste Category	Constituent Parameter	Method of Disposal
1	a. Canteen waste. b. solid waste from tree droppings and lawn	Not Analyzed.	Vermi Composting  Organic Manure
2.	Plastic Waste	Not analyzed	Provision Separate Dust bins
3.	Solid Waste from Lab	Not analyzed.	Composting Organic Manure Proposed during year 2014-15

**VIII. PLANTATION AWARENESS PROGRAM**

The institute has organized various has organized Tree Plantation program at College Campus and surrounding villages through NSS unit within the Institute. The plantation program includes plantation of various types of ornamental and medicinal wild plant species in large numbers in each surrounding villages. This activity is done during the month of August. Every Year the institute organize Tree Plantation program on the eve of Birth Anniversary of Late Dr. Panjabrao Alias Bhausaheb Deshmukh.



**Green initiatives by the college:****II.VERMICULTURE COMPOSTING CULTURE**

The institute has started vermi culture composting culture in house in Collaboration with Dr. PDKV University Akola near by college Canteen. The main purpose of this is to reduce disposable waste in the college campus and after complete process of vermin composting it is used as manure. The main benefits of the process are to reduce the waste in the environment .

**XI. ENVIRONMENT AWARENESS PROGRAM**

While maintain the environmental awareness program in the campus it is compulsory subject to all second year student which is irrespective of particular branches. Syllabus topics must consist of following:

- a. Air Pollution its causes, effects & installation of various devices that reduces the air pollution.
- b. Water Pollution its causes, effects & various methods to prevent the it.
- c. Sound Pollution its causes, effects & installed equipments that reduces it.
- d. Noise Pollution its effects on surroundings.

**XII. AWARENESS OF CARBON CONSUMPTION**

1. Students and are Staff members and made totally aware of pollution that are caused by use of vehicles & bicycles.
2. In the college campus almost 90% of students are using bicycles.
3. The carbon consumption awareness programmer improves to help in carbon emission at individual as well as social level and avoids Air and Noise pollution in the campus due to vehicles or any activity in it
4. Due to awareness programme in the campus air quality within it is non polluted.

**7. INITIATIVE TO WORDS GREEN CAMPUS BY VARIOUS DEPARTMENTS****I. CHEMICAL & POLYMER TECHNOLOGY****a) PLASTIC WASTE MANAGEMENT****i) Recycling Process**

1. Grinding
2. Extrusion
3. Standard Industrial palates

**ii) Pyrolysis :- (Value added Products )**

These Products in the Three States –

- Solid Liquid and Gaseous.
- They have Absence of Oxygen.
- Pyrolysis is reverse process to recover hydrocarbons.





**Green initiatives by the college:**

iii) Liquid fuel: Industries require Greece. Due to increase in temperature in industries and because of melting of grease in Mechanical Process get higher temperature, greasing is to be done frequently. The grease normally used in industry contents its excreted from Soap. We have added polymeric base to Greece for which our Institute have patent. Polymer liquid fuel can be uses as boiler fuel. We have been practically using liquid fuel with blending of Polymer base in several Industrial Unit at M.I.D.C., Akola successfully which is without in basic designing for Burning Unit.

## iv) Modification of Bitumen

In construction of Village Roads, State and National Highways. Bitumen is normally used because of heavy traffic Bitumen develops cracks to reduce the cracking of Bitumen. We have added 4% of Plastic Waste for bridging the cracks and improvisation penetration index P.W.D.(Public Work Department, Akola ) has accepted addition of 4% of Plastic waste, for their Road Projects for, which we having and Reading and Test Certificates.

v) Plastic for Energy recovery from waste. We have designed, Kilns for 'down jet combustion. Down jet Combustion Technique show minimal level of Car and other Gases. Where the efficiency is seen to be 35% to 40%.

## vi) Seed Processing:

In seed Processing Units for cleaning of cotton seeds and removal of sheathing. There was a tradition of using Hydrochloric Acid(HCL) , Sulphuric Acid ( $H_2SO_4$ ) is created – about 60 to 80%. Which is highly corrosive and hazardous to environment and health and this spend acid used to be drained in low line areas quarries, which change nature of soil resulting in contamination of water and environment. We have developed environment solution of generation of dry Hydrochloric Acid in gaseous form. We have developed and technique where dry HCL gas is used without use of Sulphuric Acid ( $H_2SO_4$ ). The non use of Sulphuric Acid ( $H_2SO_4$ ) is instrumental in preserving the Environment. This is a Pilot Project.

## viii) Seed Coating:

We have developed a Water Soluble Polymer for coating of seeds. This maintains the desired moisture level for germination. This help ensuring quality of seed and its branding. For example :Soya been Seeds: Soya been is only seed having its embryo outside it. In transportation, because of frequent impacts during loading and unloading the germination value is significantly reduced. Because of Polymer Coating the germination quality increased to level of more than 70% and process is Cost Effective.





### Green initiatives by the college:

A Long lasting road from waste plastic for a better and green world....

Disposal of waste plastic is a major problem. It is non-biodegradable & It mainly consists of low-density polyethylene. Burning of these waste plastic bags causes environmental pollution. To find its utility in bituminous mixes for road construction, Laboratory performance studies were conducted on bituminous mixes. Laboratory studies proved that waste plastic enhances the property of the mix. Improvement in properties of bituminous mix provides the solution for disposal in an useful way. Plastic roads mainly use plastic carry bags, disposable cups and bottles that are collected from garbage dumps as an important ingredient of the construction material.

When mixed with hot bitumen, plastics melt to form an oily coat over the aggregate and the mixture is laid on the road surface like a normal tar road.

What are waste plastic roads?

The roads constructed using waste plastic, popularly known as Plastic Roads, are found to perform better compared to those constructed with conventional bitumen.

1) The Indian Centre for Plastics in the Environment (ICPE) has been promoting the use of plastic waste to construct asphalt roads.

2) A few trial roads have been paved.



Aggregate of 20mm, 10 mm.

Stone Dust and Lime as Filler 60/70,80/100 grade bitumen. Waste plastic in the shredded form. (PVC is not Used)

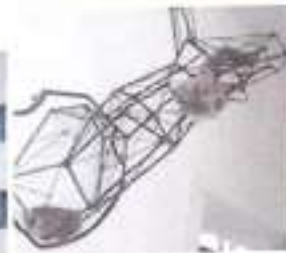
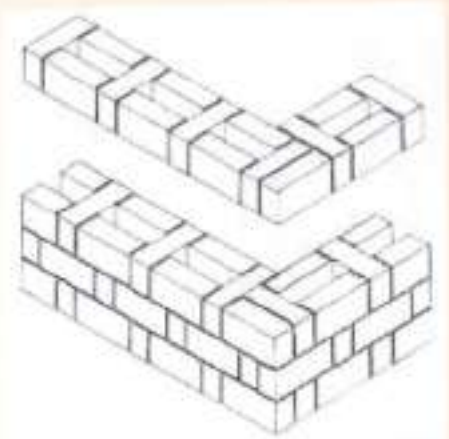
### II) ARCHITECTURE DEPARTMENT-

Planning of building is compact planning with multiplexing of spaces e.g. Barrier free studios that can be used as exhibition spaces. Studios are equipped with furniture that is space efficient. We have provided built in cupboards in studios for students equipments. Steel windows are used which admit 100% light and ventilation. Walls of Studios are constructed with rat trap bond so as to protect from harsh sun rays in summer.





## ARCHITECTURE DEPARTMENT-



Tank for rain water harvesting



## Bills for Rain water Harvesting, Bore Well Recharge







**Tree Plantation Dt. 24 July 2021 Venue- School Of Architecture Campus**



**Campus Interpretation, Coet, Akola**

Students of second year, Third year n Fourth year studied different trees n and birds by visiting campus of College of Engineering and Technology Akola. Students draw sketches of college, trees.





**Study of campus flora along with expert Dt. 12 December 2021:**

In continuation with Campus Interpretation, ON Date 11 December 2021 we have arranged an Experiential Field Survey of our premises. Guidance regarding plant identification, characteristic features of plants, bushes, shrubs, trees, creepers were given by Botany expert Dr. S. P. Rothe. Prof. D.L. Jade, Prof. S.V. Dhomane, Ar. Malini Nathe, Ar. Gulfam Shaikh and students of Architecture were present.



**Tree plantation:** Tree plantation Activity was carried out by COET Akola under NSS program. Teaching, supporting staff, students of first year, and Hon'ble Principal actively participated in this activity.





**Cleanliness drive:**

on the occasion of Gandhi Jayanti on 2<sup>nd</sup> october 2019 the staff and students of School of Architecture organized the cleanliness drive. The students and teachers actively participated in cleanliness drive. Teachers planted trees on the both the sides of the walkway.





संत गाडगेबाबा अमरावती विद्यापीठ, अमरावती संलग्न  
श्री शिवाजी शिक्षण संस्था, अमरावती द्वारा संयोजित  
अभियांत्रिकी व तारिकी पर्यावरणालय, अकोला (बाभुळगांव)  
नेकदारे 'अ' दर्जा प्राप्त



# राष्ट्रीय सेवा योजना

## मेडीकल चेकअप व रक्तदान शिबीर

दिनांक ०५ ऑगस्ट :: वेळ : दुपारी २ ते ४





**Initiative to reduce the use of energy:**

Inspection and the study covered the following areas to summaries the present status of environment management on the campus:

Water management: Raw Water, Drinking Water, Laboratory Waste Water, Sewage Water, Rain Strom Drain Water,

Energy Conservation: Consumption of Petrol, Diesel, LPG, Electricity, Batteries

Waste management: Green area management

Focus area of study: Water management, Air & Noise Pollution Management, Energy use & conservation, Waste Management, Green Belt area & Bio-diversity, Environmental Initiative.

Water management: Water is a valuable natural resource for all living organisms. College examines the quality and usage of water in the college campus. Water auditing is conducted for the evaluation of facilities of raw water intake and determining the facilities for water treatment and reuse. The concerned auditor investigates the relevant method that can be adopted and implemented to balance the demand and supply of water.

Major observations in regard of water usages and conservation plan:

1. At present waste water is not recycled or reused in any form in the college premises.
2. Drip irrigation and sprinklers should be used for watering the garden.
3. The rain water is drained by storm water drain and released to Nallha inside the boundary of the college at low terrain

**Environmental awareness initiative:**

COETA conducts regular training to staff and faculties regarding use of bicycles, controlled use of paper, plantation target and implementation. Display of environment protection banners, posters like save water, save energy at prominent places, waste disposal bins for wet and dry waste disposal bins for wet and dry waste disposal are some of the initiatives taken.





### Recommendations / Analysis

Internal Green & Environment Audit Committee surveyed and scrutinized the overall environmental performance of the College and recommendations were made as per the following:

- i) Review trees planted in the college campus, designate each and every tree with numbers. Assign scientific and vernacular names to the trees.
- ii) Provide sufficient, accessible and well-displayed dustbins at mostly seen areas in the college campus for collection of recyclable waste.
- iii) Automated sensors such as Energy & Flow Meters should be installed to prevent the overflow from water tanks. Install a water meter and assign a specific person to record water consumption in the college campus.
- iv) The Internal Green and Environment Audit Committee appreciate the way Garden and trees are maintained, but the committee recommends to add more trees, shrubs in pots at every possible place in the campus.
- v) Safe disposal of chemicals, liquid waste and e-waste is mandatory and special care to be taken to maintain it. The NOC to stock and use certain chemicals is necessary if not acquired opt it ASAP.
- vi) College should take initiative in reducing its dependance on MS&ED power distribution network and support renewable and carbon-neutral electricity generation options such as generation of electricity by solar energy.
- vii) Old fans that makes clicking, grinding, rattling, and ticking noise, must be repaired immediately or be replaced with new one. The disturbing sound from old fans create noise pollution and it is not advisable in the classroom. The students may loose important study lessons due to lack of concentration in the studies.
- viii) PUC certificate for all the vehicles entering the campus to be made mandatory and to be checked by security at the entrance of the college.
- ix) Waste water management still needs to be practiced and important measures such as repair leaking taps and avoid excessive watering of trees.
- x) Sensors for lights in classrooms and in washrooms are necessary to reduce use of electricity on the campus of of the college.



## SAVING OUR PLANET

Saving our planet,  
lifting people out of poverty,  
advancing economic growth  
these are one and the same fight.

We must connect the dots  
between climate change,  
water scarcity, energy shortages,  
global health, food security and  
women's empowerment.  
Solutions to one problem  
must be solutions for all.

— Ban Ki-moon

*Thank  
you!*

Prepared by:  
Internal Green & Environment Audit Committee  
College Of Engineering And Technology, Akola  
Babhulgaon, District: Akola

*Dr. R. K. Shinde*





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# DETAILED ENERGY AUDIT REPORT

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## College of Engineering and Technology, Akola

Babhulgaon (Jh) N.H. No-6, Nagpur Road, Akola,  
Maharashtra 444104

Dec 2022

### Conducted By

**PPS** Energy Solutions Pvt. Ltd.

Plot No-18, Girish Housing Society  
Warje, Pune – 411058, Maharashtra, India.

For PPS Energy Solutions Pvt. Ltd.

*Ravi*



Dr. Ravi G. Deshmukh  
Energy Auditor Class - A  
MEDA/ECN/2021-22/EA-11



**MAHARASHTRA ENERGY DEVELOPMENT AGENCY**



**Maharashtra Energy Development Agency**

(Government of Maharashtra Institution)

Aundh Road, Opposite Spicer College Road, Near Commissionerate of Animal Husbandary,

Aundh, Pune, Maharashtra 411067

Ph No: 020-35000450

Email: [eee@mahaurja.com](mailto:eee@mahaurja.com), Web: [www.mahaurja.com](http://www.mahaurja.com)

ECN/2021-22/CR-28/3412

06<sup>th</sup> July, 2021

**CERTIFICATE OF REGISTRATION  
FOR CLASS 'A'**

We hereby certify that, the firm having following particulars is registered with **MAHARASHTRA ENERGY DEVELOPMENT AGENCY (MEDA)** under given category as "Energy Planner & Energy Auditor" in Maharashtra for Energy Conservation Programme of MEDA.

**Name and Address of the firm** : M/s PPS Energy Solutions Pvt. Ltd.  
B-403, Bharat Vihar, S.No-78,  
Bharti Vidyapith, Campus,  
Katraj, Pune-411043.

**Registration Category** : Empanelled Consultant for Energy Conservation  
Programme for Class 'A'

**Registration Number** : MEDA/ECN/2021-22/Class A/EA-11

- Energy Conservation Programme intends to identify areas where wasteful use of energy occurs and to evaluate the scope for Energy Conservation and take concrete steps to achieve the evaluated energy savings.
- MEDA reserves the right to visit at any time without giving prior information to verify quarterly activities performed by the firm and canceling the registration, if the information is found incorrect.
- This empanelment is valid till **05<sup>th</sup> July, 2023** from the date of registration, to carry out energy audits under the Energy Conservation Programme
- The Director General, MEDA reserves the right to cancel the registration at any time without assigning any reasons thereof.

General Manager (EC)





## PREFACE

Energy Audit is a key parameter of systematic approach for decision-making in the area of energy management. It attempts to determine how and where energy is used and to identify methods for energy savings. There is now a universal recognition of the fact that new technologies and much greater use of some that already exists provide the most hopeful prospects for the future. The opportunities lie in the use of existing renewable energy technologies, greater efforts at energy efficiency and the dissemination of these technologies and options.

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

Present energy audit is a mare mile marker towards destination of achieving safe, healthy and energy efficient unit. We would like to emphasize that an energy audit is a continuous process. We have compiled a list of possible actions to conserve and efficiently utilize our scarce resources and identified their savings potential. The next step would be to prioritize their implementation. Implementation of recommended measures can help consumes to achieve significant reduction in their energy consumption levels.



## WHY ENERGY AUDIT?

An energy audit determines the amount of energy consumption affiliated with a facility and the potential savings associated with that energy consumption. Additionally, an energy audit is designed to understand the specific conditions that are impacting the performance and comfort in your facility to maximize the overall impact of energy-focused building improvements.

An energy audit is a systematic review of the energy consuming installations in a facility to ensure that energy is being used sensibly and efficiently. An energy audit usually commences with the collection and analysis of all information that may affect the energy consumption of the facility, then follows with reviewing and analyzing the condition and performance of various installations and facility management, with an aim at identifying areas of inefficiency and suggesting means for improvement.

Through implementation of the suggested improvement measures, facility owners can get the immediate benefit for paying less energy bills. On the other hand, lowering of energy consumption in facility will lead to the chain effect that the power supply companies will burn less fossil fuel for electricity generation and relatively less pollutants and greenhouse gases will be introduced into the atmosphere, thus contributing to conserve the environment and to enhance sustainable development.





## ACKNOWLEDGEMENT

We express our sincere gratitude to the authorities of College of Engineering and Technology, Akola for entrusting and offering the opportunity. It is our immense pleasure to present the detailed energy audit report.

