

Draft Report

ENERGY AUDIT



AVANTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Approved by AICTE, Permanently Affiliated to JNT University Kakinada,
ACCREDITED BY NAAC and Recognized under 2(f) & 12 (b) by UGC, New Delhi)
Tamaram, Makavarapalem, Narsipatnam (RD), Visakhapatnam-531113

May 2023



Submitted By

Dr. T. Srinivasa Rao, Chairman, Energy Audit

Sri. P. Varahala Dora, Member, Energy Audit

Sri. S. Rishikesh, Member, Energy Audit

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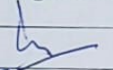
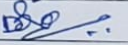
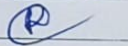
Lr: AIETM/Committees/Energy Audit/2023-24/1

Date: 27/04/2023

APPOINTMENT OF ENERGY AUDIT COMMITTEE -ORDERS


The Principal is pleased to appoint the following faculty as members of Energy Audit Committee for the year 2023-24. They are directed to take up the assignment and carry out Energy Audit and submit the recommendations for effective utilization of Energy in our campus.

ENERGY AUDIT COMMITTEE

S.NO	Name of the Committee Member	Designation	Position	Signature
1.	Dr. T. Srinivasa Rao	HOD, Dept. of EEE	Chairman	
2.	Sri. P Varahala Dora	Assoc. Professor, EEE	Member	
3.	Sri. S Rishikesh	Assoc. Professor, EEE	Member	

Copy to:

1. All the Members
2. Coordinator, IQAC
3. Administrative Officer


Principal
Avanthi Institute of Engg. & Technology
Tamaram, Makavarapalem Md.,
Anakapalli District., Pin: 531 113

Executive Summary

This section presents a brief summary of the results of the detailed energy audit carried out at AIET, Visakhapatnam during **May 2023**.

The audit was mainly targeted at identifying practical, sustainable and economically viable Resource saving opportunities in all sections of the facility, resulting from a detailed study and analyses of technical parameters. The audit involved using a wide range of sophisticated, portable, diagnostic and measuring instruments to generate refined data and facilitate complex analyses to give a more reliable basis for evaluation of energy saving potential and economic viability.

AIET has its building located at Tamaram, Makavarapalem, Narsipatnam (RD), Visakhapatnam. The building occupies an area of **19,379 Sq.m.**The main energy source to the facility is electricity which is obtained from TANGEDCO. The plant has one DG set for back-up power of 250 kVA. The following table gives total cost of energy sources.

The study has identified an annual energy saving potential of **1,12,464kWh (amounting to Rs.8.5lakhs and 60 % of the total bill)** of electricity with involvement of technology change. The total cost of implementation for the proposals is estimated to be **Rs. 45.3 lakhs**.

A summary list of recommendations, the saving potential and implementation cost is given in the next page. The details of various proposals are given in detail in this report:

Summary of recommendations

SI.No	Particulars	Energy Savings, kWh/year	Cost Savings, Rs. Lakh(s)/year	Investment Rs. Lakh(s)	Payback Period, months
1.	Increase temperature setting of air conditioners to 25°C	23760	1,78,200	nil	nil
2.	Replace 40 W Flourescenttubelights by 26 w led tubelights	9768	0.73620	0.70000	12
3.	Replace existing ceiling fans by energy efficient BLDC FANS.	15,576	1,16,820	9,30,000	108
4.	Install a 60 kw solar power plant in the terrace of the building	63,360	4,75,200	36,00,000	91

Annual Monetary savings – Rs.8.5 Lakhs

Introduction

1.1 ABOUT COLLEGE

Avanthi Educational Society under the Leadership of Sri M.Srinivasa Rao Garu as chairman was started in the Year 1991. Within a short span of its establishment, the group has made a remarkable stride in the field of education offering various courses at Under Graduate, Post Graduate, Pharmacy & Engineering levels. This milestone is achieved as the institution carved itself to impart quality and career oriented education, countering the challenges of the modern world through planning, dedication, determination, prompt execution and with the innovative ideas of our advisory board.

Today, Avanthi Educational Society is proud to have a strength of over 16000 students with 15 institutions under its ambit. It is the path of glory towards the success during the last 32 years. The institution has been adjudged many times as the second best educational institutions in the twin cities and 16th best in all over India through the impartial survey made by the renowned magazine "India Today".

