ALVA'S
Education Foundation

Alva's Institute of Engineering & Technology, Mijar

Energy Audit Report

STEP Private Limited
112, Midas, Sahar Plaza, J B Nagar,
Andheri-Kurla Road, Andheri (East),
Mumbai 400 059, India.
Email: info@stepsol.com,
Website: www.stepsol.com

Bestek Energy
8/B, Chitrakut CHS, Gaddari Road,
Dombivli (East)- 421201, India
Email: bestekenergy@gmail.com

PREPARED BY:

STEP PRIVATE LIMITED &
BESTEK ENERGY

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PRINCIPAL
Alva's Institute of Engg. & Technology,
Mijar, MOODBIDRI - 574 225, D.K

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1. Introduction

Alva's Institute of Engineering & Technology (AIET), Mijar was established in the year 2008. AIET comes under Alva's Education Foundation (AEF). AEF was established in 1995 and at present has 21 institutions.

AIET is affiliated to Visvesvaraya Technological University, Belgaum. It is approved by All India Council for Technical Education (AICTE), New Delhi and recognised by Government of Karnataka.

AIET has 1751 students enrolled and 205 teaching & non-teaching staff on its payroll. AIET offers various courses listed below:

Undergraduate Courses
Electronics & Communication Engineering
Information Science & Engineering
Computer Science & Engineering
Mechanical Engineering
Civil Engineering

Postgraduate Courses
Master of Business Administration
M. tech in Thermal Power Engineering
M. tech in Computer Science & Engineering
M. tech in Very-large-scale integration (VLSI) Design & Embedded System

Doctorate Programs
Ph.D. in Mechanical Engineering, Electronics and Communication Engineering, Computer Science, Physics, Chemistry, Mathematics and Management

Bestek Energy Private Limited (Bestek) and STEP Private Limited (STEP) team visited the college premises on March 3, 2020 to conduct Energy Audit.

Energy Audit enable the institute to:

- Define energy balance of the campus
- Implement energy efficient operational strategies
- Optimal use of control system & equipment capabilities
- Analyse the gap between present performance and benchmark
- Adopt Energy Conservation Measures (ECMs) to bridge the gap between present performance and benchmark
- Optimization of the performance of critical equipment and systems

The audit was performed to outline existing energy balance and providing solutions for minimising energy consumption. Prior to audit questionnaire and checklists were prepared, based on which the audit is conducted. College campus was inspected based on the checklist. During the audit Bestek and STEP team visited entire college campus i.e. Classrooms, hostels , kitchens, guest houses, library, washrooms, staff rooms, administration department, computer labs and other laboratories etc. Audit procedure also involved interactions with stakeholders viz. faculty, staff members, students, contract employees etc.

2. Campus Information

AIET campus consists of 3 Academic blocks (Main block, Library block and Mechanical & Civil block), 5 hostels (3 boys hostels and 2 girls hostels), 7 guest houses, 1 ground and a herbal garden. The area details of each building are presented in below,

Floor	Facilities
Academic block: Main Block	
Ground floor	Board room, Principal's office, Director's office, exam control room, administrative office, college office, 2 staff rooms, chemistry laboratory, research laboratory (R & D room), faculty office, coffee shop, stationery shop, managing trustee- AEF room, Aluminium Conductor Alloy Reinforced (ACAR) laboratory, innovation & We laboratory, first aid and medical room, machine learning laboratory, housekeeping room, computer laboratory, server room, exam office, 2 washrooms
First floor	Seminar hall, 6 classrooms, Physics department head office, Computer Science Engineering department head office, research laboratory, Analog and Digital Electronics/ Microprocessor and Microcontroller (ADE/MPMC) laboratory, Data Structure and Algorithms/ Design and Analysis of Algorithms (DSA/DAA) laboratory, server room, Visvesvaraya Technological University e- Shikshana, Database Management System/ Computer Graphics and Visualisation (DBMS/CGV) laboratory, Computer Networking/ System Software and Operating System (CN/SSOS) laboratory, engineering physics laboratory, 4 staff rooms, 2 washrooms
Second floor	Dean's office, Microcontroller & Processor (MP)/ Hardware Description Language (HDL)/ Embedded controller laboratory, Digital Signal Processing/ Very-large-scale integration/ Computer Networks (DSP/ VLSI/ CN) laboratory, project laboratory, National Cadet Corps (NCC) office, photocopy centre, 4 staff rooms, 6 class rooms, Electronics and Communication Engineering (ECE) department head office, Digital Electronics/ Analog-to-Digital Converter (DE/ADC) laboratory, Electronics & Telecommunication/ Line Interface Computer (EC/LIC) laboratory, e-Yantra laboratory, 2 washrooms
Third floor	Information and Systems Engineering department head office, network/web laboratory, ECE research centre, Microelectromechanical System (MEMS) laboratory, 4 staff rooms, 7 class rooms, envision laboratory, GNU/ Linus UNIX laboratory, IOS laboratory, electrical maintenance room, 2 washrooms
Fourth floor	6 Tutorial rooms, 4 classrooms, 3 HOD offices, CAED laboratory, computer programming laboratory, 5 staff rooms, dean (academics) office, Store room, boys common room, 2 washrooms
Academic block: Library Block	
Ground floor	Library, librarian chamber, photocopy section
First floor	Library, digital library, 2 washrooms