We acknowledge the positive support from management in undertaking the task of Detailed Energy Audit of all electrical system, thermal systems, utilities and other area and for continuous help and support before and during the Detailed Energy Audit.

We are also thankful to all field staff and agencies working with whom we interacted during the field studies for their wholehearted support in undertaking measurements and eagerness to assess the system / equipment performance and saving potential. We admire the help of all concerned staff for their active participation in completing official documentations.

We express our sincere gratitude to the authorities of College of Engineering and Technology, Akola for entrusting PPS Energy Solutions Pvt. Ltd.

**For PPS Energy Solutions Pvt. Ltd.**

**Dr. Ravi G. Deshmukh**  
**Energy Auditor Class - A**  
**MEDA/ECN/2021-22/EA-11**



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## About PPSES

M/s. PPS Energy Solutions Pvt. Ltd (PPSES) is an ambitious company, established by enterprising engineering professionals in the year 2009. The company offers services pertaining to Energy and Engineering to clients across the globe. Our team is based in Pune, a city known for its Software and Engineering talent in India. We are a rapidly growing company with a team of about 100 people which includes highly trained and experienced Techno-Managers, Analysts, and Engineers & Detailers.

We are presently working in India (Maharashtra, Assam, Madhya Pradesh, Gujarat, Andhra Pradesh, Delhi, Orissa, Chhattisgarh, Bihar, Andhra Pradesh, Telangana and Jharkhand) and Abroad (Bahrain, Stanford)

➤ We serve in majorly four areas,

- Energy Audit, Management and System Evaluations
- Power Distribution System Design, Evaluations and Monitoring
- MEP Design and Project management
- Research and Training

## PPSES Team Members

Name	Role	Academics and Expertise
Dr. Ravi Deshmukh	ECM verification, Report verification and presentation	Accredited Energy Auditor, PhD, M tech, MBA (Power), Graduate E&TC Engineer with over 18 years of experience in Energy Management, Management of Power System, street light projects, Power Exchange Operations, Power Trading and Analysis, Electrical Automation. Has worked as Expert in Iron & Steel sector and Energy
Mr .Nilesh Saraf	Co-ordination with officers, project status review.	Expert in Energy sector with 16 years of experience in Energy efficiency assessment, Industrial engineering sector & Renewable Energy.
Mr. Vinayak Apte	Energy Audit Expert And Report Preparation	Graduate Electrical Engineer with more than 10 years of experience in various sectors. He handled Energy Audits, Energy Conservation and Energy Efficiency projects in Industries, Commercial and Residential Buildings, Pump House
Mr. Vishal Gaikwad	Field study, data tabulation and analysis	Graduate Mechanical Engineer with 2 years of experience in energy efficiency assessment





## 1. EXECUTIVE SUMMARY

Detailed Energy Audit was undertaken in order to evaluate energy performance and identify potential energy conservation measures. Detailed Energy Audit was undertaken in three steps, i.e. document review of data and information initially provided by facility, site visit and preparation of this report.

Energy Audit team conducted the site visit. The site visit includes interaction with staff, electricians of facility, the collection/review of further data and a field inspection of the facility and equipment.

The salient observations and recommendations are given below.

1. The Total Cost of Energy is around **Rs. 17,44,436/-** per Annum
2. Average monthly units consumed are **8,308 kWh** equivalent to **Rs. 80,583/-**
3. Average electricity charges works out to be **Rs. 9.09/-**

This brief report has therefore sought to provide a high-level overview of the status of energy efficiency at facility, combined with an illustration of areas where further, previously unidentified savings opportunities may exist.

Our survey has identified further potential opportunities, ranging from “no & low cost” measures, through to those that will require significant capital expenditure.

Note: Investment figures mentioned in are only indicative, further detailed study is recommended.

### Summary of Recommended Energy Conservation Measures:

Sr.No.	Equipment Name	ECM Details	Investment (Rs. In Lacs)	Savings (kWh/year)	Carbon credit (Tons of Co2)	Saving ( Rs.In Lacs /Year )	Payback (Years)
1	Tube Lights	Replacement of conventional lights with suitable LEDs	5.56	12220.20	10.39	1.11	4.47
2	Fans	Replacement of existing fans with energy efficient Super fans	11.10	13635.16	11.59	1.24	8.96



Sr.No.	Equipment Name	ECM Details	Investment (Rs. In Lacs)	Savings (kWh/year)	Carbon credit (Tons of Co2)	Saving ( Rs.In Lacs /Year )	Payback (Years)
3	AC	Optimize the temperature setting to 23-25 degree celsius	0.00	90.79	0.08	0.01	0.00
4	Water Cooler	Optimisation of Water Cooler	0.02	1113.00	0.95	0.10	0.18
5	APFC	Optimize the Power Factor	1.28	0.00	0.00	0.66	4.04
6	Sanct. Demand (KVA)	To Increase Sanctioned Demand 55 kVA to 70 kVA	0.00	0.00	0.00	0.36	0.00
<b>Total</b>			<b>17.96</b>	<b>27059.15</b>	<b>23.00</b>	<b>3.12</b>	<b>5.76</b>

Note: Estimated savings may base on operating conditions

**During the Energy Audit, Total Estimated Investment of Rs. 17,96,000/- yields Total Estimated Savings of Rs. 3,12,000/- which 18 % of the Total Energy Cost of Rs. 17,44,436/- with an overall payback period of 5.76 Years.**

#### Other Recommendations:

- A. Regular cleaning and maintenance of equipment's is important to reduce energy losses.
- B. Use of star rated equipment's is also strongly recommended specially in case of Fans and Air conditioning.
- C. Cleaning of ceiling fan and exhaust fan blades will reduce the drag on the fan and intern will reduce energy loss.
- D. Awareness amongst energy users is very essential step to reduce wastage of electricity
- E. Energy conservation awareness programs can be conducted once a year. Increasing energy awareness of energy users motivates them to work as a team can lead to reductions in energy consumption and save the money.

Year	Investment (Rs. In Lacs )	Saving ( Rs.In Lacs /Year )	Cum Savings(Rs Lakh)	Net savings (Rs Lakh)
0	-18	0	0	-18
1	0	3	3	-15
2	0	3	6	-12
3	0	3	9	-9
4	0	3	12	-5





Year	Investment (Rs. In Lacs )	Saving ( Rs.In Lacs /Year )	Cum Savings(Rs Lakh)	Net savings (Rs Lakh)
5	0	3	16	-2
6	0	3	19	1
7	0	3	22	4
8	0	3	25	7
9	0	3	28	10
10	0	3	31	13
11	0	3	34	16
12	0	3	37	19
13	0	3	41	23
14	0	3	44	26
15	0	3	47	29

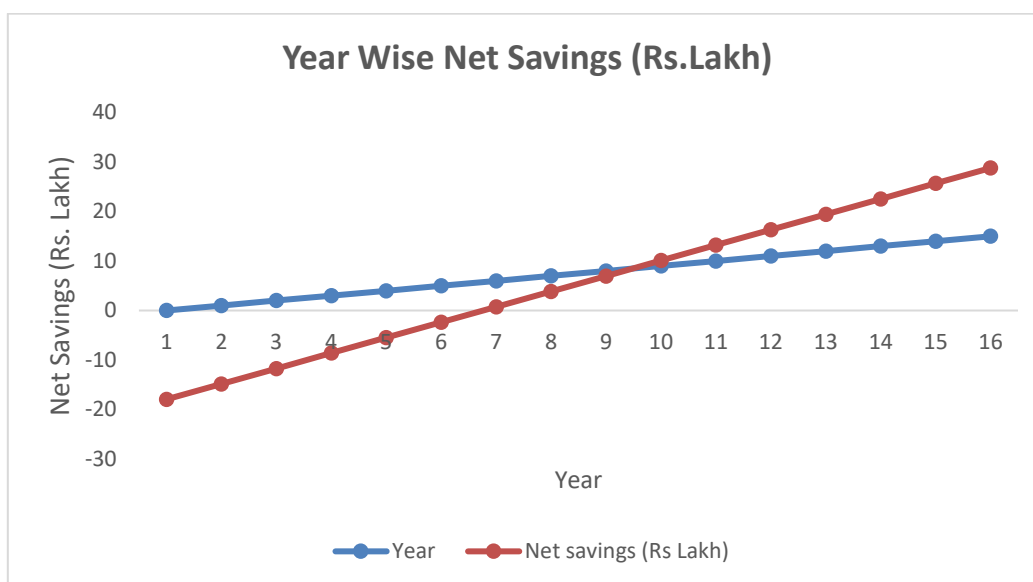


Figure 1 Net Savings (Rs. Lakhs) Vs Year

For PPS Energy Solutions Pvt. Ltd.

*Ravi*

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## 2. GENERAL AUDIT REVIEW

Facility can implement faster payback energy conservation measures (ECMs) which have already been considered and for which the ECMs are fully developed.

Other General Points:

1. Energy conservation awareness programs can be conducted once a year. Increasing energy awareness of staff, students and motivating them to work as a team can lead to reductions in energy consumption and save the money. Savings estimates range in the order of 5 to 10%. When implemented effectively these savings can be realized quickly and cost effectively.
2. Most of the fans are of older design and not energy inefficient.
3. Most of the places the tube light installed are energy efficient and fittings are in healthy condition.
4. Natural day light is efficiently used in corridor and few classrooms and labs areas.

It is believed that with the current approach and organization of energy management, energy can be reduced in a systematic, cost effective manner. We hope that this report will help facility to implement these changes and provide direction to the Energy Management Team.





### 3. ABOUT ENERGY AUDIT

#### Objective

The overall objective of the assignment is to quantify energy saving in existing system and achieve reduction in energy consumption pattern.

Hence, the detail objectives are as under,

1. To calculate the energy consumption
2. To evaluate the performance of the equipment
3. To find out the energy saving opportunities
4. To quantify the total energy savings
5. To find out the ways to achieve energy efficiency

#### 3.1. Scope of Work

Following is the scope of work envisaged for this assignment,

##### Data Collection

To collect the details of various electrical and mechanical system and their ratings, the available drawings and details shall be studied. Detail load list shall be prepared and checked.

##### A, B, C Analysis

With the details available from load list, analysis shall be carried out depending on the present usage trends. All the power consuming equipment's shall be classified in three categories depending on their ratings, condition and operating time. The area for larger potentials for savings shall be identified.

##### Field Study

The detail field study on site shall include the following as well as all other measures required for energy audit study,

- a. Lay out the system and study of Electrical distribution
- b. Study of area wise power distribution and Measurement of power consumption
- c. Study of instrumentation provided
- d. Measurement of motor currents, voltages, power etc. parameters by energy analyzer and measurement of water flow, pressures etc. parameters of pumps simultaneously and



other measurements as needed to characterize the system and required for calculating efficiency at various combinations

- e. Study of air conditioner operations and system requirements
- f. Analysis of readings obtained from field with the standard consumption.

### 3.2. Approach and Methodology

1. Understanding the Scope of Work and Resource Planning
2. Identification of Key Personnel for the assignment/ project
3. Structured Organization Matrix
4. Steps in preparing and implementing energy audit assignment
  - a) Discussions with key facility personnel
  - b) Site visits and conducting “walk-through audit”.
  - c) Preliminary Data Collection through questionnaire before audit team’s site visit
  - d) Steps for conducting the detailed audit
    - Plan the activities of site data collection in coordination with the facility in-charge.
    - Study the existing operations involving energy consumption
    - Collect and collate the energy consumption data with respect to electricity consumption
    - Conduct performance tests to assess the efficiency of the system equipment/ electricity distribution, lighting, and identify energy losses.
    - Discuss with facility personnel about identified energy losses.
5. List proposed efficiency measures
  - Develop a set of potential efficiency improvement proposals
  - Baseline parameters
  - Data presentation
  - System mapping
  - List of potential Energy Savings proposals with cost benefit analysis.
  - Review of current operation & maintenance practices
6. Preparation of the Draft Energy Audit Report
7. Preparation and submission of final Energy Audit Report after discussion with concerned persons





## 4. ENERGY DETAILS

Maharashtra State Electricity Distribution Company Limited (MSEDCL) provides the electricity supply for facility. Billing is carried out with the help of Two meter according to 146 HT-VIII B Tariff.

Detailed Energy Audit was conducted for the load connected to the mains supply used.

Mainly energy is used on this facility for the following purposes:

- 1) Lighting Load
- 2) Ceiling Fans
- 3) Water Cooler
- 4) Water Pump
- 5) Air Conditioner
- 6) Other Appliances

Based on above it is clear that followings equipment's have highest potential for energy savings

Table 1 Name of Equipment

Sr. No.	Name of the Equipment
1	Lighting Load
2	Ceiling Fan
3	Water Cooler
4	Water Pump
5	Air Conditioner
6	Other Appliances

### 4.1. Electricity Bill Analysis

#### 4.1.1. Details of Consumer No.: 318719023920

#### Consumer Details

Table 2 Consumer Details

Parameter	Details
<b>Consumer No.</b>	<b>318719023920</b>
Consumer Name	The Principal, College of Engineering & Tech
Address	AT Babhulgaon Tq. & Dt. Akola
Pin Code	444000
Connected load ( KW)	250.00
65% of con. Demand (KVA)	35.75
Sanctioned Load (KW)	250
Sanct. Demand (KVA)	55
Tariff	146 HT-VIII B
Bu/ Circle No	610



## Consumption Details

Table 3 Billing Data

Month	kWH	KVAH	Billed MD	Demand Rate (Rs/KVA)	Billed PF	Industrial Units	Basic Unit rate (Rs/kWh)	Demand Charges (Rs)	Energy Charges (Rs)	TOD (Rs)	Electricity Duty (Rs)	Excess MD Charges	Total Current Bill (Rs)
Oct-21	5543	6121.00	44	432	0.905	6121	9.21	109008.00	56374.00	-117.00	16525.00	0.00	96310.00
Nov-21	6414	7458.00	55	432	0.860	7458	9.21	23760.00	68688.18	386.00	20370.00	0.00	118640.00
Dec-21	6473	7690.00	41	432	0.841	7690	9.21	17712.00	70824.90	-750.00	112714.00	0.00	112710.00
Jan-22	6,067	6509.00	41	432	0.931	6509	9.21	17712.00	59947.89	-803.00	16905.00	0.00	98610.00
Feb-22	6,910	7175.00	48	432	0.963	7175	9.21	20736.00	66081.75	-73.90	19059.00	0.00	111164.00
Mar-22	10354	10715.00	56	432	0.966	10715	9.21	24192.00	98685.15	-162.80	27616.21	648.00	159530.00
Apr-22	10534	10814.00	67	454	0.974	10814	8.96	30418.00	96893.44	-121.00	30130.00	8172.00	175372.00
May-22	10736	11029.00	66	454	0.973	11029	8.96	29964.00	98819.84	121.00	30380.21	7491.00	175130.00
Jun-22	10487	10952.00	64	454	0.957	10952	8.96	29056.00	98129.92	672.30	33427.13	6129.00	192810.00
Jul-22	7380	7916.00	49	454	0.932	7916	8.96	22246.00	70927.36	81.00	23502.23	0.00	136940.00
Aug-22	10514	11599.00	68	454	0.906	11599	8.96	30872.00	103927.04	833.00	35944.30	8853.00	207340.00
Sep-22	8217	8672.00	62	454	0.947	8672	8.96	28148.00	77701.12	177.00	27455.11	4767.00	159880.00
<b>Avg</b>	<b>8302</b>	<b>8888</b>	<b>55</b>	<b>443</b>	<b>0.930</b>	<b>8888</b>	<b>9.09</b>	<b>31985</b>	<b>80583</b>	<b>20</b>	<b>32836</b>	<b>3005</b>	<b>145370</b>
<b>Max</b>	<b>10736</b>	<b>11599</b>	<b>68</b>	<b>454</b>	<b>0.974</b>	<b>11599</b>	<b>9.21</b>	<b>109008</b>	<b>103927</b>	<b>833</b>	<b>112714</b>	<b>8853</b>	<b>207340</b>
<b>Min</b>	<b>5543</b>	<b>6121</b>	<b>41</b>	<b>432</b>	<b>0.841</b>	<b>6121</b>	<b>8.96</b>	<b>17712</b>	<b>56374</b>	<b>-803</b>	<b>16525</b>	<b>0</b>	<b>96310</b>
<b>Sum</b>	<b>99629</b>	<b>106650</b>				<b>106650</b>		<b>383824</b>	<b>967001</b>	<b>243</b>	<b>394028</b>	<b>36060</b>	<b>1744436</b>