Avanthi Institute of Engineering and Engineering (AIET), Makavarapalem, Visakhapatnam was started in the year 1999 and offers various courses at Engineering and PG level. The college is provide with rooms, computer center, laboratories and seminar hall with audio-visual equipments. Industry Institute interaction is conducted regularly to emphasize on the latest trends in the present market.

It is very near to Narsipatnam. Frequent bus facilities is avaiable both from and to Visakhapatnam and Narsipatnam. Very safe and secure hostel facility is available for Girl students. These are the additional facilities besides excellent academic atmosphere in the college campus.

Courses Offered

1. B.Tech ((Electronics & Communication Engg.)
2. B.Tech (Electrical and Communication Engineering)
3. B.Tech (Computer Science and Engineering)
4. B.Tech (Mechanical Engineering)
5. B.Tech (Computer Science and Engineering- AI&ML)
6. M.Tech (CSE)
7. M.TECH (VLSI Design)
8. M.TECH (Power Electronics)
9. M.TECH (Power Systems)
10. M.TECH (Digital Electronics And Communication Systems)
11. Master in Business Administration
12. Master of Computer of Applications

1.2 SCOPE OF THE STUDY

The energy audit was conducted with the following scope of work to cover the energy utilisation in various areas of the campus.

- Conduct Awareness Programme on 'Energy Conservation'
- Assess the inputs, outputs and wastage for each usage area
- Develop benchmarks for energy consumption
- Evaluate the tariff and optimisation of tariff
- Assess potential for renewable energy sources
- Identify energy saving measures
- Discussion and brainstorming of the measures evolved
- Cost benefit analysis of the evolved measures.

1.3 AUDIT APPROACH

As per the Energy Conservation Act, 2001 "Energy audit" means 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. The audit was carried out by undertaking a field visit to the site during **March 2020**. During the field visit, a number of on-site measurements were taken for various equipment in the campus along with collection of energy consumption, equipment and operational data from the administration **and technical departments personnel**. Discussions were held with concerned Technical / Managerial staff so as to fully understand the working requirements to arrive at practically realizable solutions. The audit team collected relevant data and made key measurements.

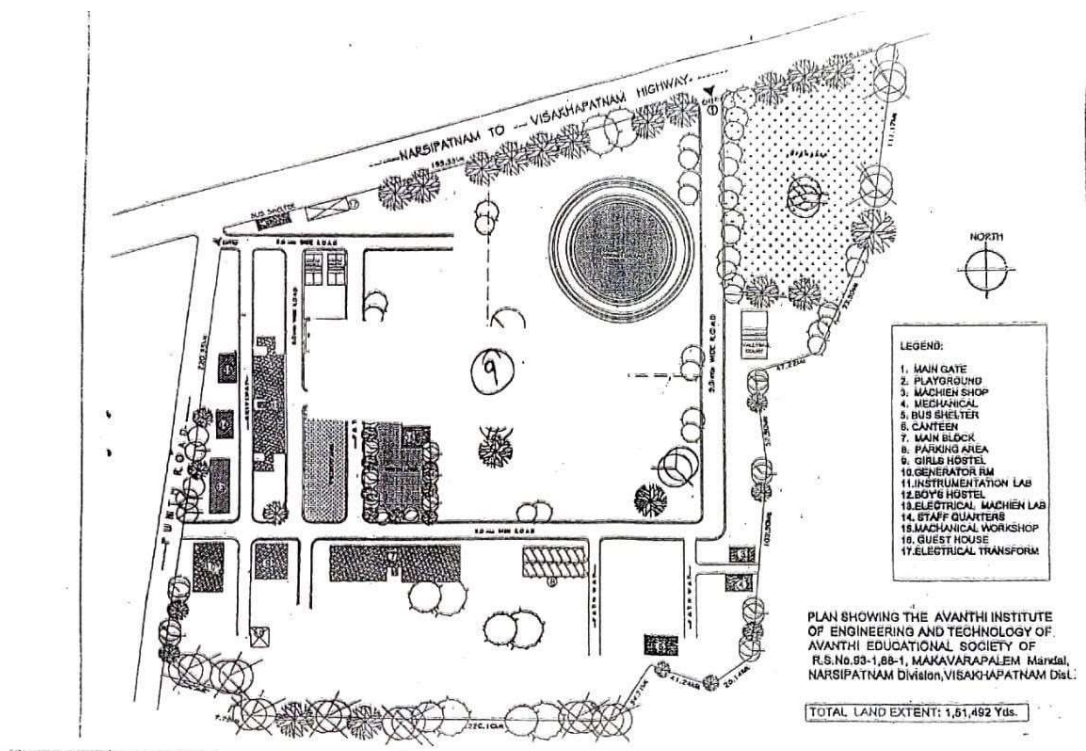
The following areas were covered as part of the study:

- Tariff
- Electrical Systems : Distribution and management
- Air conditioners
- Lighting
- Ceiling and pedestal fans
- UPS
- Servo stabilisers
- Computers
- **Various machinery in Laboratories**
- CCTV system
- DG sets

After carrying out the measurement & field study, the preliminary observations of the study were discussed with the management. The report presents the field measurements, operational data, data analysis, key observations made, and recommendations for achieving energy use efficiency for each of the above-mentioned equipment/area. The recommendations are followed by cost-benefit analysis. Major emphasis is laid on short and medium term measures. The ultimate aim of this exercise is to enable the management to understand and prioritize energy efficiency measures identified through the study.

1.4 CAMPUS DESCRIPTION

Avanthi Institute of Engineering and Engineering (AIET), Makavarapalem, Visakhapatnam and is an affiliated college of JNTUK Kakinada. The Campus consists of Administrative Block, Academic Block, Laboratories, Hostel Blocks, Canteens and Teaching and Non-Teaching Quarters. There are 1815 students, 75 faculty and 40 staff members in the campus.



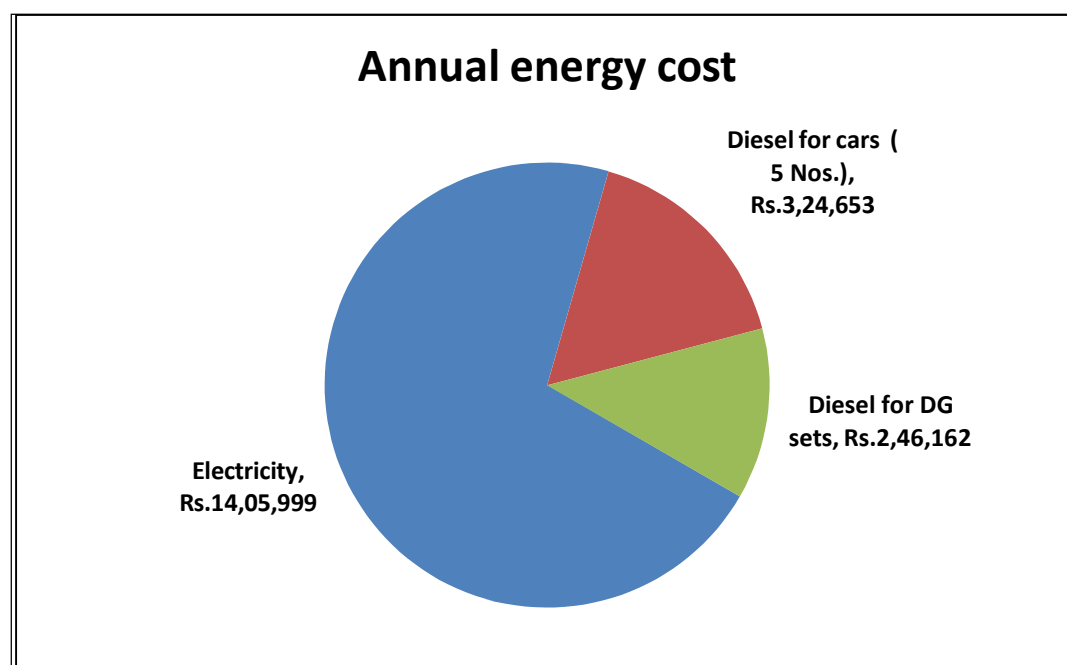
1.5 ENERGY SOURCES

The main source of energy used in the campus is electricity from Andhra Pradesh Eastern Power Distribution Company Limited (APEPDCL). In times of power shutdown the Diesel Generators are operated which use Diesel as a fuel and Diesel is also used for cars and busses of AIET Transportation Department.