Second floor	Placement lounge, 3 classrooms, staff room, Master of Business Studies (MBS) dean room, training & placement head cabin, seminar hall, training & placement head cabin, meeting hall, office, computer laboratory, 2 washrooms
Third floor	Music room, 3 staff rooms, 2 seminar hall, 3 classrooms, 2 washrooms
Fourth floor	Auditorium
Academic block: Mechanical & Civil Block	
Basement Floor	Physical education room, machine shop laboratory, metallography laboratory, foundry & forging laboratory
Ground floor	Energy conservation engineering laboratory, fluid mechanics & machinery laboratory, measurement & metrology laboratory, Computer-Aided Mass Appraisal/ Computer-Integrated Manufacturing (CAMA / CIM) laboratory, Heat and Mass Transfer (HMT) laboratory, design laboratory, faculty room, laboratory, indoor game room, tutorial room, 2 washrooms
First floor	Concrete & highway laboratory, geotech laboratory, geology laboratory, surveying lab, classroom, basic electrical laboratory, environmental laboratory, staff room, store room, preparation room, 1 washroom
Second floor	Cafeteria, 4 classrooms, 2 staff rooms, 2 washrooms
Third floor	2 Drawing halls, 5 classrooms, 3 staff rooms, 2 washrooms
Fourth floor	Computer-Aided Mass Appraisal/ Computer-Aided Machine Drawing (CAMA/CAMD) laboratory, Computer-Aided Fixture Design (CAFD) laboratory, Mechanical department head cabin, 5 classrooms, 3 staff rooms, 1 washroom
Fifth floor	Seminar hall, 4 classrooms, 6 staff rooms , 2 tutorial rooms, Civil department head cabin, ladies waiting room, 1 washroom
Girls Hostel- Kaveri Block A	
Ground floor	Office, 16 rooms with attached washroom
First floor to fifth floor	16 Rooms on each floor with attached washroom
Girls Hostel- Kaveri Block B	
Ground floor	Wash area, store room, dining area, kitchen, dishwash area, handwash area
First floor	Office, dining area, dish wash, kitchen, store room, handwash area
Second floor to fifth floor	15 Rooms, 7 bathrooms, 9 toilets
Boys Hostel- Kumardhara Block A	
Ground floor	Office, 24 Rooms, 12 bathrooms, 16 toilets
First floor to fifth floor	24 Rooms, 12 bathrooms, 16 toilets
Boys Hostel- Kumardhara Block B	
Ground floor	Dining area, handwash area, kitchen, store room, dishwash area
First floor	Dining area, handwash area, dishwash area kitchen, worker's room, 2 bathrooms, 2 toilets

Second floor to fifth floor	12 Rooms, (5 bathrooms, 5 toilets in common area)
Boys Hostel- Kumardhara Block C	
Ground floor	Kitchen, Store room, handwash area, dishwash area, warden office
First floor to fifth floor	24 Rooms, (8 bathrooms, 12 toilets in common area)
Boys Hostel- Kumardhara Block D	
Ground floor	Kitchen, Store room, handwash area, dishwash area
First floor to fifth floor	26 Rooms, (8 bathrooms, 12 toilets in common area)
Guest Houses	
AC01, GHR, GH01, GH02, GH03, GH04 and GH05	