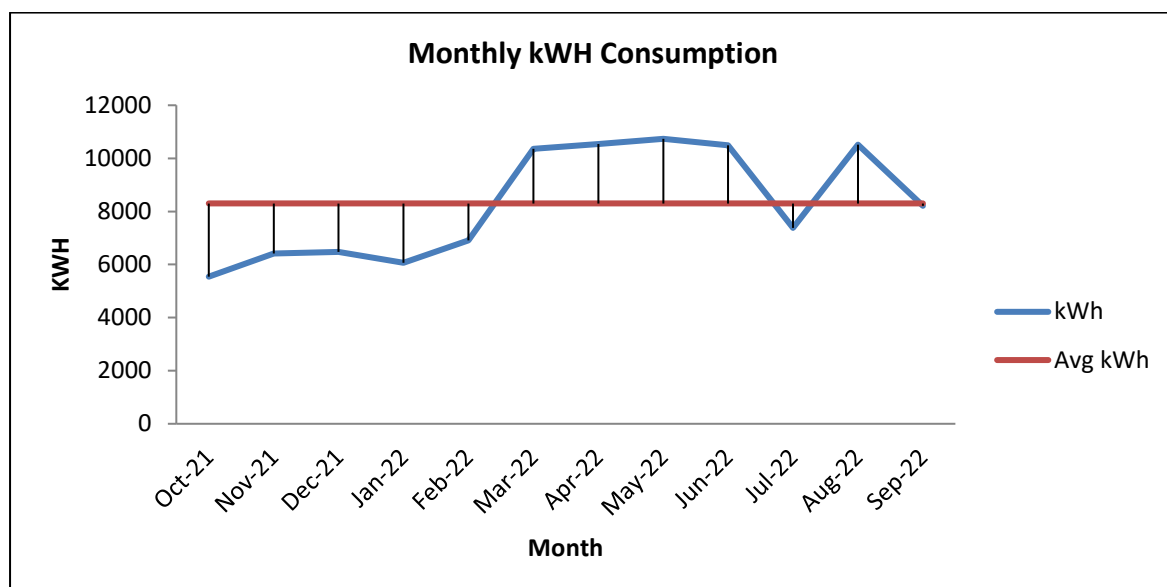


Figure 2 Monthly kWh Consumption

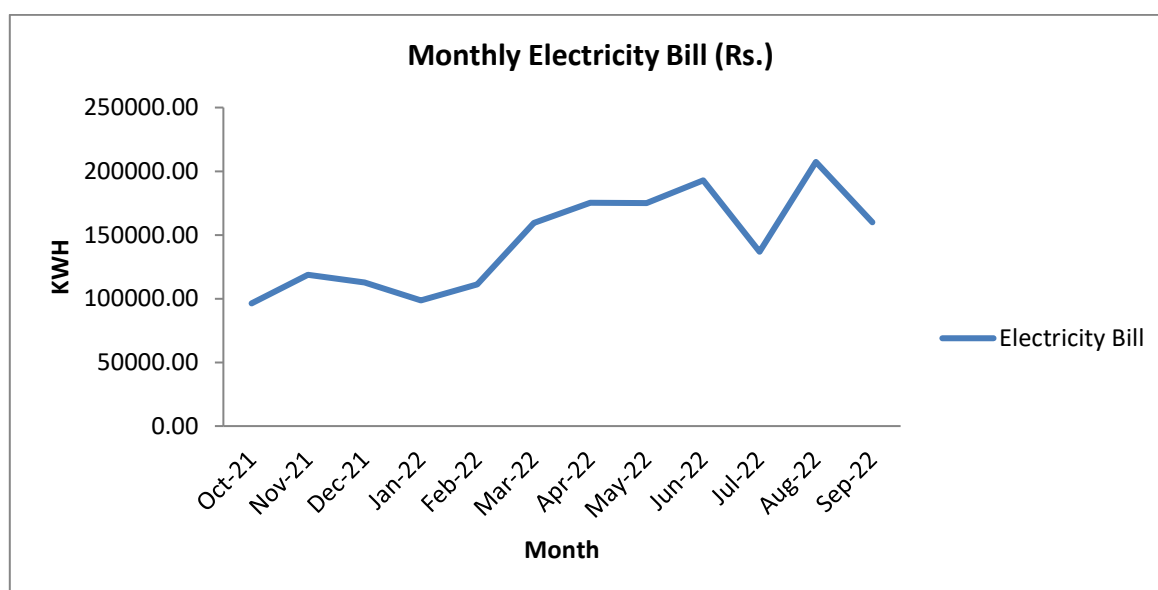


Figure 3 Monthly Electricity Bill

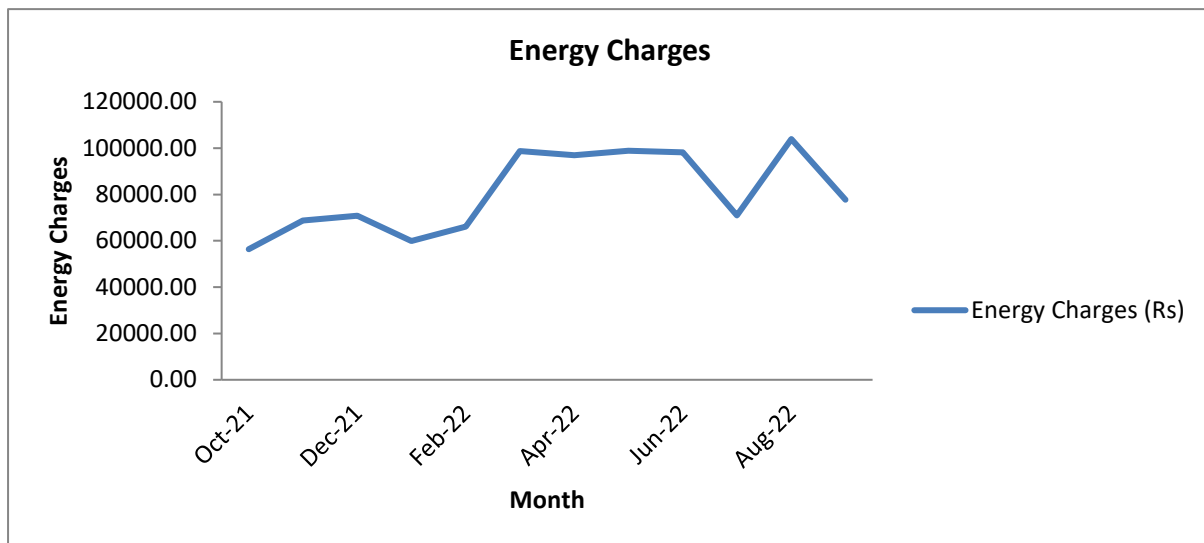


Figure 4 Monthly Energy Charges

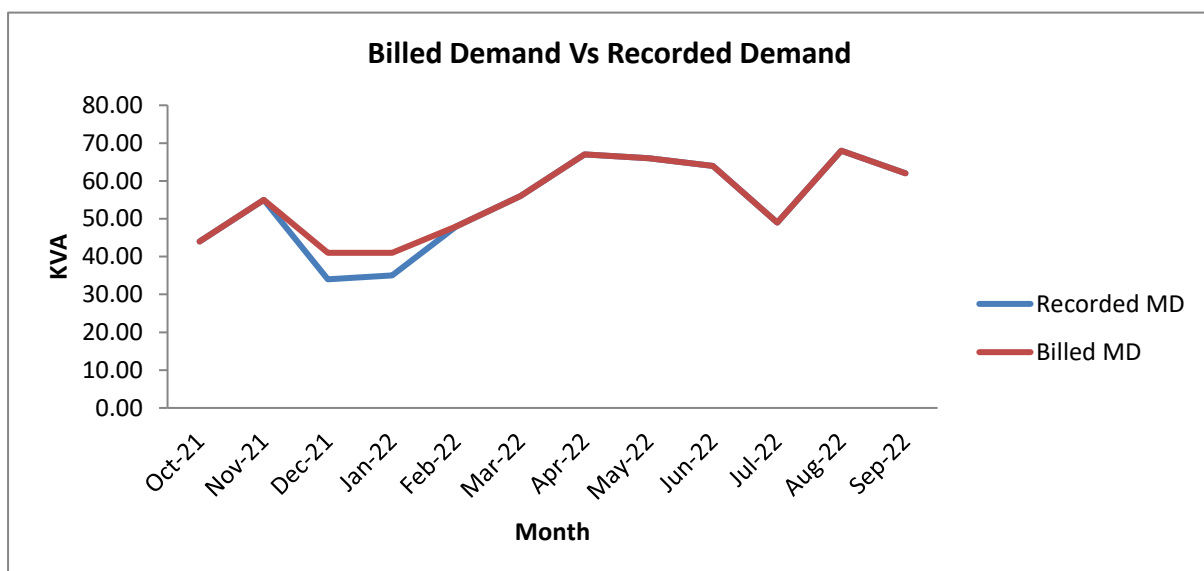


Figure 5 Monthly Billed Demand and Reached Demand



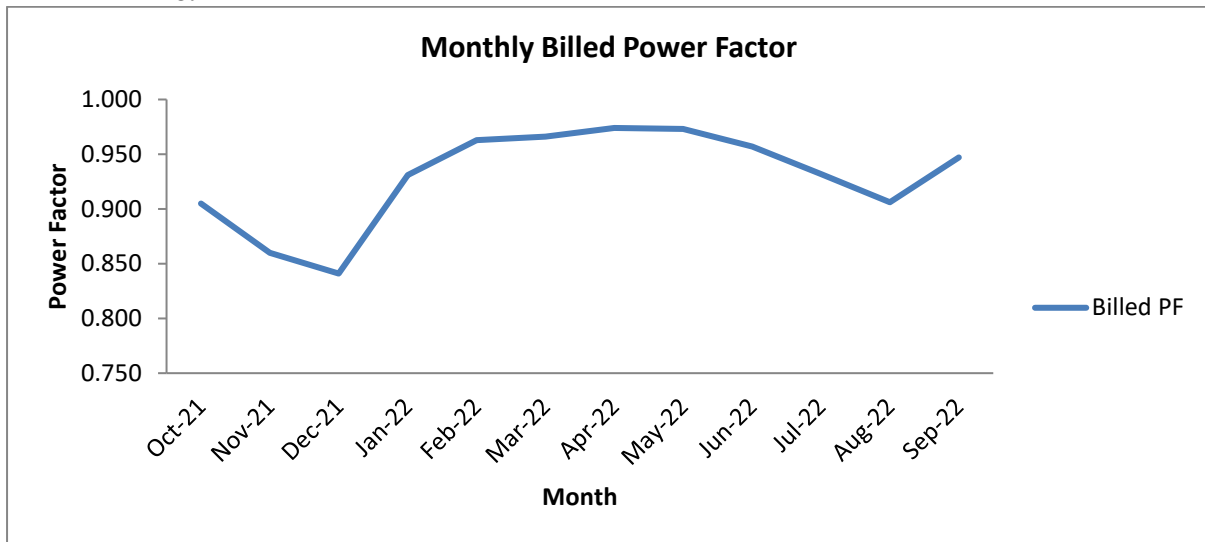


Figure 6 Monthly Billed Power Factor

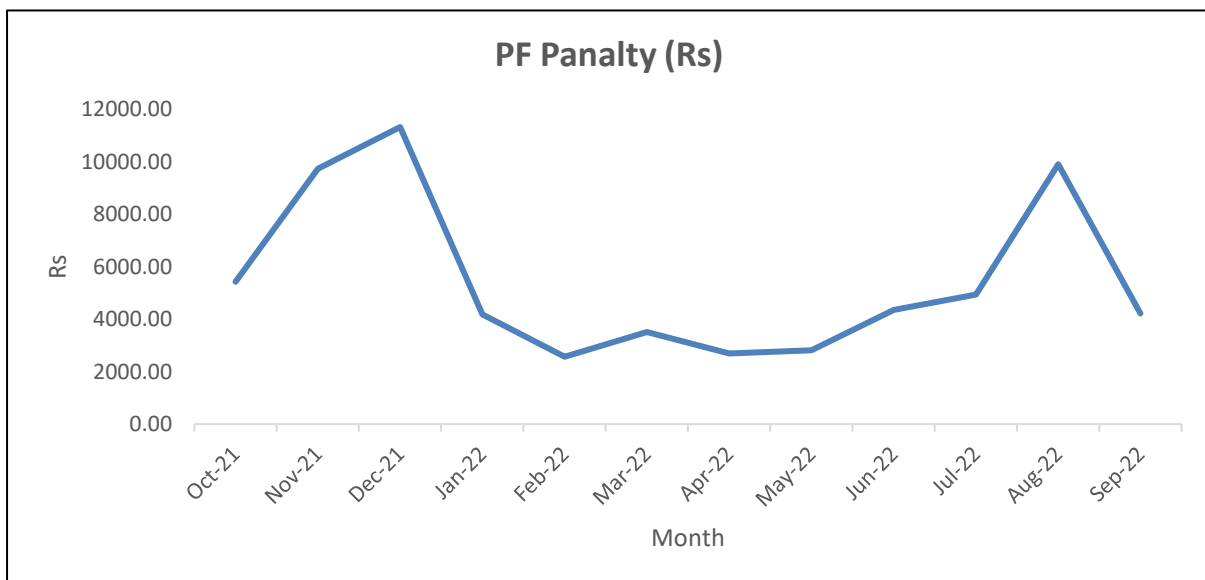


Figure 7 Monthly Power Factor Penalty

### Comments:

1. Average monthly units consumed is **8,302 kWh** equivalent to **Rs. 80,583/-**
2. Average electricity charges works out to be **Rs. 9.09/-**



Table 4 Billing Data – Zone wise Consumption and Demand

Month	"A" Zone Units	"A" Zone Demand	"B" Zone Units	"B" Zone Demand	"C" Zone Units	"C" Zone Demand	"D" Zone Units	"D" Zone Demand	TOD (Rs)
Oct-21	1338	0.00	2863	44.00	741	0.00	1179	0.00	-117.00
Nov-21	1267	19.00	38839	54.00	1001	55.00	1351	46.00	386.00
Dec-21	1937	21.00	3565	34.00	840	28.00	1348	22.00	-750.00
Jan-22	1788	12.00	2782	35.00	848	24.00	1091	17.00	-803.00
Feb-22	1390	14.00	3688	48.00	989	33.00	1109	21.00	-73.90
Mar-22	1906	15.00	5963	56.00	1448	49.00	1398	21.00	-162.80
Apr-22	1904	16.00	6026	67.00	1462	55.00	1423	27.00	-121.00
May-22	2173	17.00	5189	66.00	2177	57.00	1490	28.00	121.00
Jun-22	1430	18.00	6427	64.00	1961	54.00	1135	30.00	672.30
Jul-22	1228	19.00	4623	49.00	1161	41.00	904	33.00	81.00
Aug-22	1268	11.00	7279	68.00	2072	63.00	980	40.00	833.00
Sep-22	1177	11.00	5375	62.00	1295	51.00	824	27.00	177.00
<b>Avg</b>	<b>1567</b>	<b>14</b>	<b>7718</b>	<b>54</b>	<b>1333</b>	<b>43</b>	<b>1186</b>	<b>26</b>	<b>20</b>
<b>Max</b>	<b>2173</b>	<b>21</b>	<b>38839</b>	<b>68</b>	<b>2177</b>	<b>63</b>	<b>1490</b>	<b>46</b>	<b>833</b>
<b>Min</b>	<b>1177</b>	<b>0</b>	<b>2782</b>	<b>34</b>	<b>741</b>	<b>0</b>	<b>824</b>	<b>0</b>	<b>-803</b>
<b>Sum</b>	<b>18806</b>		<b>92619</b>		<b>15995</b>		<b>14232</b>		<b>243</b>