1.6 ENERGY CONSUMPTION& ENERGY COST

Annual energy consumption for the plant during the year 2019 is given below in the table.

Energy source	Annual Quantity	Annual Cost
Electricity	1,80,724 kWh	Rs.14,05,999
Diesel for Transportation Department	4708 litres	Rs. 3,24,653
Diesel for DG sets	3517 litres	Rs. 2,46,162
Total annual energy cost		Rs. 19,76,814



Electricity forms the major energy cost accounting for 71% of the total energy expenditure.

The electricity tariff of APEPDCL applicable for AIET is LM2B2 (Private Educational Institutions & Hostels). Accounting to the tariff one unit or kWh is charged at Rs. 7.50. In addition a fixed charge of Rs. 120 per kW is also charged. The connected load for AIET is 110 kW. The cost of diesel is Rs 100 per litre.

Campus Energy System

2.1 ELECTRICAL SYSTEM

AJET has an LT connection with a connected load of 110 kW with Andhra Pradesh Eastern Power Distribution Company Limited (APEPDCL). The service details are given below.



EASTERN POWER DISTRIBUTION COMPANY OF ANDHRA PRADESH LIMITED

HT bill for the month of : 04/2022 Dated : 05-05-2022 GST No. 37AAACE987681ZH

Payable on or before: 19-May-2022 VSP389
 Contracted MD (KVA/HP) 93 SRI M.SRINIVASA RAO
 Specified Voltage(KV) 11 CORRESPONDENT
 Actual Volatge(KV)(Comm Fdr) 11 AVANTHI INSTITTE OF ENG&TECH,TAMAVAM,MAKAVARAPALEM(M);VSP
 Category IIA(I) COMMERCIAL-HT

(DISC.DT : 03-Jun-2022) , MC Date : , MF Date : , MRT Date :

Changes		KWH	KVAH	KVA	PF	LF%
Reading On (1)(A)	01/05/2022	380579.0000	416125.5000	66.7400		
Reading On	01/04/2022	368232.5000	403193.5000			
Difference		12346.50	12932.00			
Multiplying Factor		1	1	1		
Total Consumption		12347	12932	66.7400	0.95	13
Monthly Min Consumption			1860	74.40		
Main Consumption	12932 Colony		0	L&F		
Demand Charges Normal Rate	Rs	475.00	For	74.4000	KVA	35340.00
Demand Charges Penal Rate (80 %)	Rs	475.00x2	For	0.00	KVA	0.00
Energy Charges Rate(All Units)	Rs	7.65	For	9344	KVAH	71481.60
Excess Energy Charges Rate	Rs		For	0	KVAH	0.00
Electricity Duty Charges		1.00	For	12932	KVAH	10096.02
Colony Charges Rates			For		KVAH	
L&F Charges Rate			For		KVAH	
Energy Charges Include Fuel Cost Adj	Ps		For		KVAH	
Fuel Surcharge Adjustment (,) (,)	Ps		For		KWH	0.00
True up Charge	Ps		For		KWH	0.00
				TODCharges		3659.00
				TODIncentive(-)		0.00

Handwritten note: 12932 / 13

Supplier Name	KWH Share	KVA Share	TOD	INCENTIVE	% Wheeling	
SOLAR UNITS	3588					
						Sub Total 120576.62
						Customer Charges 1406.00
						Grid support charges 1800.00
						Wheeling Charges 0.00
						Transmission Charges 0.00
						RKVAH Surcharge HYDEL 0.00
						RKVAH Surcharge WIND 0.00
						OPEN ACCESS CROSS SUBSIDY 0.00
						ACD SURCHARGE 0.00
						Late Payment Charges 0.00
						Interest On ED 0.00
						Penal Interest 0.00
						Transformer Hire Charges 0.00
						Difference Voltage Charges 0.00
						Load Factor Incentive (-) 0.00
						Total 123782.62
						TCS 0.00
						TCS S/F 0.00
						25% Rebate Application 0.00
						Ferro Incentive (-) 0.00
						PooledCost Adj (-) 0.00
						NetIcdAmt(Icd-Tds)(0.00-0.00) (-) 0.00
						Other Credit Adj 0.00
						Loss (or) Gain 0.38
						Net Bill Amount 123783.00
						(Previous Years)Arrears before 31-Mar-2022 0.00
						(Current Years)Arrears after 01-Apr-2022 -0.39
						Net Payable Rs 123783.00

(Rs One Lakh Twenty Three Thousand Seven Hundred and Eighty Three only)

NOTE:- This is a provisional bill. After verification of records, the bill will be revised as per Restrictions and Control measures issued by Hon'ble APERC.