During Audit, STEP & Bestek team interacted with following stakeholders:

Name	**Designation, Department**
Dr. Praveen J	Dean, Academics
Dr. Ajith Hebbar	HOD, Civil Engineering
Nikhil Alva	Administrative Officer
Bhargavi K V	Assistant Professor, Electronics & Communication
Sachin K	Assistant Professor, Electronics & Communication
Shankargiri	Assistant Professor, Civil Engineering
Pritam Shetty	Head Librarian
Nilesh	Site Civil Engineer
Rashmi	Instructor, Electronics & Communication
Parshwanath	Laboratory Instructor
Jagadish	Maintenance Department
Swathi	Head Warden, Girls Hostels
Ravi Chandra	Supervisor, Boys Hostel A & B
Sunil	Supervisor, Boys Hostel C & D
Sudhakar Poonja	Housekeeping Contractor, A 2 associates
Priya	Photocopy Centre Operator
Sushmitha M.	Student
Seema H. K.	Student
Madhura	Student
Deekshith	Student
Pramod	Student
Krushika	Student
Chaitra	Student

3. Environmental Setting

AEF has a common its ‘Shobhavana campus’ in Moodbidri. It is termed as ‘Shobhavana campus’ due to presence of trees and herbs within the campus. AIET campus, Alva’s College of Naturopathy & Yogic Sciences, Alva’s Homeopathic Medical College and hostels, guest houses, Alva’s Naturopathy Treatment Centre, butterfly garden, bird garden are all present in Shobhavana campus.

AIET campus is spread around 52811.48 m^2 area and located adjacent to Mangalore- Solapur highway (NH 169). It is 24 km from Mangalore International Airport & 27 km from Mangalore city. It is surrounded by forest area.

Alva’s Institute of Engineering and Technology Campus

Location of Alva's Institute of Engineering and Technology- Shobhavana Campus

4. Energy Audit

The methodology followed for energy audit consisted of following:

a) Understand the facility and its energy use
b) Collection of various available data pertaining to energy consumption
c) Study power distribution in the premises
d) Measurements on overall power consumption of the premises
e) Visit to the sub areas to understand load centres and areas of energy saving
f) Analysis of the collected data
g) Identify various energy saving opportunities in the premises
h) Cost vs benefit analysis for feasible energy saving measures
i) Report of measured data, analysis & suggestions for sustainable energy and cost savings

5. Power Distribution

a) AIET receives power through 'Mangalore Electricity Supply Company Limited'. A substation is located in the campus, which has 750 kVA capacity transformer. A net meter is provided as AIET has rooftop solar PV installations on roofs of main block and boys hostel C & D.
b) Inside the building, the electric supply is divided for different areas. Panel is located at ground floor level below staircase.
c) Two diesel generators (DG) are provided as a backup in case of power failure. The DG sets are of capacity 365 KVA and 320 KVA provided for hostels and Academic Blocks respectively. DG operation details are not maintained separately.

Main power supply transformer

Meter chamber

Control panel- main block

DG set- 320 KVA

The energy consumption data for past few months from the energy bills shared by AIET was analysed as follows:

Month	RMD	BMD	PF	kWh Import	kWh Export	Net kWh	PF Penalty	Bill Amt	Rs/ kWh
May 19	368	368	0.90	136020	20	136000	0	1069155	7.9
June 19	48	340	0.91	112920	40	112880	0	880928	7.8
July 19	308	340	0.86	74080	40	74040	8885	574220	7.8
Aug 19	278	340	0.88	93440	40	93400	5605	724526	7.8
Sept 19	278	340	0.89	98940	20	98920	2954	763612	7.7
Oct 19	265	340	0.88	94980	200	94780	5687	734666	7.8
Nov 19	276	340	0.88	107120	60	107060	6424	832673	7.8
Dec 19	287	340	0.89	110720	20	110700	3321	862350	7.8

RMD- Recorded Maximum Demand, BMD- Billed Maximum Demand, PF- Power Factor

Comments/ Suggestions:

a) Monthly energy consumption is shown in **Figure 1**. The minimum energy consumption is 74080 kWh and maximum is 136020 kWh with an average of 103000 kWh per month.

b) Majority of the solar PV energy is consumed by facility and hardly any export to grid is seen.

c) Based on the energy bill amount and consumption, the average charges of energy for the facility are Rs. 7.8 / kWh.

d) The PF is not being maintained above 0.9 which leads to penalty in most of the months (refer **Figure 2**). Automatic Power Factor Control Panels (APFC) can help maintaining the PF thus avoiding PF penalty and reducing losses. This will also improve kWh consumption.

e) As presented in **Figure 3**, BMD is greater than RMD in most of the past months. Hence, contract demand can be optimized and demand to be controlled in some months to reduce the additional demand charges.

f) Regular effective monitoring of energy consumption by important load centres is suggested.