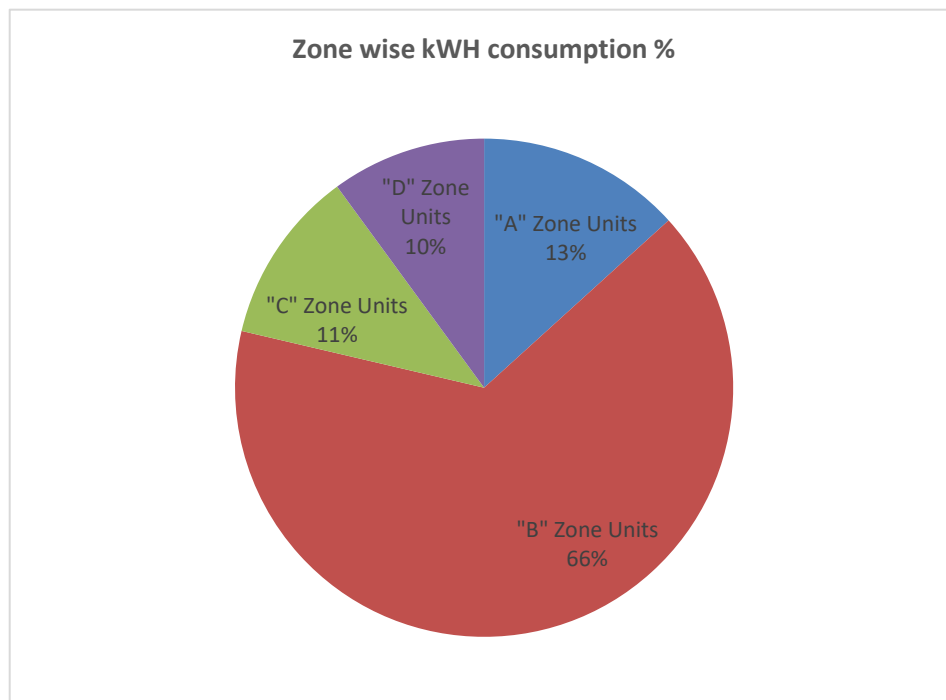


Figure 8 Zone wise kWh Consumption %





#### 4.2. Connected Load Quantity of Buildings

Table 5 Connected Load of Facility

Fixtures	Wattage	Main Building			School of Architecture			Computer Building				Work shop	Gest Room	Total Qty	Total Connected Load in KW
		Ground Floor	First Floor	Second Floor	Ground Floor	First Floor	Second Floor	Ground Floor	First Floor	Second Floor	Third Floor				
Ceiling Fan	75	97	86	97	19	24	27	10	13	12	23		4	412	30.90
Ceiling Fan	100	54	7	26										87	8.70
LED TubeLight	20	45	16	12	5	5		1					4	88	1.76
LED Light POP	12													0	0.00
CFL TubeLight	36	78	25	23				3	6					135	4.86
CFL TubeLight	28	7	12											19	0.53
CFL TubeLight	40	15	89	108	15	20	32	10	10	13	25			337	13.48
Computer	200	120	65	20	1	1			10	81	240			538	107.60
Printer	150	22	21	3										46	6.90
LED POP	5												12	12	0.06
LED POP	15													0	0.00
Projector	150	2	2											4	0.60
CPU	100													0	0.00
TubeLight	40	1												1	0.04
Laptop	100													0	0.00
Water Cooler	150		1											1	0.15
Oven	2000		1											1	2.00
Exhaust Fan	55		2					2		2				6	0.33
Exhaust Fan	110		3											3	0.33
Lab Equipment	200													0	0.00
Fridge 5 star	240		1											1	0.24
Multiprocessor control system	1000		1											1	1.00

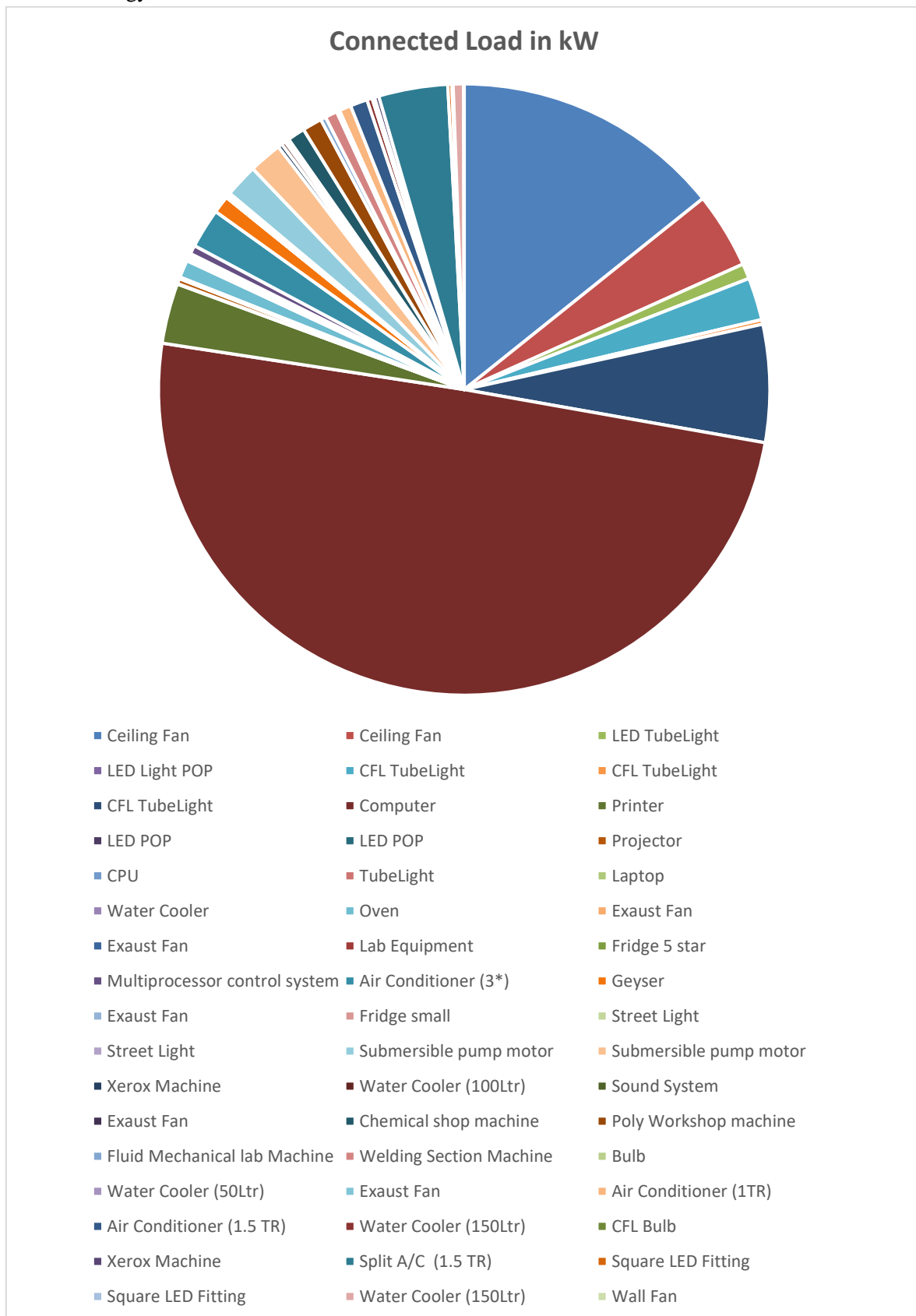


Fixtures	Wattage	Main Building			School of Architecture			Computer Building				Work shop	Gest Room	Total Qty	Total Connected Load in KW
		Ground Floor	First Floor	Second Floor	Ground Floor	First Floor	Second Floor	Ground Floor	First Floor	Second Floor	Third Floor				
Air Conditioner (3*)	2266		1										1	2	4.53
Geyser	2000												1	1	2.00
Exhaust Fan	35												1	1	0.04
Fridge small	350												1	1	0.35
Street Light	30												4	4	0.12
Street Light	10												10	10	0.10
Submersible pump motor	3800												1	1	3.80
Submersible pump motor	3800												1	1	3.80
Xerox Machine	500	1												1	0.50
Water Cooler (100Ltr)	450			1										1	0.45
Sound System	350			1										1	0.35
Exhaust Fan	75			2										2	0.15
Chemical shop machine	250											8		8	2.00
Poly Workshop machine	150											15		15	2.25
Fluid Mechanical lab Machine	200											3		3	0.60
Welding Section Machine	200											7		7	1.40
Bulb	40				1									1	0.04
Water Cooler (50Ltr)	250				1									1	0.25





Fixtures	Wattage	Main Building			School of Architecture			Computer Building				Workshop	Guest Room	Total Qty	Total Connected Load in KW
		Ground Floor	First Floor	Second Floor	Ground Floor	First Floor	Second Floor	Ground Floor	First Floor	Second Floor	Third Floor				
Exhaust Fan	65				1									1	0.07
Air Conditioner (1TR)	1350				1									1	1.35
Air Conditioner (1.5 TR)	1970							1						1	1.97
Water Cooler (150Ltr)	600							1						1	0.60
CFL Bulb	18	16												16	0.29
Xerox Machine	500	1												1	0.50
Split A/C (1.5 TR)	1980	4												4	7.92
Square LED Fitting	18	26												26	0.47
Square LED Fitting	9	15												15	0.14
Water Cooler (150Ltr)	600	2												2	1.20
Wall Fan	55	1												1	0.06
<b>Total</b>														<b>1822</b>	<b>216.76</b>



**Figure 9 Distribution of Connected Load**





## 5. ACTUAL MEASUREMENTS

### 5.1. Study of Loading Pattern for 318719023920:

The Three-phase portable power analyzer was installed at incoming panel and data is recorded. Following data shows the loading pattern, Voltage, Current PF variation.



Figure 10 Main Incomer

Table 6 Study of Loading Pattern of 366556000438

Parameter		R-Phase	Y-Phase	B-Phase	Total/Neutral
Voltage (V)	Avg	421.34	421.13	421.09	-
	Max	441.10	441.80	441.70	-
	Min	351.80	351.40	351.40	-
Current (A)	Avg	12.65	15.00	10.58	6.84
	Max	27.57	35.36	32.95	21.54
	Min	8.64	8.80	4.62	2.46
Active Power (W)	Avg	1489.16	3028.44	1802.06	6319.68
	Max	6272.00	8005.00	7106.00	20932.00
	Min		1125.00	24.00	1200.00
Power Factor	Avg	0.46	0.77	0.55	0.58
	Max	1.00	1.00	1.00	0.96
	Min	0.01	0.53	0.05	0.20



Parameter		R-Phase	Y-Phase	B-Phase	Total/Neutral
<b>V % THD</b>	<b>Avg</b>	1.15	1.17	1.12	-
	<b>Max</b>	1.77	1.62	1.74	-
	<b>Min</b>	0.67	0.70	0.55	-
<b>I % THD</b>	<b>Avg</b>	20.48	15.10	58.10	-
	<b>Max</b>	35.08	37.86	87.49	-
	<b>Min</b>	14.18	7.94	24.43	-

#### Comments:

- 1) Average, Maximum and Minimum variations for all the Phases is Not within the limit of +/- 6%
- 2) The voltage unbalance between the Phases is Absent.
- 3) The current unbalance between the Phases is Present.
- 4) Total Harmonic Distortion for voltage is within the limits of 5% and Total Harmonic Distortion for Current is Not within the limit of 15%.

#### Recommendation:

- 1) To minimize the Neutral current, it is recommended to balance the load equally among the three phases.