Senior Accounts Officer
 Operation Circle, APERDCL
 VISAKHAPATNAM

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Tariff	Category of Consumer	Unit charges (Rs./kWh)	Fixed charges (Rs./kW)
LM2B2	Private Educational Institutions & Hostels	7.50	120

Though the supply is 3 phase most of the loads in use are of **single phase**. The premise has one DG set of **250 kVA** which acts a standby and is operated during **power failure period from grid**. The **single line diagram of the electricity system is given below**.

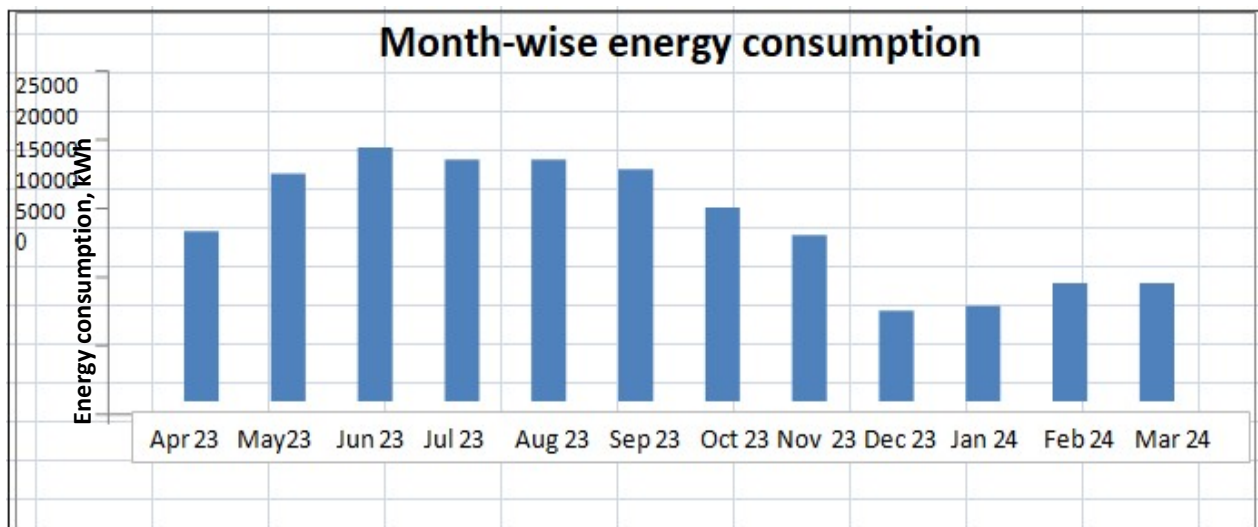
From the main panel board the incoming 3 phase 440 V supply three separate feeders supply power to Main Block, Laboratories, Hostel Blocks, Canteens and Teaching and Non-Teaching Quarters. The 250 kVA DG set is connected to the panel board through a bus coupler.