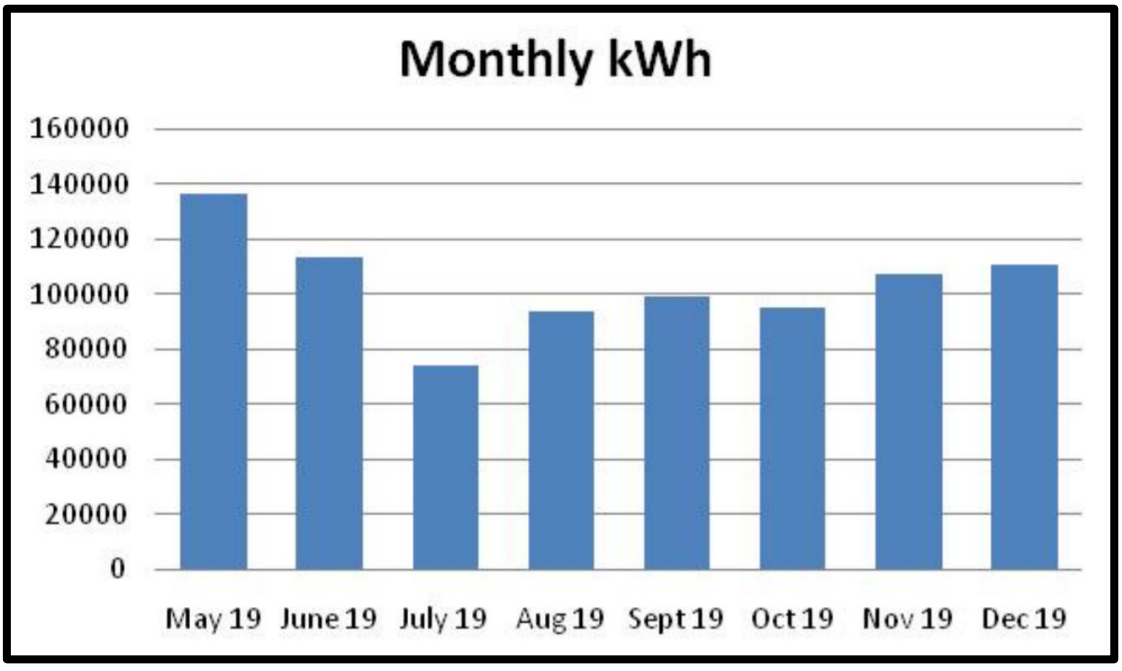


Figure 1. Monthly power consumption

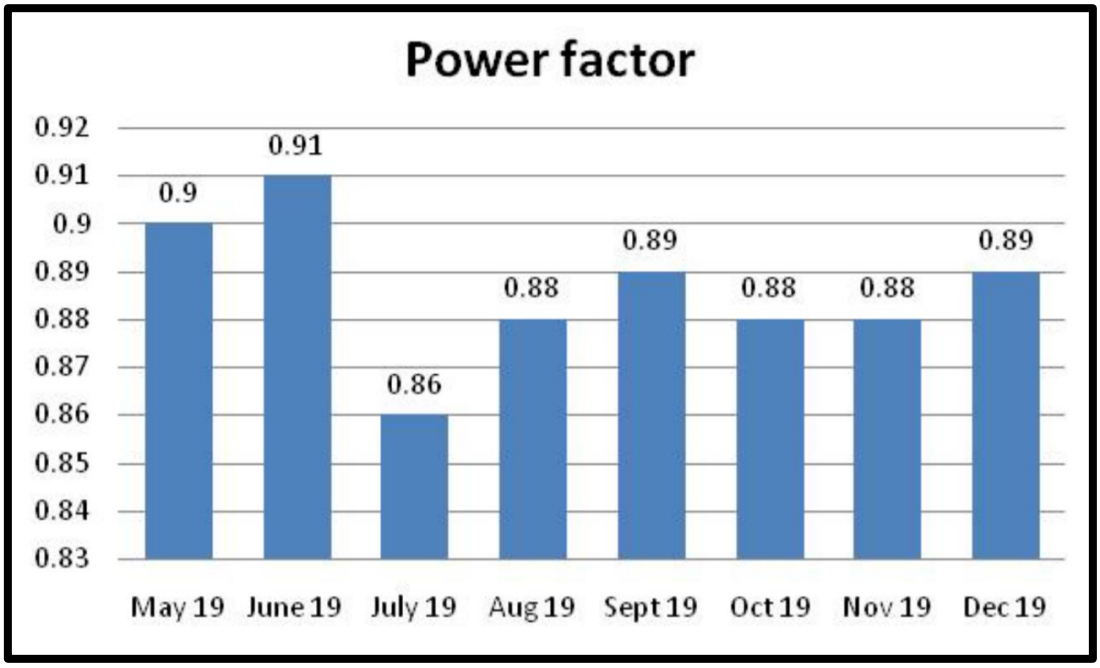


Figure 2. Power factor per month

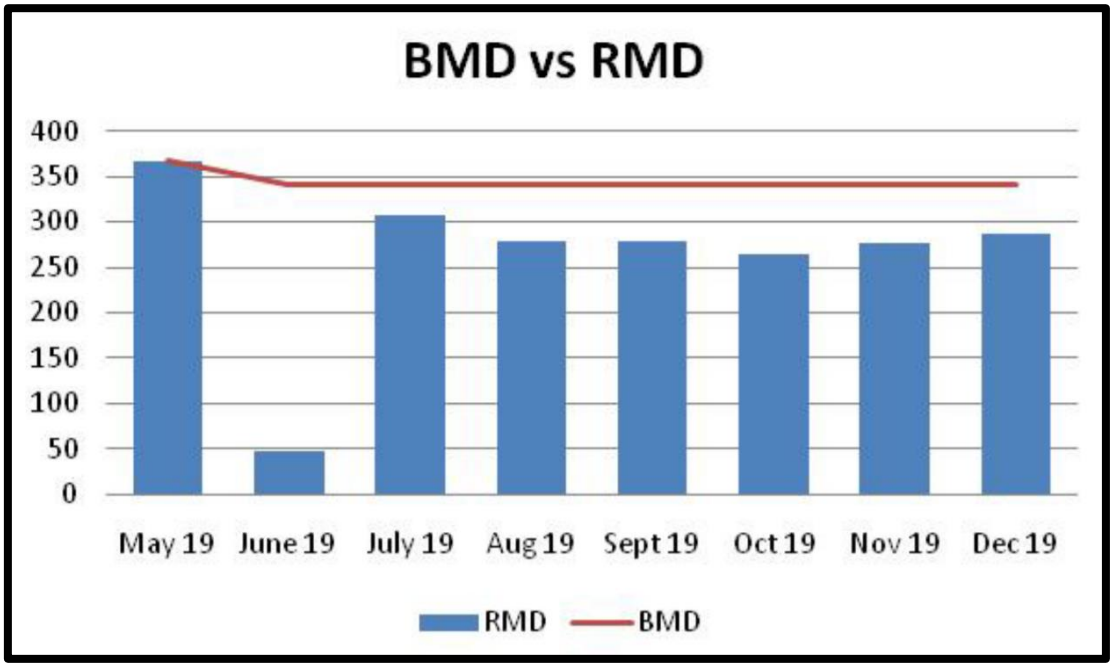


Figure 3. Recorded Maximum Demand (RMD) per month

6. End Use Profiling and Analysis

Based on the end use, equipment data available pertaining to the connected load and, the overall distribution of load is presented in **Figure 4**.