### Voltage Variation:

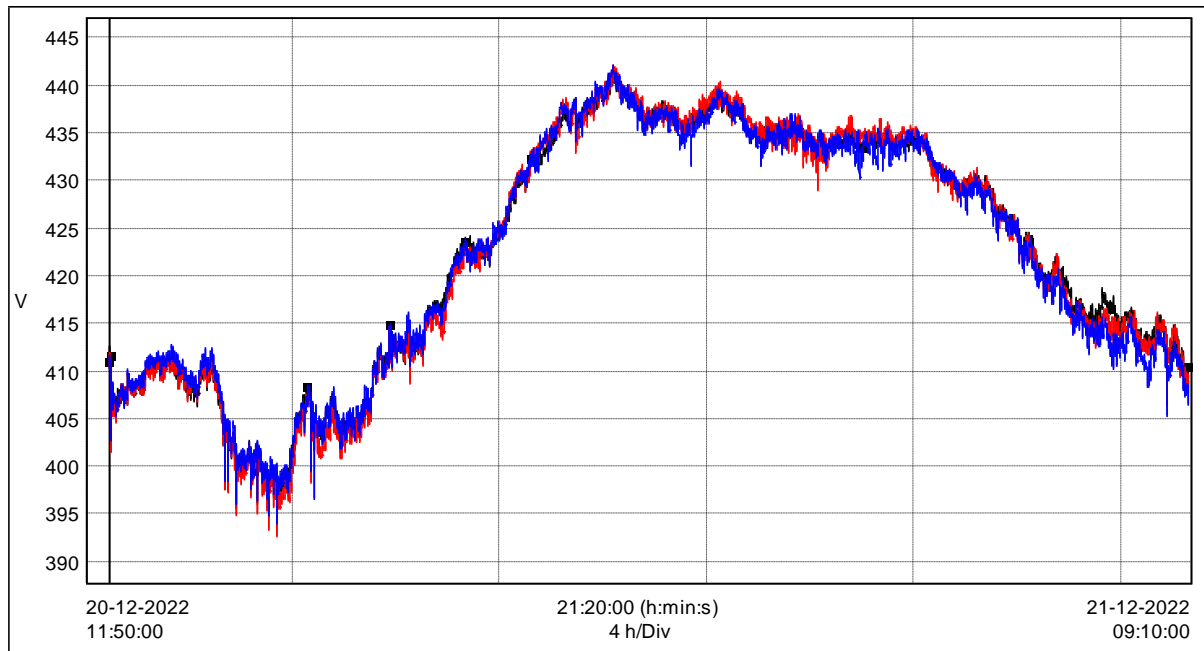


Figure 11 Voltage vs Time Period

### Current Variation:

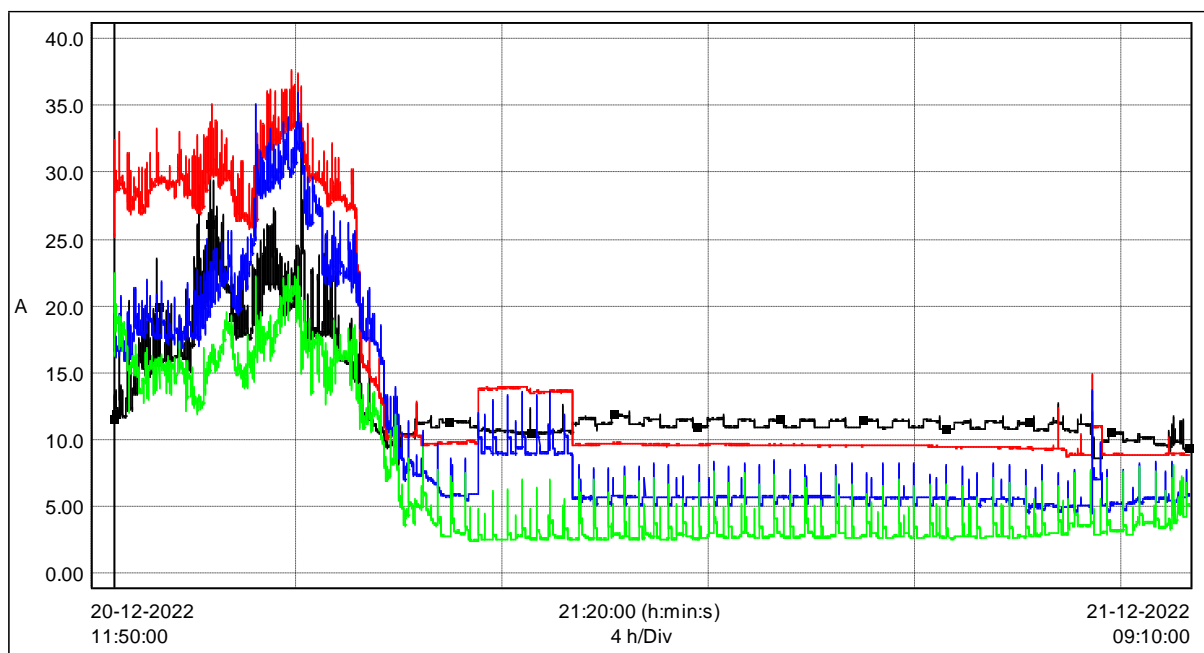


Figure 12 Current vs Time Period



### Power Variation:

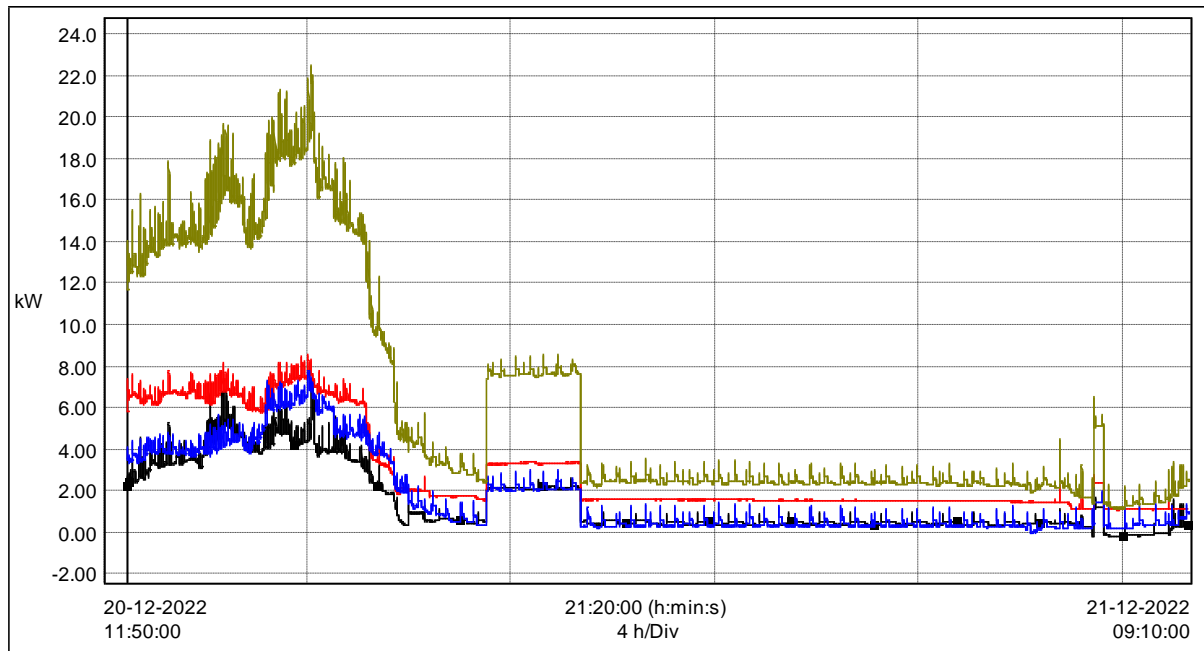


Figure 13 Power vs Time Period

### Power Factor Variation:

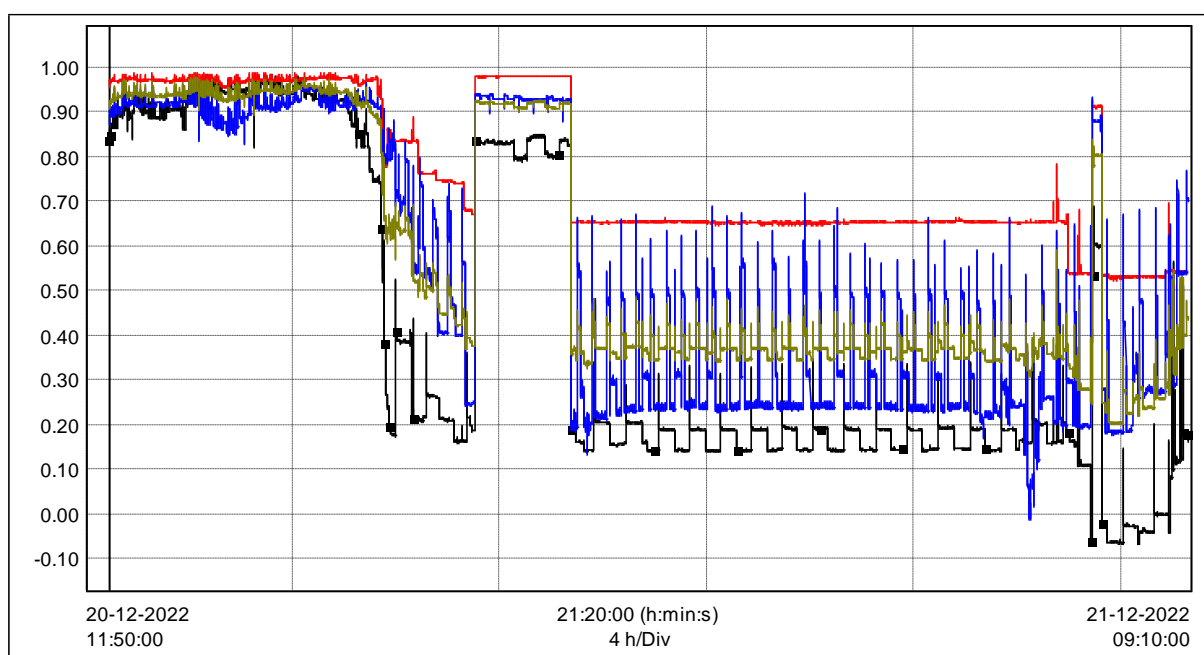


Figure 14 Power Factor vs Time Period





### Voltage Total Harmonic Distortion Variation:

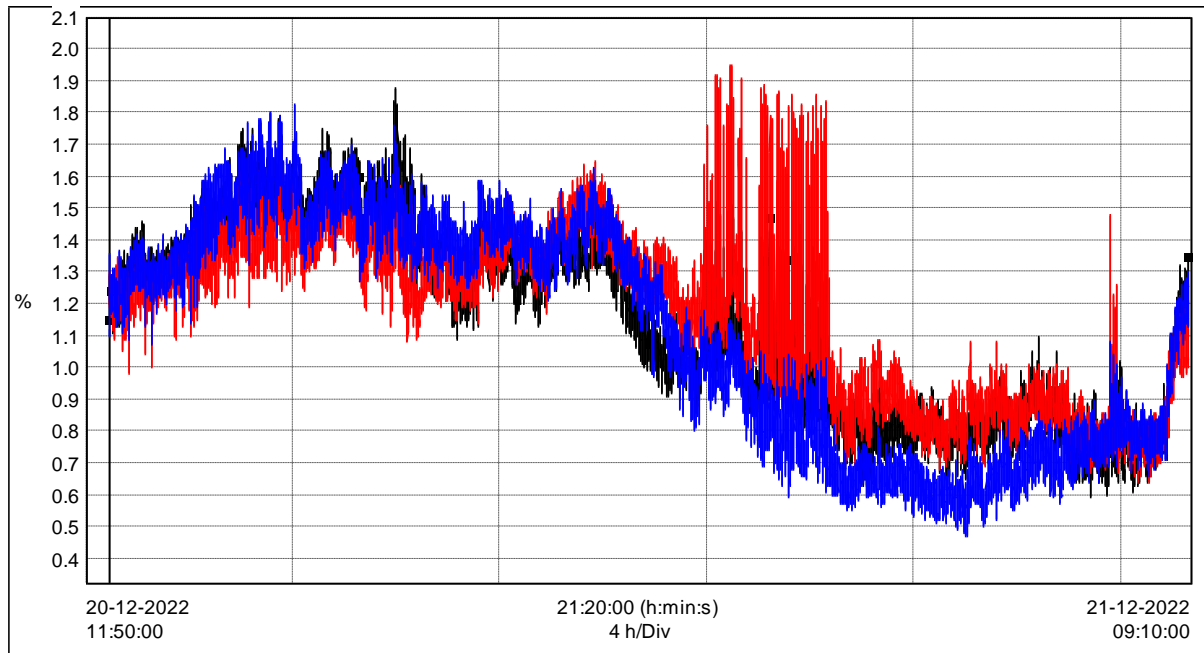


Figure 15 Voltage THD % vs Time Period

### Current Total Harmonic Distortion Variation:

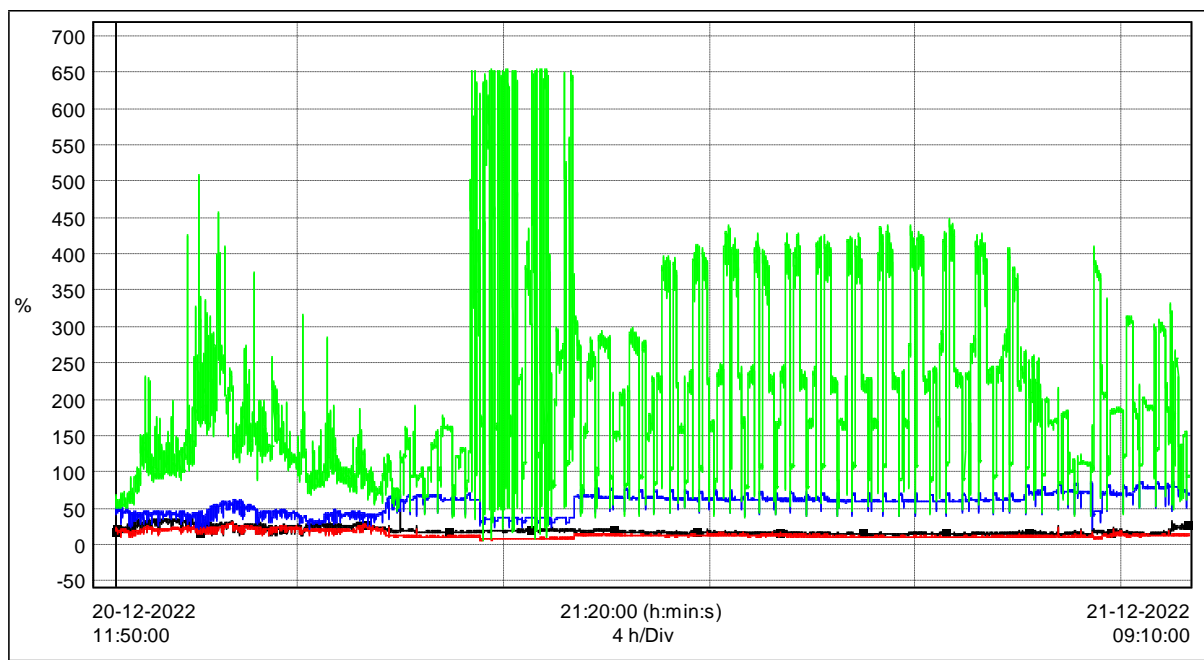


Figure 16 Current THD % vs Time Period



## 6. ENERGY CONSERVATION MEASURES

### *ECM 1: Replacement of Tube Lights with More Efficient Lights*

ECM No.	Energy efficiency improvement measures	Investment Rs. In Lakh	Estimated Saving		Estimated Savings Rs. In Lacs	Estimated Payback Years
			Electricity	Carbon credit		
			kWh	(Tons of CO <sub>2</sub> )		
1	Replacement of conventional lights with suitable LEDs	5.56	12220.20	10.39	1.11	4.47



Figure 17 Lighting Fixture

#### **Observations:**

Facility has installed Tube Light of 28W, 36 W and 40 W in their premises

#### **Recommendations:**

During energy audit, it is observed that facility has installed Tube Light of 28W, 36 W and 40 W at some of the places in the facility Also energy team at facility has already replaced some of the CFLs with LEDs. The operating hours for these lightings are around 4.5 hours. Tube Light of 28W, 36 W and 40 W with equivalent LED fixture thereby achieving significant reduction in energy consumption. The LEDs could be replaced in such a manner that it has same fixture so there will not be retrofitting cost attached to the replacement. The replacement could be done in a phased manner. LED lights have better efficacy as well as better lifetime than conventional lights



**Energy Saving Calculations:**

Particular	Unit	Value
<b>Energy Saving Calculation</b>		
Power consumption of existing lights	KW	18.87
Power consumption of suitable LED light	KW	9.82
Average power saving after replacement with LED light	KW	9.05
Replacement of conventional lights with suitable LEDs	Nos	491
Average working hour per day	Hrs	4.5
No. of working days in a year	Days	300
<b>Cost Benefit Calculation</b>		
Annual Energy Saving potential	kWh	12220
Electricity tariff	Rs/unit	9.09
Annual Cost Saving	Rs. Lakh	1.11
Total investment cost	Rs. Lakh	4.96
Annual Saving	Rs. Lakh	1.11
Simple Payback Period	Years	4.47



### *Investment Details*

Type of Existing Fitting	Wattage	Qty	Proposed LED W	CSR NO	Price - Rs/Unit	Dismantling cost	TOTAL COST	Existing KW	Proposed KW	Saved kW	Investment Rs Lakh	GST 12%	Total Investment
Tube Light	40	337	20	2-1-23	926	15	3.26	13.48	6.74	6.74	3.26		
Tube Light	36	135	20	2-1-23	926	15	1.39	4.86	2.70	2.16	1.39		
Tube Light	28	19	20	2-1-23	926	15	0.31	0.53	0.38	0.15	0.31		
<b>TOTAL</b>		<b>491</b>			<b>2778.00</b>	<b>45.00</b>	<b>4.96</b>	<b>18.87</b>	<b>9.82</b>	<b>9.05</b>	<b>4.96</b>	<b>0.60</b>	<b>5.56</b>



### Investment Details

CSR no	Description	Material	Labour	Total	Dismantling cost	Quantity	Total Cost
2-1-23	Supplying & erecting LED 20W tube light fitting (4 feet) with aluminium housing, heat sink, integrated HF electronic driver complete.	881	45	926	15	337	325952
2-1-23	Supplying & erecting LED 20W tube light fitting (4 feet) with aluminium housing, heat sink, integrated HF electronic driver complete.	881	45	926	15	135	138900
2-1-23	Supplying & erecting LED 20W tube light fitting (4 feet) with aluminium housing, heat sink, integrated HF electronic driver complete.	881	45	926	15	19	31484
	<b>Total</b>						<b>4.96</b>
	<b>12% GST on total Investment cost</b>						<b>0.60</b>
	<b>Total cost</b>						<b>5.56</b>



**ECM 2: Replacement of Old Fan with Energy Efficient Super Fan**

ECM No.	Energy efficiency improvement measures	Investment Rs. In Lakh	Estimated Saving		Estimated Savings Rs. In Lacs	Estimated Payback Years
			Electricity	Carbon credit		
			kWh	(Tons of CO <sub>2</sub> )		
2	Replacement of existing fans with energy efficient Super fans	11.10	13635.16	11.59	1.24	8.96



**Figure 18 Ceiling Fans**

**Observations:**

During energy audit, it is observed that facility has old 100 W and 75 W fan and its energy consumption is on higher side.

**Recommendations:**

During energy audit, it is observed that facility has installed non star rated fan of 100 W and 75 W so we recommend to replace energy consuming fan with energy efficient super fan





### Energy Saving Calculations:

Particular	Unit	value
Existing energy consumption of Fan	kWh/year	34848
Wattage of Energy Efficient Super Fan	Watt	35
Energy consumption after replacing with Energy Efficient Super Fan	kWh/year	15369
Operating hrs/day	Hrs/day	4
No. of working days in a year	Days	220
Diversity factor	%	70%
Annual Saving	kWh/year	13635
Unit rate	Rs/kWh	9.09
Annual Saving	Rs. In Lacs	1.24

Fan category	Nos	Estimated Running kW
Ceiling Fan 100W	87	8.70
Ceiling Fan 75 W	412	30.90
<b>Total</b>	<b>499</b>	<b>39.60</b>

### Investment Details

CSR No	Description	Material	Labour	Total	Quantity	Total Cost
2-14-4	Dismantling the existing ceiling fan /exhaust fan / cabin fan / bracket fan complete with accessories, G.I. down rod, frame etc. and making the site clear.	0	37	37	499	18463
2-12-21.	Supplying and erecting five star rated energy saving Ceiling fan 230 V A.C. 50 cycles 1200 mm complete erected in position as per specification no. FG-FN/CF	1858	91	1949	499	972551
	<b>Total</b>					<b>9.91</b>
	<b>12% GST on total Investment cost</b>					<b>1.19</b>
	<b>Total cost</b>					<b>11.10</b>



### ECM 3: Optimization of Set Temperature of ACs

Sl. No.	Energy efficiency improvement measures	Investment Rs. In Lacs	Estimated Saving		Savings Rs. In Lacs	Payback Year
			Electricity	Carbon credit		
			kWh	(Tons of Co2)		
3	Optimize the temperature setting to 23-25 degree Celsius	0.00	90.79	0.08	0.01	0.00

#### Observations:

Facility has installed Split AC of 1 Ton and 1.5 Ton of 3 star and 5 star in their premises

#### Recommendations:

During assessment, it is observed that Split AC of 1 Ton and 1.5 Ton of 3 star and 5 star set point was 22<sup>0</sup> C. Hence, it is recommended to increase set temperature setting to 23<sup>0</sup> C as well as improve maintenance of AC frequency.

It is known that, a 1°C raise in evaporator temperature can help to save almost 3% on power consumption (this also can be verified from BEE guideline: Chapter 4. HVAC and Refrigeration System).

The TR capacity of the same refrigeration will also increase with increase in the evaporator temperature, as given in table below:

Effect of variation in Evaporator Temperature on Compressor Power Consumption			
Evaporator Temperature (°C)	Refrigeration Capacity* (tons)	Specific Power Consumption	Increase in kW/ton (%)
5	67.58	0.81	-
0	56.07	0.94	16
-5	45.98	1.08	33
-10	37.2	1.25	54
-20	23.12	1.67	106

\* Condenser temperature 40°C



### Energy Saving Calculations:

Particular	Unit	Value
Estimated Annual Consumption of ACs	kWh/hr	3026
Estimated Saving	%	3%
Operating Hrs per day	hrs/day	4
Operating days per year	Days/year	100
Estimated Saving	kWh/year	91
Unit Rate	Rs/kWh	9.09
Annual Saving	Rs Lakh/year	0.01

Sr No	Type	Wattege	Qty	Annual Consumption
1	Air Conditioner (1TR)	1350	1	540
2	Air Conditioner (1.5 TR)	1970	1	788
3	Split A/C (1.5 TR)	1980	4	792
4	Air Conditioner (3*)	2266	2	906
<b>Total</b>			<b>8</b>	<b>3026</b>





**ECM 4: Optimization of Water Cooler**

ECM No.	Energy efficiency improvement measures	Investment Rs. In Lakh	Estimated Saving		Estimated Savings Rs. In Lacs	Estimated Payback Years
			Electricity	Carbon credit		
			kWh	(Tons of CO <sub>2</sub> )		
4	Optimization of Water Cooler	0.02	1113.00	0.95	0.10	0.18



Figure 19 Water Cooler

**Observations:**

Facility has 6 nos. of Water Cooler 3 of 600 W, 1 of 450 W, 1 of 250 W, 1 of 150 W and power of Water coolers is continuously On for 7 hours per day.