EB meter 110 kW

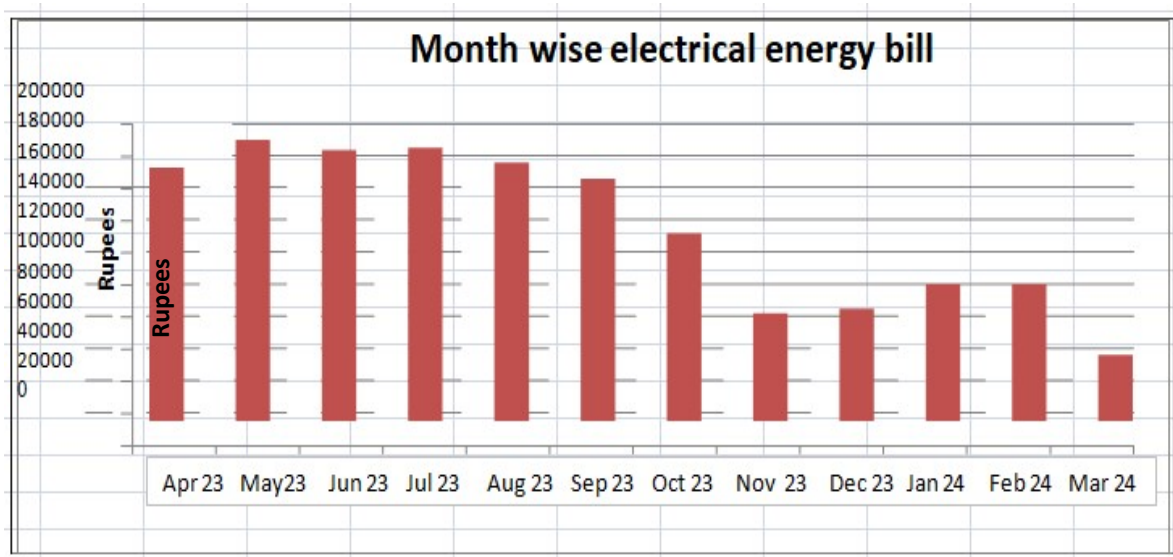
2.2 ELECTRICAL ENERGY USE PATTERN

The electrical energy consumption for various months is given in the following graph.



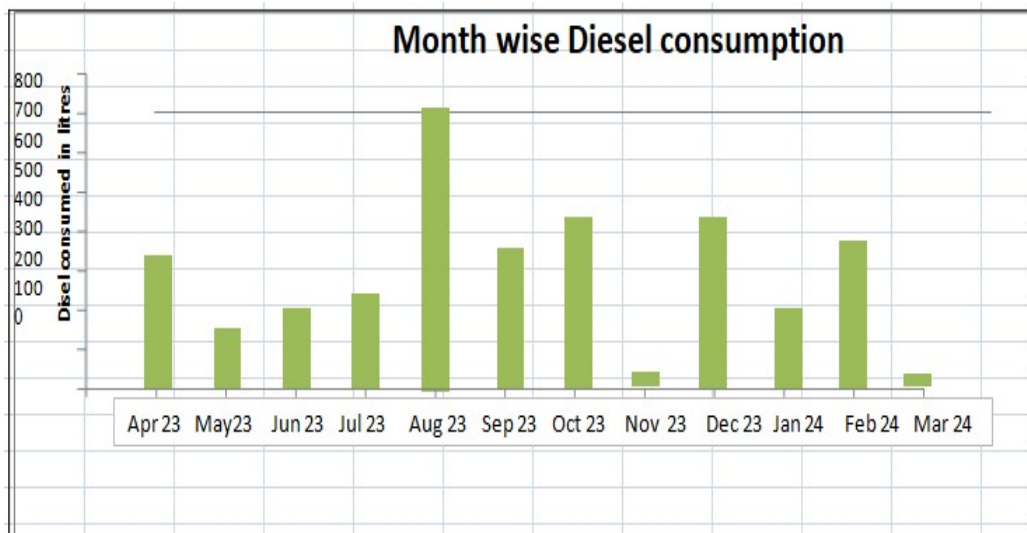
Energy consumption is found to be lower during the month of **December and January**, which could be due to lower energy requirements for air conditioners. The peak energy consumption is during the month of **June 2023-24** in which **21312 kWh** was consumed.

The energy cost varies directly in proportion to energy consumed. The energy bill consists of two components. **The variable component which depends on the energy consumed determines the energy cost. The fixed component is to be paid at the rate of Rs. 120/kW for a connected load of 110 kW.** This to be paid every month as fixed charges.



2.3 DIESEL GENERATING (DG) SETS

The plant is equipped with one DG set of 250 kVA. It is used in times of power cuts and power shortage. There is **no metering and monitoring of electrical energy generated from DG set**. However the diesel consumption is monitored and the annual consumption is around **3517 litres amounting to Rs. 2.5 lakhs**. The month wise diesel consumption is given in the figure below.