Equipment	Quantity
Tube Lights & light emitting diodes (LEDs)	3662(1% LEDs)
Fans	2194
Air Conditioners	80
Computers	998
Printers	56
Projectors	76
Refrigerators	7

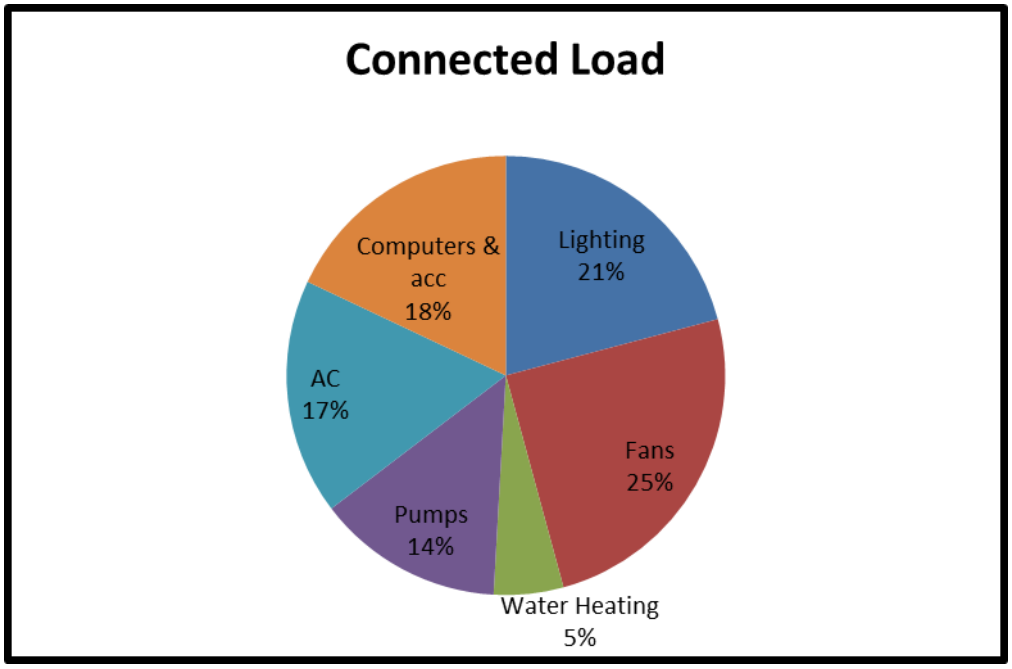


Figure 4. Overall distribution load

6.1 Lighting

Majority of the indoor lighting used in the facility is fluorescent tube lights (FTL) (40 watt). In Auditorium, compact fluorescent lamps (CFL) of 36W x 2 Nos. are used. In most of the areas, illumination is adequate and lux levels found to be within limits.

In case of external lighting it was observed that following lights are used:

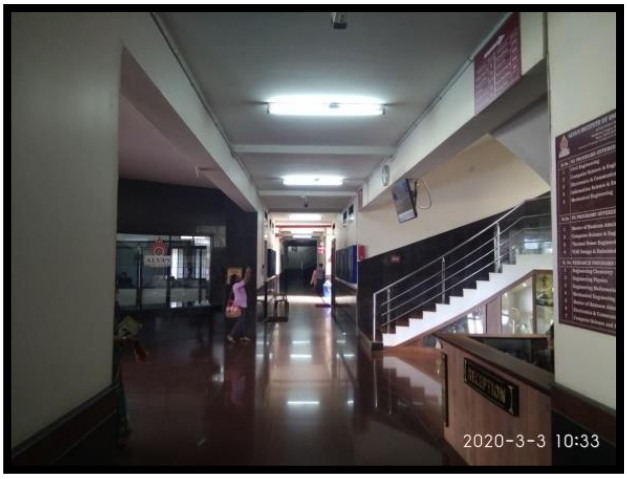
- 400 W – Halogen lights – 10 Nos.
- LED Street lights – 90 Watt- 6 Nos.

Since the lighting load is 21%, energy efficiency improvement in this area will result in substantial energy and demand savings.

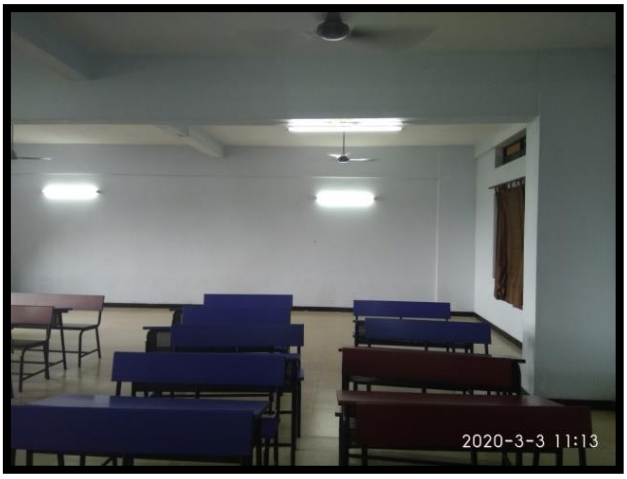
Parameter	Unit	
Old FTL	Watt	40
New LED	Watt	18
Saving	Watt	22
Qty	Nos	3662
Annual Hrs	Hrs	2000
kWh saved	kWh	161128
Tariff	Rs/kWh	7.8
Amount	Rs	1256798