**Recommendation:**

It is recommended to install Temperature control circuit which will turn on power of Water cooler at 21 deg C and turn off power when temperature of water reaches to 16 Deg C. Calculations are done for Energy saving considering automatic power ON of water cooler for 3.5 hours per day



### Energy Saving Calculations:

Particular	Unit	Value
<b>Energy Saving Calculation</b>		
Power consumption of RO and Water Cooler	KW	2.65
Supply Water Temperature	Deg C	26.00
Inlet Temperature T1	Deg C	21.00
Outlet Temperature T2	Deg C	16.00
Average working hour per day	Hrs	7
No. of working days in a year	Days	120
Existing consumption of Water cooler without automation	kWh/year	2226.00
Energy consumption of of water cooler with control circuit	kWh/year	1113.00
<b>Cost Benefit Calculation</b>		
Annual Energy Saving potential	kWh/year	1113
Electricity tariff	Rs/unit	9.09
Annual Cost Saving	Rs. Lakh	0.10
Total investment cost	Rs. Lakh	0.02
Annual Saving	Rs. Lakh	0.10
Simple Payback Period	Years	0.18

Name of Equipment	Wattage	Qty	Existing KW
Water Cooler (150Ltr)	600	3	1.80
Water Cooler (100Ltr)	450	1	0.45
Water Cooler (50Ltr)	250	1	0.25
Water Cooler	150	1	0.15
<b>TOTAL</b>		<b>6.00</b>	<b>2.65</b>



**ECM 5: Optimization of Power Factor**

ECM. No.	Energy efficiency improvement measures	Investment Rs. In Lacs	Savings Rs. In Lacs	Payback Year
5	Optimize the Power Factor	1.28	0.66	4.04



Figure 20 Main Panel

**Observations:**

From last 12 months' electricity bill analysis, average billed power factor is 0.929

**Recommendations:**

It is recommended to install capacitor banks of 85 KVAR with APFC panel

After implementation of recommendation gained estimated annual saving and payback is tabulated below





### Energy Saving Calculations:

Particular	Value	Unit
Total Annual Consumption	99629	kWh/Year
Unit Rate	9.09	Rs./kWh
Total Annual Energy Charges	905627.61	Rs./year
With Operation of all Capacitor banks, Annual Energy Saving	31696.97	Rs./year
Annual Energy Saving	0.32	Rs (Lakhs)/year
Billed PF Penalty	0.66	Rs (Lakhs)/year
Present Billed Power Factor	0.929	
Desired Billed Power Factor	1	
Multiplying Factor	0.395	
Total Connected Load	216	kW
Size of required Capacitor Bank	85.32	kVAR
Rate of Capacitor Bank	1500	Rs./KVAR
Total Investment	1.28	Rs.
Payback	4.04	Years

Month	Billed PF	PF Penalty (Rs)
Oct-21	0.905	5425.07
Nov-21	0.860	9733.39
Dec-21	0.841	11327.80
Jan-22	0.931	4182.57
Feb-22	0.963	2567.93
Mar-22	0.966	3515.53
Apr-22	0.974	2697.57
May-22	0.973	2817.67
Jun-22	0.957	4354.33
Jul-22	0.932	4934.81
Aug-22	0.906	9910.01
Sep-22	0.947	4224.05
<b>Avg</b>	<b>0.93</b>	<b>5474.23</b>
<b>Max</b>	<b>0.97</b>	<b>11327.80</b>
<b>Min</b>	<b>0.84</b>	<b>2567.93</b>
<b>Sum</b>		<b>65690.73</b>



**ECM 6: To Increase Sanctioned Demand 55 kVA to 70 kVA**

ECM No.	Energy efficiency improvement measures	Investment Rs. In Lakh	Estimated Saving		Estimated Savings Rs. In Lacs	Estimated Payback Years
			Electricity	Carbon credit		
			kWh	(Tons of CO <sub>2</sub> )		
6	To Increase Sanctioned Demand 55 kVA to 70 kVA	0.00	0.00	0.00	0.36	0.00

**Observations:**

From last 12 months' electricity bill analysis, it is observed that sanction demand for the facility is 55 kVA. Actual reached Demand is last 12 months is exceeded for 6 times. Hence facility has paid penalty under the title excess demand charges in monthly electricity bill.

**Recommendations:**

It is recommended to increase the Contract Demand from 55 kVA to 70 kVA

After implementation of recommendation gained estimated annual saving and payback is tabulated below

**Energy Saving Calculations:**

Cost Benefit Calculation		
Penalty Charges For Excess Demand	Rs. Lakh	0.36
Annual Cost Saving	Rs. Lakh	0.36
Total investment cost	Rs. Lakh	0.00
Annual Saving	Rs. Lakh	0.36
Simple Payback Period	Years	0.00



Month	Sanctioned Contract Demand (kVA)	Recorded/Billed Contract Demand (kVA)	Recommended Contract Demand (kVA)	Demand Charges (Rs)	Excess MD Charges
Oct-21	55	44	70	109008.00	0.00
Nov-21	55	55	70	23760.00	0.00
Dec-21	55	41	70	17712.00	0.00
Jan-22	55	41	70	17712.00	0.00
Feb-22	55	48	70	20736.00	0.00
Mar-22	55	56	70	24192.00	648.00
Apr-22	55	67	70	30418.00	8172.00
May-22	55	66	70	29964.00	7491.00
Jun-22	55	64	70	29056.00	6129.00
Jul-22	55	49	70	22246.00	0.00
Aug-22	55	68	70	30872.00	8853.00
Sep-22	55	62	70	28148.00	4767.00
<b>Avg</b>		<b>55</b>		<b>31985.33</b>	<b>3005.00</b>
<b>Max</b>		<b>68</b>		<b>109008.00</b>	<b>8853.00</b>
<b>Min</b>		<b>41</b>		<b>17712.00</b>	<b>0.00</b>
<b>Sum</b>		<b>1322</b>		<b>383824.00</b>	<b>36060.00</b>





## 7. List of Instruments

### POWER ANALYSER



Picture 1 ALM 20 Power Analyzer

ALM 20 Power Analyzer is designed for Measuring power network parameters

#### TECHNICAL SPECIFICATIONS

Number of channels	3U/3I
Voltage (TRMS AC + DC)	100V to 2000V ph-ph /50V to 1000V ph-N
Voltage ratio	Up to 650 kV
Current (TRMS AC + DC)	5mA to 10,000 Aac / 50 mA to 5,000 Adc (depending on Clamp)
Current ratio	Up to 25 kA
Frequency	42.5 - 69 Hz, 340 - 460Hz
Power values	W, VA, VAR, VAD, PF, DPF, cos $\phi$ , tan $\phi$
Energy values	Wh, VAh, VARh
Harmonics, THD	on V, U, I & In up to 50th order
Electrical safety	IEC 61010, 1000V CAT III / 600V CAT IV
Protection	IP54



## **DIGITAL CLAMP METER**



**Picture 2 MECO 3150 DIGITAL CLAMP METER**

Power Clamp meter is a Portable Digital multi-functional measuring instrument. Designed for Measuring selected power network parameters, AC/DC Voltage, AC/DC current, Resistance, Continuity, Diode and Frequency.

### **TECHNICAL SPECIFICATIONS**

<b>DC VOLTAGE (Auto Ranging)</b>	
Ranges	4V, 40V, 400V, 1000V
Overload Protection	1200V DC/800V AC
<b>AC VOLTAGE (Auto Ranging) 40-500Hz</b>	
Range	4V, 40V, 400V, 750V
Overload Protection	1200V DC/800V AC
<b>RESISTANCE (Auto Ranging)</b>	
Range	400Ω, 4KΩ, 40KΩ, 400KΩ, 4MΩ, 40MΩ
Test Current	0.7mA on 400Ω, 0.1mA on 4KΩ
<b>Diode Test</b>	
Measurement Current	1.0 ± 0.6 mA Approx
Open Circuit Voltage	0.4V Approx
Overload Protection	500V DC / AC
<b>Frequency (Auto Ranging)</b>	
Range	10.00Hz, 50.00Hz, 500.0Hz, 5.000kHz, 50.00kHz, 500.0kHz
Sensitivity	3V
Overvoltage Protection	200V DC or AC peak



## **DIGITAL CLAMP METER**



**Picture 3 RISH POWER CLAMP 1000 A/400 A AC-DC**

Power Clamp meter is a Portable Digital multi-functional measuring instrument. Designed for Measuring selected power network parameters, AC/DC Voltage, AC/DC current, Resistance, Continuity, Diode and Frequency.

### **TECHNICAL SPECIFICATIONS**

Measuring function	Measuring range
kWh	9.999 kWh
	99.99 kWh
	999.9 kWh
	9999 kWh
Ahr	999.9 Ahr
Phase angle	0.0°....360.0°
Power Factor	-1...0...1
Harmonics (RMS & %)	1...13
	14...49
THD	0...99.9%
Crest Factor	1.0...2.9
	3.0...5.0
Power Clamp 1000A peak	1400 A/ 1400 V
Power Clamp 400A peak	100 A
	560 A/ 1000 V
Power Clamp 1000A INRUSH	999.9 A
Power Clamp 400A INRUSH	99.99 A
	400 A
Resistance	9999 Ohm
Continuity	Below 40 Ohm





## **THERMAL IMAGER**



**Picture 4 FLIR TG 167 Thermal imager**

FLIR TG 167 Thermal imager is designed to easily find unseen hot and cold spots in electrical cabinets or switch boxes, giving you quality image detail on even small connectors and wires.

### **TECHNICAL SPECIFICATIONS**

Accuracy	±1.5% or 1.5°C (2.7°F)
Detector Type	Focal plane array (FPA), uncooled micro bolometer
IR Resolution	80 × 60 pixels
Laser	Dual diverging lasers indicate the temperature measurement area, activated by pulling the trigger
Memory Type	Micro SD card
Object Temperature Range	-25°C to 380°C (-13°F to 716°F)
Thermal Sensitivity/NETD	<150 mK
Display	2.0 in TFT LCD



## **INFRARED THERMOMETER**



**Picture 5 HTC IRX 64 Infrared thermometer**

HTC IRX 64 infrared thermometer is useful instrument to measure the surface temperature. Infrared thermometers are ideal for taking temperatures need to be tested from a distance. They provide accurate temperatures without ever having to touch the object you're measuring (and even if your subject is in motion).

### **TECHNICAL SPECIFICATIONS**

Specification	Range
IR	-50°C~1050 °C
Contact	-50°C~1370 °C
IR Temp. Resolution	0.1°C
Basic Accuracy	+/- 1.5% of reading
Emissivity	Adjustable 0.10 ~ 1.0
Optical resolution	30 : 1



## LUX METER



Picture 6 Nishant NE 1010 Lux meter

Nishant NE 1010 Lux meter is used to measure the lux levels.

### TECHNICAL SPECIFICATIONS

Measuring range	0 Lux ~200, 000 Lux/0 Fc~185, 806 Fc
Accuracy	$\pm 3\% \text{ rdg} \pm 0.5\% \text{ f.s. (}<10,000 \text{ Lux)}$
	$\pm 4\% \text{ rdg} \pm 10\% \text{ f.s. (}>10,000 \text{ Lux)}$
Digital Updates	2 times/s
Photometric sensor	Silicon diode
Battery life	18 hours (continuous operation)
Operating temperature and humidity	0°C ~ 40°C, 10% RH ~ 90% RH
Storage temperature and humidity	-20°C ~ 50°C, 10% RH ~ 90% RH
Power	9V battery
Unit Size	52.5 x 52.5 x 166 mm
Auto power off	After 5 minutes





## 8. Solar PV System

Facility has installed grid tied Solar PV System of 51 kW on the Main building, Solar panel installation work is completed. MSSEDCL Connection is pending.



Figure 21 Solar PV System

For PPS Energy Solutions Pvt. Ltd.

*Ravi*

**Dr. Ravi G. Deshmukh**  
Energy Auditor Class - A  
MEDA/ECN/2021-22/EA-11



## 9. Site Photos



Figure 22 Site Photos

# DETAILED ENERGY AUDIT REPORT

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June 2019

Conducted By:

**PPS Energy Solutions Pvt. Ltd.**  
Engineering Consultants

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This report was prepared for College of Engineering and Technology, Akola, Akola. The information herein is confidential and shall not be divulged to a third party without the prior written permission of PPS Energy Solutions Pvt. Ltd, Pune, its affiliates and subsidiaries, including PPS Energy Solutions Pvt. Ltd, and their respective officers, employees or agents, individually and collectively, referred to in this clause as 'PPSES'. PPS Energy assumes no responsibility and shall not be liable to any person for any loss, damage or expense caused by reliance on the information or advice in this document or howsoever provided, unless that person has signed a contract with the relevant PPSES entity for the provision of this information or advice and in that case any responsibility or liability is exclusively on the terms and conditions set out in that contract.

## **ACKNOWLEDGEMENT**

We express our sincere gratitude to the authorities of College of Engineering and Technology, Akola for the trust given to us and offering the opportunity to conduct energy assessment. We appreciate the initiative taken by the management.

We are grateful to College of Engineering and Technology, Akola for their initiative to undertake Energy Audit and continuous help and support before and during the audit also we are thankful for their positive support in undertaking the task of system mapping and energy efficiency assessment of all electrical system, air-conditioners, utilities and other equipment.

PPS Energy Solutions Pvt. Ltd. Pune

### **Contact Details from COET Akola-**

Dr. S.K. Deshmukh (Principal)- 9011023931

## ENERGY AUDIT TEAM

The company offers services pertaining to Energy and Engineering to clients across the globe. Our team is based in Pune, a city known for its software and engineering talent in India. We are a rapidly growing company field of power saving solution and we believe in “POWER SAVED IS POWER PRODUCED” which includes highly trained and experienced techno-managers, analysts, and engineers & detailers.

We are presently working in India (Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh, Delhi, Orissa, Chhattisgarh, Bihar, Andhra Pradesh, Telangana, Assam, Rajasthan and Jharkhand) and Abroad (Bahrain, Stanford and Laos).

We serve in majorly four areas,

- Energy Audit, Management and System Evaluations.
- Power Distribution System Design, Evaluations and Monitoring.
- MEP Design and Project management.
- Research and Training.

### Team Members

Name	Role	Field of expertise
Mr. Prashant Darade	Energy Manager and Lead Auditor	Certified Energy Manager with 8 years of experience in Energy efficiency assessment, Industrial engineering sector
Mr. Nilesh Saraf	Project Co-Coordinator, Verification of Electrical safety, Field Study	Graduate Engineer, Sr. Consultant, experience in Renewable Energy projects, energy efficiency assessment
Mr. Milind Balpande	Field study, data tabulation and analysis	Electrical engineer, 2 years of experience in Energy Efficiency Assessment
Miss. Utkarsha Bharate	SLD preparation, report preparation,	Graduate in Electrical &Power Engineering, 3 years of experience in Energy Efficiency Assessment



## 1. Executive Summary

The Energy Efficiency Assessment was undertaken in order to evaluate energy performance and identify potential energy conservation measures. The assessment was undertaken in three steps, i.e. document review of data and information initially provided by facility, on site activity and preparation of this report.

The on-site activity was conducted by assessment team consist of discussion with staff, electricians, collection/review of further data and a field inspection of the facilities and equipment's.

The facility has executed a number of energy conservation measures at the time of audit itself.

This brief report has therefore sought to provide a high-level overview of the status of energy efficiency at College of Engineering and Technology, Akola, Akola, combined with an illustration of areas where further, previously unidentified savings opportunities may exist.

### 1.1 Summary of Recommended Energy Conservation Measures:

Our survey has identified further potential opportunities, ranging from “no & low cost” measures, through to those that will require significant capital expenditure.