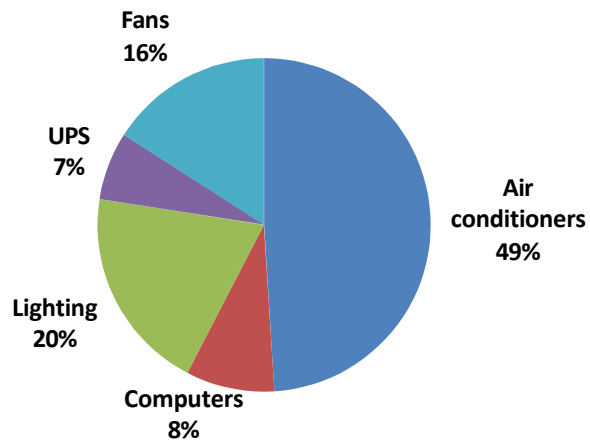
2.4 ENERGY BALANCE

Energy balance entails analysis of the site's energy use, identifying the sources of energy, determining the amount of the energy supplied and detailing what the energy is used for. The power measurements have been taken for various loads and based on this an energy balance has been made. The energy balance details are shown in the following figure.

Sr.No.	Equipments	Watts	Number	Approx. Operating hrs	Watts	Load factor	kWh/day
1.	Air conditioners						
	A/c 1.5 & 3.5 ton	3.5 ton	63	8	4000	0.1	201.6
	S	1.5	50	8	2000	0.1	80
	Split AC	2 ton	20	8	2500	0.1	40
	Celing mounted Cassette		6	8	5000	0.1	24
	Window AC		7	8	2000	0.1	11.2
2.	Tube	0	0	0	0	0	0
3.	Ceiling Fan	60	310	8	60	0.7	104.16
4.	Exhaust Fan	0	0	0		1	0
5.	Tube Lights	40	560	8	40	0.6	107.52
6.	LED bulb	40	26	8	40	1	8.32
		30	30	8	30	1	7.2
		100	62	8	100	0.6	29.76
7.	Table/pedestal fan	60	64	8	60	0.7	21.504
8.	Lamp	0	0	0		1	0
9.	Incandescent bulb					1	0
10.	Any other loads.. Computer, Printer, Projector, Laptop, Scanner, CCTV, Biometry Machine, Xerox machine, Router, LED TV, Amplifier,						
	Printer		17	8	200	0.05	1.36
	UPS	20 KVA	1	8	1000	1	8
	UPS	15 KVA	2	8	750	1	12
	UPS	10 KVA	1	8	500	1	4
	UPS	5 KVA	4	8	250	1	8
	Servo stabilizer	15 KVA	1	8	750	1	6
	Servo stabilizer	3 KVA	2	8	150	1	2.4
	Computers	20 Watts	407	8	20	1	65.12
	Canon IR ADVV Printer and copier	20 Watts	9	8	20	0.2	0.288
	CCTV DVR	850 Watts	3	8	850	0.2	4.08
	CCTV NVR	750 Watts	2	8	750	0.3	3.6
Total average energy consumption per day							750.112

The energy balance shows the dominance of Air conditioners which turns out to be energy guzzlers. They consume 49% of the total energy consumption. Lighting and fans also account for a significant portion of the energy consumed. The summary of the energy balance is shown in the following figure.

Energy Balance 750 (kWh/day)



Energy Conservation Opportunities

31 INCREASE TEMPERATURE SETTING OF AIR CONDITIONERS TO 25°C

Maximum energy is consumed by the air conditioners in the campus. The energy consumption of the AC's is very sensitive to the set temperature. Increasing the air-conditioner temperature setting by just 1°C can save about 6 per cent of electricity consumption, according to the Bureau of Energy Efficiency. A temperature of 25°C is sufficient to satisfy human comfort as per International stands. An increase from 21°C to 25°C will result in 24% saving in energy consumption. Hence it is suggested to maintain a set temperature of 25°C in all the air conditioners throughout the campus.



High energy guzzling window air conditioners.

Split air conditioners without any star rating.