a) It is recommended to use LED lights for indoor use, which would save 1.6 lakh kWh and Rs. 12.6 lakhs.
b) This would also result in reduction in demand saving of 50 KW.
c) Replacement of halogen lights to LED lights will save 5000 kWh and Rs. 40,000.
d) Street lights can be converted into solar operated street lights to save energy.
e) In Auditorium 36 W x 2 Nos. CFL fittings are used which can as well be replaced with LED lights for better energy efficiency and life.

In library, although LED lights are installed, they are kept ON continuously irrespective of occupancy. It is suggested to divide lighting fixtures into separate circuits and keep certain circuits ON optimize the usage and increase fixture life. In some areas, occupancy sensor may be installed.



Corridor- ground floor- main block



Classroom

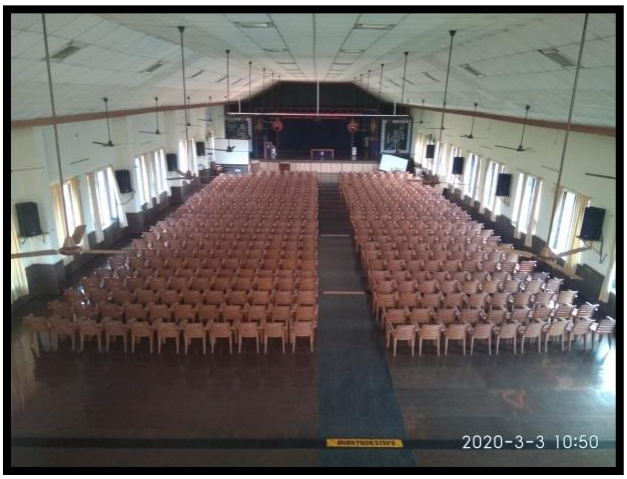
Halogen light

LEDs in Library

6.2 Ventilation

a) Ceiling fans and wall mounted exhaust fans are mainly used in most of the areas. In the entire AIET campus 2194 are ceiling fans are used.
b) The ceiling fans are of old and consume 80-100 watts. These can be replaced with new technology energy efficient fans. The energy saving and payback calculation is as under:

Parameter	Unit	
Old Ceiling fan power consumption	watts	80
New ceiling fan power consumption	watts	40
Saving in power consumption	watts	40
Operating hours per day	hrs	10
Operating days per year	days	200
Annual Saving in energy consumption	kWh	80
Number of replacements	Nos	2194
Total Annual savings	kWh	175520
Cost of Energy per unit	Rs/kWh	7.8
Annual Energy cost saving	Rs	1369056
Cost of Standard fan	Rs	1000
Cost of energy efficient fan	Rs	1800
Additional investment	Rs	1755200
Simple Payback	Months	15



Fans present in auditorium

6.3 Air Conditioning

a) Air conditioning requirement in the facility is catered by split air conditioners (ACs) of various makes. These air conditioners are around 5 years old or more. Majority of the air conditioners are with 2-3 star ratings, few air conditioners without any rating.

b) It is recommended to replace all non-star ACs at least by 3 star air conditioners. The typical savings calculations for both scenarios are mentioned as below:

Parameter	**Unit**	
Non star AC power consumption	watts	1500
New 3 star AC Power consumption	watts	920
Saving in power consumption	watts	580
Operating hours per day	hrs	8
Operating days per year	days	200
Annual Saving in energy consumption	kWh	928
Number of replacements	Nos	1
Total Annual savings	kWh	928
Cost of Energy per unit	Rs/kWh	15
Annual Energy cost saving	Rs	13920
Cost of 3 Star AC	Rs	25000
Simple Payback	Months	22

c) If 2 star ACs (which are regularly operated) can be replaced with 5 Star ACs, considerable energy and cost savings can be achieved. The savings calculations for both scenarios are mentioned as below:

Parameter	Unit	
2 star AC power consumption	watts	1170
New 5 star AC Power consumption	watts	780
Saving in power consumption	watts	390
Operating hours per day	hrs	10
Operating days per year	days	200
Annual Saving in energy consumption	kWh	780
Number of replacements	Nos	1
Total Annual savings	kWh	780
Cost of Energy per unit	Rs/kWh	15
Annual Energy cost saving	Rs	11700
Cost of 5 Star AC	Rs	30000
Simple Payback	Months	31

AC with 3 star rating

6.4 Electric Motors

a) Electric motors are used for water pumps. These motors are old and less energy efficient (80%).
b) It is recommended to replace these motors with energy efficient motors.
c) Energy savings obtained through replacement can be around 15%.

6.5 Water Heaters

Hot water is used for Boys hostel A & B. Heat pumps water heaters are installed in these hostels which cater the need of hot water. For girls hostel, geysers are installed apart from solar system for hot water generation.

Electric motor

Water Heater

7. Renewable Energy

a) Ongrid Solar Rooftop PV System has been installed in 2018 by 'Renew Power'. Synchronization certificate dated October 26, 2018 was available for review. Solar panels are present on the terrace of main block and boys hostel C & D and are 128 KVA and 64 KVA respectively.
b) AIET is paying for the energy generated through this system at agreed rate.
c) Systems installed are under Opex model.
d) A dedicated person is deputed on site by Renew Power for operation and maintenance of the systems.
e) Solar power generated by these systems is monitored by Renew Power and monthly manual readings are taken for energy billing. Solar energy generation (kWh) for past 6 months is as under:

Location	Sept 19	Oct 19	Nov 19	Dec 19	Jan 20	Feb 20
Main block	9898	13336	16125	13900	17550	14850
Boys hostel C & D	4608	6211	7416	6390	8070	6930

f) Electricity generated from solar energy is connected to power distribution system under net metering. Upon analysis of past few months, it is observed that maximum exported energy is 200 kWh in the month of October 2019.

g) Solarizer (Solar water heaters) of capacity 10 KL and 6 KL are present in girls hostels and boys hostel C &D respectively for supply of hot water. Solarizers are installed by 'Emmvee Solar Systems Private Limited' in the year 2013.
h) AIET is also planning to install additional solar PV system for extra energy generation.

Rooftop Solar PV system

8. Summary and Conclusion

Energy Audit was undertaken in order to evaluate energy consumption of different end users and identify potential energy conservation measures. The assessment was carried out based on reviewing the available energy usage data, measurements of energy usage at available load, information provided by facility during site visit and discussions with the staff.

Based on the same, following observations/ suggestions may be noted,

<u>Suggestion related to energy saving:</u>

a) Demand optimization and controlling the demand by installing demand controller can save Rs. 1 lakh per year.
b) Power Factor to be regularly monitored. Keeping PF near unity (at least above 0.9) will save the penalty of Rs. 0.7 lakh per year and also reduce the active energy consumption.
c) Presently FTL and CFL are mostly used for lighting. Replacement of all FTL and CFL by LEDs would save 1.6 lakh kWh units, which is Rs. 12.6 lakhs per year. Payback shall be less than year.
d) Normal ceiling fans are widely used and may be replaced by energy efficient fans which would bring down the energy consumption by 50%. Changing all fans shall save 1.75 lakh kWh units and Rs. 13.7 lakhs per year. The payback period shall be less than 2 years.
e) Lighting and fans constitute more than 55% of the total load of the campus. These are two areas where energy efficiency should be deployed to achieve demand reduction. Demand saving due to energy efficiency (EE) in these areas shall be 100 kVA.
f) Old / non star window ACs and split ACs to be replaced by new star rated (minimum 3 star) ACs.

g) Old and less energy efficient pump motors can be replaced with energy efficient motors. This will achieve at least 15% energy saving.

General suggestions:

It is suggested to monitor building wise energy consumption and benchmarking of kWh/ sq.ft. should be decided for sustainable improvement.

The institute is using considerable solar energy for captive use which shows their energy consciousness. However, this solar generation to be monitored with regard to grid energy and monthly analysis to be maintained for maximum output.