ECM No.	Energy efficiency improvement measures	Investment Rs. In Lakh	Estimated saving		Estimated Savings Rs. In Lacs	Estimated Payback Years
			Electricity	Carbon credit		
			kWh	(Tons of CO <sub>2</sub> )		
1	Replacement of existing fans (100,75,60 Watt) with energy efficient fans	15.42	36705	29	7.33	2.1
2	Replacement of conventional lights (TFL) of 40W with suitable 18W LED Tubes	3.66	13026	10	5.44	0.7
3	Optimize the AC temperature setting to 24°C	0.00	4018	3	0.47	Instant
4	Power Factor correction	1.50	15072	12	3.01	0.5

Note: Estimated savings alterations are on operating conditions and considering 7-8 hours per day operation and 180 days working per annum also the Investment figures mentioned in are only indicative, further detailed study is recommended

## 1.2 Prioritization of Energy Conservation Measures

On energy saving basis:

ECM No.	Energy efficiency improvement measures	Investment Rs. In Lakh	Estimated saving		Estimated Savings Rs. In Lacs	Estimated Payback Years
			Electricity	Carbon credit		
			kWh	(Tons of CO <sub>2</sub> )		
3	Optimize the AC temperature setting to 24°C	0.00	4018	3	0.47	Instant
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## 1.3 General audit review

College of Engineering and Technology, Akola can implement faster payback energy conservation measures (ECMs) which have already been considered and for which the ECMs are fully developed.

Other general points:

1. Awareness amongst students and staff is very essential step to reduce wastage of electricity.
2. Energy conservation awareness programs can be conducted once a year. Increasing energy awareness amongst employees and students will motivates them to work as a team can lead to reductions in energy consumption and save the money.
3. Savings estimate is in the range of 25 to 30%. When implemented effectively these savings can be realized quickly and cost effectively.

It is believed that with a revised approach and organization of energy management, the energy losses can be reduced in a systematic, cost effective manner. We hope that this report will help College of Engineering and Technology, Akola to implement these changes and provide direction to the Energy Management Team.

## **2. About College of Engineering and Technology, Akola**

College of Engineering and Technology is located at Babhulgaon, Nagpur Road, Akola, is one of the constituent institutions of Shri Shivaji Education Society, founded in academic year 1983. It offers a wide range of graduate programs in the fields of Civil, Mechanical, Electrical and Computer Science Engineering along with Architecture and Post-Graduation Courses. It is spread around 36.3 acres of land.

### **.Objective**

The overall objective of the assignment is to quantify energy savings in existing system and achieve reduction in energy consumption pattern.

Hence the objectives of this energy audit are as under,

1. To find out the energy consumption.
2. To find out the energy saving opportunities.
3. To quantify the total energy savings.
4. To find out the ways to achieve energy efficiency.

### **2.1 Scope of work**

Following is the scope of work envisaged for this assignment,

#### **Data collection**

To collect the details of various electrical and mechanical system and their ratings, the available drawings and details shall be studied. Detail load list shall be prepared and checked.

#### **A, B, C analysis**

With the details available from load list, analysis shall be carried out depending on the present usage trends. All the power consuming equipments shall be classified in three categories depending on their ratings, condition and operating time. The area for larger potentials for savings shall be identified.

#### **Field Study**

The detail field study on site shall include the following as well as all other measures required for energy audit study,

- a. Lay out the system and study of Electrical distribution.
- b. Study of area wise power consumption.
- c. Study of instrumentation provided.
- d. Measurement of motor currents, voltages, power etc. parameters by energy analyzer and measurement of water flow, pressures etc. parameters of pumps simultaneously and other measurements as needed to characterize the system and required for calculating efficiency at various combinations.
- e. Study of air conditioner operations and system requirements.
- f. Analysis of readings obtained from field with the standard consumption.



## **2.2 Approach and Methodology**

1. Understanding the Scope of Work and Resource Planning.
2. Identification of Key Personnel for the assignment/ project.
3. Structured Organization Matrix.
4. Steps in preparing and implementing energy audit assignment.
  - a) Discussions with key facility personnel.
  - b) Site visits and conducting “walk-through audit”.
  - c) Preliminary Data Collection through questionnaire before audit team’s site visit.
  - d) Steps for conducting the detailed audit.
    - Plan the activities of site data collection in coordination with the facility in-charge.
    - Study the existing operations involving energy consumption.
    - Collect and collate the energy consumption data with respect to electricity consumption.
    - Conduct performance tests to assess the efficiency of the system equipment/ electricity distribution, lighting, and identify energy losses.
    - Discuss with facility operation / maintenance personnel about identified energy losses.
5. List proposed efficiency measures.
  - Develop a set of potential efficiency improvement proposals.
  - Baseline parameters.
  - Data presentation.
  - System mapping.
  - List of potential Energy Savings proposals with cost benefit analysis.
  - Review of current operation & maintenance practices.
6. Preparation of the Draft Energy Audit Report.
7. Preparation and submission of final Energy Audit Report after discussion with concerned persons.

### **2.3 About PPS Energy Solutions Pvt. Ltd.**

M/s. PPS Energy Solutions Pvt. Ltd (PPSES) is an ambitious company, established by enterprising engineering professionals in the year 2004. The company offers services pertaining to Energy and Engineering to clients across the globe. Our team is based in Pune, a city known for its Software and Engineering talent in India. We are a rapidly growing company with a team of about 100 people which includes highly trained and experienced Techno-Managers, Analysts, and Engineers & Detailers.

We are presently working in India (Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh, Delhi, Orissa, Chhattisgarh, Bihar, Andhra Pradesh, Telangana, Assam, Rajasthan and Jharkhand) and Abroad (Bahrain, Stanford, Laos). We provide services for,

- Energy Audit, Management and System Evaluations.
- Power Distribution System Design, Evaluations and Monitoring.
- MEP Design and Project management.
- Research and Training.
- Services for Solar Installation.

### 3. Energy Details

The energy efficiency assessment was conducted for the load connected to the mains supply used. Mainly energy is used on this facility for the following purposes:

- 1) Lighting
- 2) Ceiling fans
- 3) Office Equipment's
- 4) Lab Equipment's
- 5) Computer Systems
- 6) Air Conditioner
- 7) Water Pumping

Based on above it is clear that followings buildings have high potential for energy savings

**Building Details of College of Engineering and Technology, Akola**

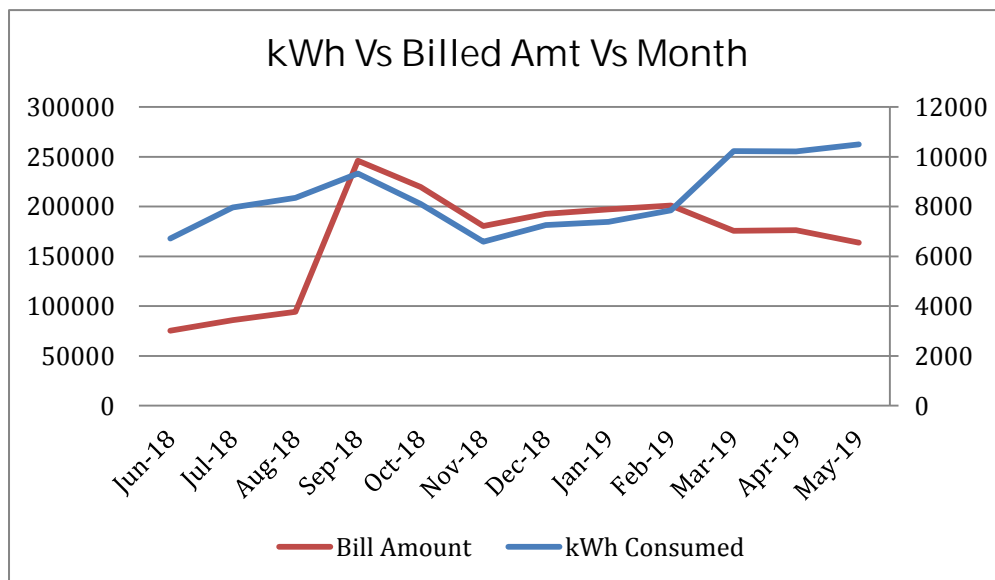
Sr. No.	Name of the Building
1	Class Rooms
2	Administration Department
3	Labs
4	Playground
5	Library
6	Departments of various streams



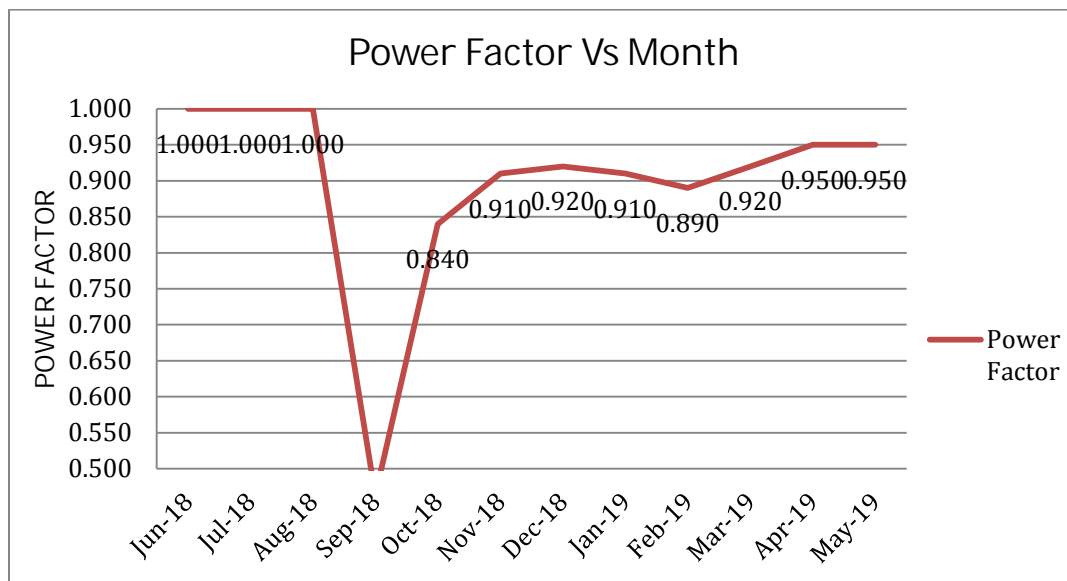
### 3.1 Analysis of Electricity Bills.

The energy consumption of last 12 months is tabulated as follows.

Sr. No.	Month	kWh Consumed	Power Factor	PF Incentives /Penal	Reco Demand (kVA)	Billed Demand	Bill Amount
1	Jan-19	7382	0.910	0.00	32	43	197112
2	Feb-19	7853	0.890	0.00	45	45	201018
3	Mar-19	10228	0.920	0.00	66	66	175708
4	Apr-19	10213	0.950	-5944.36	67	67	176391
5	May-19	10496	0.950	-5927.09	46	50	163761
6	Jun-18	6719	1.000	-5632.16	38	42	75365
7	Jul-18	7967	1.000	-6408	46	46	85770
8	Aug-18	8348	1.000	-6980.28	57	57	94216
9	Sep-18	9326	0.463	27431.76	56	56	246034
10	Oct-18	8107	0.840	3291.32	49	49	219655
11	Nov-18	6584	0.910	0.00	39	43	180431
12	Dec-18	7256	0.920	0.00	27	43	192823
		<b>100479</b>	<b>0.89608333</b>		<b>47.3333</b>	<b>50.6</b>	<b>2008283.55</b>
<b>Cost of electricity per unit</b>							<b>19.9870973</b>



**Graph 01- kWh Vs Billed Amt Vs Month**



**Graph 02- Power Factor Vs Month**

**Observations:**

1. Electricity consumption is varying month to month.
2. Electricity bill is not paid time to time, pending amount is seen in almost all bills, There is incentive if you pay bill early you can avail that incentives by paying early bill.
3. Power factor is not maintained to unity, so penalty is imposed for not maintaining power factor from September month.
4. Average annual overall electricity rate is very high as power factor is not maintained

**3.2 Connected Load of College of Engineering and Technology, Akola**

LOADSHEET								
Sr. No.	Name of FLOORE	Name of Block	Appliance	Qty	Wattage (W)	No of working Hours	Total KWh Aprox Consumption per year	Remarks
1	GROUND FLOOR CIVIL DEPT.	MATERIAL TESTING LAB	TUBELIGHT	17	40	5	612	
			FAN	10	100	5	900	
			PC	21	200	5	3780	
		TRANSPORTATION ENERGY LAB	PRINTER	2	100	2	72	
			PC	4	200	5	720	
			TUBELIGHT	12	40	5	432	
			FAN	6	100	5	540	
		M.E.(STRUCTURAL ENG.)	TUBELIGHT	7	40	5	252	
			FAN	5	100	5	450	
			PC	8	200	5	1440	
		TOILET	TUBELIGHT	4	40	3	86.4	
		COMPUTER CENTER	LED TUBELIGHT	18	18	4	233.28	
			FAN	10	100	5	900	
			AC	1	2000	5	1800	
			PRINTER	2	100	2	72	
			PC	62	150	5	8370	
		OFFICE	LED TUBELIGHT	14	18	8	362.88	
			FAN	11	100	8	1584	
			AC	1	2000	8	2880	
			XEROX	1	500	1	90	
			PRINTER	1	100	1	18	
			PC	1	200	6	216	
		PRINCIPAL CABIN	AC	2	2000	6	4320	
			FAN	4	100	8	576	
			LED PANEL LIGHT	4	9	8	51.84	
			PC	1	200	8	288	
			PRINTER	1	100	1	18	
			LED TUBELIGHT	6	18	8	155.52	
		CONFERENCE HALL	LED PANEL LIGHT	8	9	2	25.92	
			LED PANEL LIGHT	4	3	2	4.32	
			AC	2	2000	2	1440	



			PROJECTOR	1	150	1	27	
			FAN	2	100	2	72	
		ACADEMIC SECTION	LED TUBELIGHT	6	18	3	58.32	
			FAN	4	100	3	216	
			PRINTER	3	100	1	54	
			PC	7	200	3	756	
		GIRL COMMON ROOM	FAN	4	100	5	360	
			LED TUBELIGHT	4	18	5	64.8	
		SPORT DEPT.	TUBELIGHT	2	40	5	72	
			FAN	1	100	5	90	
			PC	1	200	3	108	
		ADMISSION CELL	TUBELIGHT	4	40	8	230.4	
			FAN	3	100	8	432	
			PC	3	200	8	864	
			COOLER	2	450	8	1296	
			PRINTER	2	100	2	72	
		TRANNNING AND PLACEMENT	COOLER	1	450	5	405	
			TUBELIGHT	7	40	5	252	
			FAN	5	100	5	450	
			PC	4	200	5	720	
			PRINTER	2	100	1	36	
		FINANCE SECTION	TUBELIGHT	5	40	5	180	
			PC	5	200	5	900	
			COOLER	1	450	5	405	
			PRINTER	3	100	1	54	
		MAINTENANCE SECTION	TUBELIGHT	2	40	5	72	
			FAN	1	100	5	90	
		DEPT.OF STORE	TUBELIGHT	2	40	3	43.2	
			FAN	1	100	3	54	
		CENTRAL LIBRARY	LED TUBELIGHT	24	18	6	466.56	
			FAN	16	100	6	1728	
			PC	5	200	6	1080	
			PRINTER	1	100	2	36	
		READING HALL	TUBELIGHT	15	40	5	540	
			FAN	10	100	5	900	
		READING SECTION	TUBELIGHT	5	40	5	180	
			FAN	4	100	5	360	
		DIGITAL LIBRARY	LED TUBELIGHT	11	18	5	178.2	

			FAN	10	100	5	900	
			PC	11	200	5	1980	
		STLD/DSP LAB LANGUAGE LAB	CFL	36	12	5	388.8	
			FAN	13	100	5	1170	
			PC	37	200	5	6660	
			PRINTER	1	100	2	36	
			Exhaust FAN	4	80	4	230.4	
		CORRIDOR	TUBELIGHT	15	40	8	864	
			CFL	20	12	8	345.6	
		WATER COOLER	WATER COOLER	2	1000	6	2160	
		CONFERENCE HALL	TUBELIGHT	13	40	3	280.8	
			FAN	8	100	3	432	
		ALL CLASS ROOM = 5	TUBELIGHT	5	40	8	288	
			PROJECTOR	1	150	8	216	
			FAN	5	100	8	720	
2	1ST FLOOR MECHANICAL DEPT.	CABIN AND LAB	TUBELIGHT	20	40	5	720	
			FAN	16	100	5	1440	
			AC	1	2000	5	1800	
			COOLER	1	450	5	405	
			PRINTER	1	100	1	18	
		MECHANICAL LAB	TUBELIGHT	16	40	6	691.2	
			FAN	16	100	6	1728	
			PC	2	200	6	432	
		PG RESEARCH LAB POLY	FAN	8	100	6	864	
			TUBELIGHT	18	40	6	777.6	
			PC	2	200	6	432	
		CHEMICAL DEPT. CORRIDOR	TUBELIGHT	19	40	6	820.8	
			WATER COOLER	1	1000	6	1080	
		CHEMICAL LAB	TUBELIGHT	29	40	6	1252.8	
			FAN	19	100	6	2052	
			PC	32	150	6	5184	
			AC	1	2000	6	2160	
			PRINTER	1	100	1	18	
		CLASS ROOM=2	TUBELIGHT	5	40	8	288	
			FAN	6	100	8	864	
			PROJECTOR	1	150	8	216	
		CLASS ROOM=5	TUBELIGHT	5	40	8	288	
			PROJECTOR	1	150	8	216	
			FAN	5	100	8	720	