Energy consumption for Air conditioners per day	370 kWh
Percentage energy savings by raise in the set temperature from 21°C to 25°C	24%
Annual energy savings	24% x 370 x 22 days x 12 months
	23760 kWh/year
Annual monetary savings	23760 x 7.50
	Rs. 1,78,200

32 REPLACE 40 W FLOURESCENT TUBELIGHTS BY 26 W LED TUBELIGHTS

AJET has already installed a number of LED tube-lights in an effort to save energy. However there are still 560 nos. of 40 W tube-lights which consumes twice the energy needed for conventional tube-lights. It is suggested to replace these lamps by 26 W LED tube-lights as and when the existing tube fails.

Energy consumption for 40 W FTL lamps	107 kWh
Energy consumption by replacing existing lamps with 26 W LED.	$107 \times 26/40$
	70 kWh
Energy savings per day	$107 - 70 = 37$ kWh
Annual energy savings	37 kWh x 22 days x 12 months
	9768 kWh/year
Annual monetary savings	9768×7.50
	Rs. 73,260
Investment	Rs. 70,000
Payback period	12 months

Classroom with adequate natural lighting Use of 40W lamps in classrooms

33 REPLACE EXISTING CEILING FANS BY ENERGY EFFICIENT BLDC FANS

AJET has 310 nos. of ceiling fans each of 60 W capacity. The energy consumption of ceiling fans is 104 kWh/day. It is suggested to replace the existing fans by more efficient Brush Less Direct Current (BLDC) fans which will consume only 26 W. Since the payback period is very high, only selected fans which are continuously in operation may be replaced initially.

Energy consumption for existing fans	104 kWh
Energy consumption by replacing existing fans with 26 W BLDC fans	$104 \times 26/60$
	45 kWh
Energy savings per day	$104 - 45 = 59$ kWh
Annual energy savings	59 kWh x 22 days x 12 months
	15,576 kWh/year
Annual monetary savings	$15,576 \times 7.50$
	Rs. 1,16,820
Investment @ Rs.3000 per fan	Rs. 9,30,000
Payback period	108 months

34 INSTALL A 60 KW SOLAR POWER PLANT IN THE TERRACE OF THE BUILDING

In order to promote the use of green energy, many establishments have installed solar PV systems. A IET campus has adequate roof space to accommodate a 60 kW solar power plant. The system can be online with net metering or it can be connected to the LT side of the campus electrical network.

Average energy generation per kW of solar PV	4 kWh per day
Potential for energy generation with a 60 kW power plant.	$60 \times 4 = 240$ kWh/day
Annual energy savings	$240 \text{ kWh} \times 22 \text{ days} \times 12 \text{ months}$
	63,360 kWh/year
Annual monetary savings	$63,360 \times 7.50$
	Rs. 4,75,200
Investment @ Rs.60,000 per kW	Rs. 36,00,000
Payback period	91 months

Electricity bill details

Reading taken Date	Reading	Used Unit	CC Charges (Rs.)	Other Charges (Rs.)	Bill Amount (Rs.)	Total Bill Amount (Rs.)	Bill Paid	Payment Date
30-05-2019	43918.6	19116	143370	14068.5	157439	157439	157439	19-06-2019
29-06-2019	44451.4	21312	159840	14904	174744	174744	174744	08-07-2019
30-07-2019	44959.5	20324	152430	16078.8	168509	168509	168509	03-08-2019
29-08-2019	45467.6	20324	152430	17606.1	170036	170036	170036	04-09-2019
30-09-2019	45955.9	19532	146490	14239.5	160730	160730	160730	11-10-2019
31-10-2019	46363.6	16308	122310	28523.7	150834	150834	150834	16-11-2019
30-11-2019	46713	13976	104820	12078	116898	116898	116898	09-12-2019
30-12-2019	46903.9	7636	57270	9637.5	66908	66908	66908	07-01-2020
31-01-2020	47104.1	8008	60060	9789	69849	69849	69849	07-02-2020
28-02-2020	47352.5	9936	74520	10506	85026	85026	85026	04-03-2020
28-03-2020	Previous	Assessment	Amount	Billed	85026	85026	85026	21-04-2020

Abbreviations

1. kVA- Kilo Volt- Ampere
2. kW- Kilo Watt

3. HT- High Tension line
4. kVAr- Kilo Volt- Amperes- Reactive
5. APEPDCL - Andhra Pradesh Eastern Power Distribution Company Limited (APEPDCL)
6. LED- Light Emitting Diode
7. BLDC- Brush Less Direct Current