3	2nd FLOOR ELECTRICAL DEPT.	MATH DEPT.	TUBELIGHT	2	40	5	72	
			FAN	2	100	5	180	
			PC	2	200	5	360	
		ELECTRICAL LAB	TUBELIGHT	13	40	5	468	
			FAN	11	100	6	1188	
			COOLER	1	450	6	486	
			PC	3	200	6	648	
			PRINTER	1	100	1	18	
		DRAWING HALL 1	TUBELIGHT	9	40	5	324	
			FAN	7	100	5	630	
		DRAWING HALL 2	TUBELIGHT	6	40	5	216	
			FAN	7	100	5	630	
		ENERGY CONSERVATION LAB	FAN	7	100	6	756	
			TUBELIGHT	13	40	6	561.6	
			PC	1	200	6	216	
		STAFF ROOM	TUBELIGHT	4	40	5	144	
			FAN	2	100	5	180	
		TEXTILE	TUBELIGHT	18	40	5	648	
			FAN	14	100	5	1260	
			PC	7	200	5	1260	
			AC	1	2000	5	1800	
			COOLER	1	450	5	405	
		PHYSICS LAB	TUBELIGHT	13	40	6	561.6	
			FAN	10	100	6	1080	
			COOLER	1	450	6	486	
			PC	1	200	6	216	
		CHEMISTRY LAB	TUBELIGHT	15	40	6	648	
			FAN	10	100	6	1080	
			PC	6	200	6	1296	
			COOLER	2	450	6	972	
		AUDITORIUM HALL	FAN	33	100	6	3564	
			PC	1	200	6	216	
			TUBELIGHT	34	40	6	1468.8	
		CORRIDOR	TUBELIGHT	11	40	6	475.2	
			WATER COOLER	1	1000	6	1080	
			LED TUBELIGHT	4	18	6	77.76	
		ALL CLASS ROOM = 10	TUBELIGHT	5	40	8	288	
			FAN	5	100	8	720	
			PROJECTOR	1	150	8	216	



4	ARCHITECTURE BUILDING	ADMINISTRATIVE HALL AND STAFF ROOM	LED TUBELIGHT	28	18	6	544.32	
			FAN	22	100	6	2376	
			PC	4	200	6	864	
			PRINTER	1	100	2	36	
			LED TV	1	200	3	108	
		ADMINISTRATIVE HALL AND STAFF ROOM, LIBRARY	FAN	25	100	6	2700	
			TUBELIGHT	30	40	6	1296	
			PC	36	200	6	7776	
			WATER COOLER	1	1000	6	1080	
			PRINTER	1	100	1	18	
		STUDIO AND AUDITORIUM HALL	FAN	26	100	6	2808	
			LED FOCUS	2	150	6	324	
			TUBELIGHT	34	40	6	1468.8	
5	COMPUTER BUILDING	COMPUTER CLASS ROOM GROUND FLOOR	FAN	10	100	8	1440	
			TUBELIGHT	17	40	8	979.2	
			PROJECTOR	1	150	8	216	
		CLASS ROOM AND LAB FIRST FLOOR	FAN	14	100	8	2016	
			TUBELIGHT	15	40	8	864	
			WATER COOLER	1	1000	8	1440	
			PROJECTOR	1	150	8	216	
		CLASS ROOM AND LAB SECOND FLOOR	TUBELIGHT	20	40	8	1152	
			FAN	13	100	8	1872	
			PC	102	150	8	22032	
		CLASS ROOM AND LAB STAFF ROOM THIRD FLOOR	TUBELIGHT	10	40	8	576	
			FAN	12	100	8	1728	
			PC	33	200	8	9504	
6	WORKSHOP BUILDING	CHEMICAL SHOP	TUBELIGHT	12	40	6	518.4	
			FAN	10	100	6	1080	
			MACHINE	8	250	6	2160	
			PC	2	200	6	432	
		POLY WORK SHOP	FAN	10	100	6	1080	
			TUBELIGHT	8	40	6	345.6	
			PC	1	200	6	216	
			MACHINE	15	150	4	1620	
		FLUID MECHANICAL LAB	FAN	9	100	6	972	
			TUBELIGHT	7	40	6	302.4	
			MACHINE	3	200	4	432	
		SMITHY FITTING	FAN	8	100	6	864	

		WELDING SECTION	TUBELIGHT	6	40	6	259.2	
			MACHINE	7	200	5	1260	
		MACHINE SHOP	FAN	12	100	5	1080	
			TUBELIGHT	13	40	5	468	
			MACHINE	28	200	4	4032	
		PASSAGE GYM AND CONTROL ROOM	TUBELIGHT	21	40	5	756	
			FAN	10	100	5	900	
7	GUEST HOUSE BUILDING	GUEST HOUSE	FAN	6	100	8	864	
			TUBELIGHT	1	40	8	57.6	
			COOLER	1	450	8	648	
			AC	1	2000	8	2880	
			LED PANEL LIGHT	21	3	8	90.72	
		CANTEEN	FAN	16	100	8	2304	
			TUBELIGHT	14	40	8	806.4	
			WATER COOLER	1	1000	8	1440	
		OUTDOOR AREA	STREET LIGHT	25	30	8	1080	
			Halogen	4	400	8	2304	

### 3.3 Total Quantity of Fixture in College of Engineering and Technology, Akola

Following are the College of Engineering and Technology, Akola fixture list,

Floor	Load	Wattage	Quantity
All Floors	TFL	40	578
	FAN	100	514
	Halogen	400	4
	PC	180	405
	Split AC	2000	10
	Printer	100	23
	Xerox	500	1
	CFL	12	56
	LED Panel Light	3	25
	LED Panel Light	9	12
	Projector	150	4
	Cooler	450	11
	Exhaust Fan	80	4
	LED Focus	150	2
	LED Tube Light	18	115
	Machine	200	61
	Street Lights LED	30	25
	Water Cooler	1000	1

### 3.4 Lux Level Measurement

Lux Level														
Sr No	Name of Building or road	Lamp Type	No of Lights	Wattage	P1	P2	P3	P4	P5	P6	P7	P8	P9	Avg
1	ENERGY CONSERVATION LAB	40W Tubelight	13	520	300	280	215	310	243	228	346	238	219	264
2	Ground Floor CORRIDOR	40W Tubelight	15	600	470	420	463	530	390	609	680	560	600	525
3	Ground Floor TOILET	40W Tubelight	4	160	151	141	143	132	102	99	103	132	128	126
4	Electrical Dept. Drawing Hall 1	40W Tubelight	9	360	215	310	243	228	174	138	119	286	150	207
5	Electrical Lab	40W Tubelight	13	520	390	310	364	378	406	329	438	301	456	375
6	Chemistry Lab	40W Tubelight	15	600	510	398	390	542	528	624	632	573	589	532
7	Workshop Building Chemical Shop	40W Tubelight	12	480	170	180	350	185	225	175	250	350	195	231
8	Workshop Building MACHINE SHOP	40W Tubelight	13	520	364	385	256	379	294	304	372	327	289	330
9	Electrical Dept. Staff Room	40W Tubelight	4	160	132	83	176	183	122	104	99	167	128	133
10	CANTEEN	40W Tubelight	14	560	390	285	321	279	367	423	453	363	502	376

## 4. Energy Conservation Measures

### *ECM 1: Replacement of Old Fan with Energy Efficient Super Fan*

ECM No.	Energy efficiency improvement measures	Investment Rs. In Lakh	Estimated saving		Estimated Savings Rs. In Lacs	Estimated Payback Years
			Electricity	Carbon credit		
			kWh	(Tons of CO <sub>2</sub> )		
1	Replacement of existing fans (100 Watt) with energy efficient fans	15.42	36705	29	7.33	2.1

#### **Observation:**

All fans are in old condition and with older technology. During survey it is observed that facility has avg. 72 watt fans.

#### **Recommendations:**

To replace non star rated fans with super energy efficient super fan

#### **Energy Saving Calculations:**

Energy Saving Calculation		
Particulars	Units	Values
Power consumption of Fans	kW	0.1
Power consumption of suitable energy efficient fans	kW	0.028
Average power saving after replacement	kW	0.072
Total no. of fans to be replaced	Nos.	514
Average working hour per day	hrs	5.5
No. of working days in a year	Days	180
Cost Benefit Calculation		
Annual Energy Saving potential	kWh	36705
Electricity tariff	Rs/unit	19.98
Annual Cost Saving	Rs.	733356.60
Total investment cost	Rs.	1542000.00
Simple Payback Period	Years	2.1
<b>Note-</b> Electricity tariff rate is based on Total Annual Bill in Rs./Billed annual units (Kwh), Calculations are performed based on 180 working days and 7.3 average working hours per day		



**ECM 2: Replacement of conventional lights (Halogen and CFL) of 500W with suitable LEDs**

ECM No.	Energy efficiency improvement measures	Investment Rs. In Lakh	Estimated saving		Estimated Savings Rs. In Lacs	Estimated Payback Years
			Electricity	Carbon credit		
			kWh	(Tons of CO <sub>2</sub> )		
2	Replacement of conventional lights with more efficient lights	3.66	13026	10	5.44	0.7

**Observation:**

TFL, Halogen and CFL is now an older technology. During survey it is observed that facility has all such fixtures.

**Recommendations:**

To replace these TFL, halogens and CFL with LED lights to serve the purpose.

Energy Saving Calculation				
Particulars	Units	TFL	CFL	HALOGEN
Power consumption of lamps	kW	0.04	0.012	0.4
Power consumption of suitable LED	kW	0.018	0.008	0.1
Average power saving after replacement with LED Street light	kW	0.022	0.004	0.3
Total no. of fixtures to be replaced with suitable LED fittings	Nos.	578	50	4
Average working hour per day	hrs	5.51	5.51	1
No. of working days in a year	Days	180	180	180
Cost Benefit Calculation				
Annual Energy Saving potential	kWh	12612	198	216
Electricity tariff	Rs/unit	19.98	19.98	19.98
Annual Cost Saving	Rs.	251982.34	3963.23	4315.68
Total investment cost	Rs.	507484.00	24500.00	12000.00
Simple Payback Period	Years	2.0	6.2	2.8
<b>Note-</b> Electricity tariff rate is based on Total Annual Bill in Rs. / Billed annual units (Kwh), Calculations are performed based on 180 working days and 1 average working hours per day halogen, 5.51 for CFL and TFL. Reference rates are from govt. CSR item codes for TFL replacement with 18W LED Tube is 2-1-23, CFL replacement with 8W LED bulb is 2-1-19.				

**ECM 3: Optimize the AC temperature setting**

ECM No.	Energy efficiency improvement measures	Investment Rs. In Lakh	Estimated saving		Estimated Savings Rs. In Lacs	Estimated Payback Years
			Electricity	Carbon credit		
			kWh	(Tons of CO <sub>2</sub> )		
3	Optimize the AC temperature setting to 24°C	0.00	4018	3	0.47	Instant

Energy Saving Calculation		
Particulars	Units	Values
Power consumption of Split AC	kW	2.00
For every 1°C reduction in temperature, power consumption increases by 2%, so considering 19°C temp as current temp we have scope of 5°C of improvement in temp	%	20
Power consumption after 24°C maintenance	kW	1.60
Average power saving after temperature restriction	kW	0.40
Total no. of AC's to be monitored	Nos	10
Average working hour per day	hrs	5.58
No. of working days in a year	Days	180
Cost Benefit Calculation		
Annual Energy Saving potential	kWh	4018
Electricity tariff	Rs/unit	11.72
Annual Cost Saving	Rs. Lakh	47086.27
Total investment cost	Rs. Lakh	0.00
Simple Payback Period	Years	0.0
<b>Note-</b> Electricity tariff rate is based on Total Annual Bill in Rs. / Billed annual units (Kwh), Calculations are performed based on 180 working days and 5.58 average working hours per day		

**Recommendations:**

Having the optimum / minimum driving force (temperature difference) can help to achieve highest possible suction pressure at the compressor, thereby leading to less energy requirement. This requires proper sizing of heat transfer areas of process heat exchangers and evaporators as well as rationalizing the temperature requirement to highest possible value. A 1°C raise in evaporator temperature can help to save almost 3 % on power consumption. The TR capacity of the same machine will also increase with the evaporator temperature, as given in Table.

<b>Effect of variation in Evaporator Temperature on Compressor Power Consumption</b>			
Evaporator temperature(°C)	Refrigeration Capacity* (tons)	Specific Power Consumption	Increase in kW/ton (%)
5.0	67.58	0.81	-
0.0	56.07	0.94	16.0
-5.0	45.98	1.08	33.0
-10.0	37.20	1.25	54.0
-20.0	23.12	1.67	106.0

Condenser temperature 40°C, Hence it is recommended to change the AC temperature setting to 25 °C.

**ECM 4: Power Factor correction**

ECM No.	Energy efficiency improvement measures	Investment Rs. In Lakh	Estimated saving		Estimated Savings Rs. In Lacs	Estimated Payback Years
			Electricity	Carbon credit		
			kWh	(Tons of CO <sub>2</sub> )		
4	Power Factor correction	1.50	15072	12	3.01	0.5

**Observation:**

The average pf of the building for the year is found to be .89 which is far less than unity.

**Recommendations:**

Installation of automatic power factor controller with required capacitors is recommended.

Energy Saving Calculation		
Particulars	Units	Values
Power consumption of total building	kW	94504.00
For every unit loss of Power Factor, power losses increases by 1.5%, so considering pf=0.89 as current we have scope of improvement Of 6 units of pf	%	14175.6
Power consumption after PF correction	kW	80328.40
Average power saving after temperature restriction	kW	14175.60
No. of working days in a year	Days	180
Cost Benefit Calculation		
Annual Energy Saving potential	kWh	14176
Electricity tariff	Rs/unit	11.72
Annual Cost Saving including incentives	Rs. Lakh	166138.03
Total investment cost	Rs. Lakh	120000.00
Simple Payback Period	Years	0.7
<b>Note-</b> Electricity tariff rate is based on Total Annual Bill in Rs. / Billed annual units (Kwh). Changes in the Power Factor penalty/incentives are due to revised tariff by MERC effective since Sept18		



**Other Recommendations:**

- A. Regular cleaning and maintenance of equipment's is important to reduce energy losses.
- B. Use less papers and minimization of paper work is also strongly recommended to avoid loss of paper.
- C. Regular plumbing service of all the water taps in complete building will reduce the wastage of water due to leakages which will reduce pumping consumption
- D. Cleaning of ceiling fan and exhaust fan blades will reduce the drag on the fan and in turn will reduce energy loss.
- E. Lights also need to be cleaned to increase its efficiency.
- F. Awareness amongst students and staff is very essential step to reduce wastage of electricity
- G. Energy conservation awareness programs can be conducted once a year. Increasing energy awareness of employees and students motivates them to work as a team can lead to reductions in energy consumption and save the money.
- H. Use of ceiling fans with split AC's is also recommended to lower the cooling load.
- I. Inverter based AC's or Star rated AC's are expected to be installed for newer purchases.
- J. Star rated water pumps should be chosen for the next purchase.
- K. Tree plantations will reduce the cooling load and improve ventilation so tree plantation is also recommended in the premises.

## 5. List of Instruments

### Power analyzer

Fluke 434 power analyzer was used to meter the mains supply voltage and current inputs



Picture 1 Fluke Power analyzer

Specification of the 434 Fluke power analyzer:

Electrical	
Single Phase	YES
Three Phase	YES
USER INTERFACE	
LCD-Type	Graphic LCD
LCD-Dimension	127 x 88 mm
Traditional energy analysis	V, I, P, Q, S, F, PF, cos $\phi$ , peak, minimum, maximum, demand etc.
Voltage	1V to 1000 V phase to neutral
Current	Up to 6000 A
Frequency	42.50 to 57.50 Hz
Precision Voltage, Current, Power	$\pm 0.1\%$

### Lux meter

Indi 6171 Lux meter was used to measure the lux levels in the ground floor as well as the first floor. The lux levels at the workplaces were found to be adequate.



Picture 2 Luxmeter

### Digital Clamp Meter



Picture 3 Mastech M266 clamp meter

Mastech M266C Digital AC Clamp Meter is used to measure the instantaneous current. The temporary measurements were recorded for the Main feeder, Lightings panel, ducted air conditioners. Following are the specification for this clamp meter:

Specification	Range	Accuracy
DC Voltage	200mV	-1.005
	2V/20V/200V	-3.005
	1000V	-3.008
AC Voltage	200V	-5.01
	750V	-5.012
AC Current	20A	-5.04
	200A	-5.025
	1000A	-10.03
Resistance	200	-5.01
	2K /20K /200K /2M	-8.01
Temperature	0°C~400°C(32°F~752°F)	-3.01