



7.1 Institutional Values and Social Responsibilities

7.1.6 Quality audits on environment and energy are regularly undertaken by the institution

TABLE OF CONTENTS

Sl. No.	Contents	Page No.
1	Policy Document	2-5
2	Energy Auditing Report 2019	6-45
3	Green Auditing Report 2019	46-83
4	Energy Auditing Report 2017	84-143



**Viswajyothi College of Engineering and Technology
Vazhakulam, Muvattupuzha**

POLICY DOCUMENT ON ENVIRONMENT & GREEN ENERGY USAGE

A	Original	July 2020	
No.	Revisions	Date	Approved

		VJCET	NSS	2020	05	REV-A
--	--	--------------	------------	-------------	-----------	--------------

	Names	Designation	Sign	Date	Distribution : 1. All Authors 2. All HODs & Deans 3. Vice Principal 4. Principal 5. Director, VJCET 6. Manager, VJCET
Prepared	Mr. Santhanu P. Mohan	Asst Professor, ITD		22/09/2020	
	Mr. Aneesh Kurian	Asst Professor, EED		22/09/2020	
	Dr. Anu George	Associate Professor, MBA		24/9/2020	
Checked	Dr. Anoop C K	Professor, CED		28/9/2020	
Approved	Dr K K Rajan	Principal, VJCET		28/9/2020	

Summary

The policy on the Environment & Green Energy usage of Viswajyothi College of Engineering and Technology is covered in this document.



POLICY DOCUMENT ON ENVIRONMENT & GREEN ENERGY USAGE

The Environment and Green Energy usage Policy of Viswajyothi College of Engineering and Technology is to manage energy in such a systematic way so as to minimize its impact on the environment. The policy implies to explore the renewable energy resources to reduce the burden of the government and to find out substitute natural resources as solutions to the energy crisis.

This environment and energy policy is binding for all the components of the institution and applies to all its stakeholders and to the various activities undertaken by the institution. It will help us to embed efficiency and environmental awareness into our everyday activities, thus helping us to realize our responsibilities and commitment to conservation of natural resources and to limit its usage. The **Enviro Club**, an official platform devoted to the cause of environmental awareness, to undertake green initiatives, and to conduct green literacy programmes to save energy and to protect the environment.

Policies:

- To assess our energy usage and measure its impact on the environment.
- To count CO₂ emissions generated by our means of transportations-vehicles.
- To reduce local air pollution emissions using environment-friendly vehicles, including bicycles, public transportation and use of pedestrian-friendly roads.
- To install photovoltaic solar panels for the generation of alternate energy.
- To install LED bulbs in the complete campus to save energy.



- To develop systematic waste management mechanism.
- To develop rain water harvesting unit.
- To undertake tree plantation drive.
- To take additional measures to continuously improve our energy consumption.
- To develop and maintain an environmental management system.
- To ensure the availability of necessary resources to achieve our objectives.
- To encourage use of advanced technology to minimize energy consumption, atmospheric emissions and noise, particularly from our vehicle fleets.
- To engage in dialogue with the government agencies, municipal corporation and the affiliating university and actively work with the local organizations in the areas of environment, energy efficiency and sustainable development.
- To monitor and respond to emerging environmental and energy issues. To strengthen our employees' and students' environmental knowledge and skills in order to improve our own environmental performance.
- To provide information and training opportunities on energy saving measures.
- To offer opportunities for employees and students to engage in initiatives those contribute to environmental protection.
- To train our employees and students through our Enviro Club to make them **'Go Green Specialists'** and partners to plant trees each year.



This policy will be communicated to the students and employees via internal communication channels, and will be made available to all the stakeholders on the institutional website. The Environment and Energy Policy, objectives and targets will be reviewed on a regular basis by the Enviro Club Convener and its members under the guidance of the Principal of the college.



VISWAJYOTHI

COLLEGE OF ENGINEERING & TECHNOLOGY

Approved by AICTE New Delhi & Affiliated to APJ Abdul Kalam Technological University

Vazhakulam P.O., Muvattupuzha
Ernakulam Dist., Kerala - 686 670
Tel: 0485 2262211 / 44
Email: vjcet@vjcet.org
www.vjcet.org



UNDERSTANDING ELECTRICITY BILLS

at

**VISWAJYOTHI COLLEGE OF ENGINEERING AND
TECHNOLOGY**

VAZHAKULAM

DETAILED STUDY ON ENERGY SAVING OPPORTUNITIES & RECOMMENDATIONS FOR REDUCED ELECTRICITY EXPENDITURES



ACKNOWLEDGEMENT

I express my deep sense of gratitude to the management of Viswajyothi College of Engineering and Technology for providing me with the necessary facilities to carry out this study on energy conservation measures in the Campus.

I am thankful to the staff of the Department of Electrical and Electronics Engineering for their co-operation and assistance in conducting the equipment survey and collection of data.

I thank all other staff of VJCET who have associated with me during the course of this work.

I greatly appreciate the services of Er. Unnikrishnan Nair C.K and Er. Ansal Meeran, other members in the team, all throughout this assignment

Baby John



EXECUTIVE SUMMARY

The electricity expenditures of Viswajyothi College of Engineering and Technology (VJCET) are on the rise and the monthly demand notice from KSEBL is seen to have crossed Rs 6 lakhs. The management wants to adopt cost saving measures to reduce the above expenses which has necessitated this study.

A detailed study on the above was conducted in the campus. The study included scrutiny of electricity bills for the preceding twelve months, detailed load survey, consumption pattern, operations and operating hours of equipments and devices, status of maintenance etc. The major potential areas identified for energy savings are Air Conditioning, Lighting and Pumping systems.

The available data from offices, measured data and other primary data gathered through personal interviews with the concerned personnel have been made use for analysis. Based on the analysis, a set of recommendations has been given for each of the key energy saving potential areas.

Sample rectification works with respect to Air Conditioning and lighting systems were carried out at the Common Computing Centre and the results noted are highly encouraging.

On implementation of the recommendations, the expected reduction in Maximum Demand and energy consumption is around 20%. This can result in a monthly cost saving of approximately Rs 90,000/- on an investment cost of around Rs 6 Lakhs with a pay back of 7 months.



TABLE OF CONTENTS

Acknowledgement

Executive summary

		Page
I	Introduction	1
II	Preliminary studies	2
III	Bill analysis	3
IV	Air conditioning systems	9
V	Lighting systems	17
VI	Pumping	22
VII	Other connected loads	27
	Fans	
	Exhaust Fans	
	Computer systems	
	LCD projectors	
	Printers	
	Photocopiers	
	UPS	
	STP	
	Water coolers	
VIII	Diesel Generators	32
IX	Conclusion	36



I

INTRODUCTION

VJCET is a High Tension(HT) consumer of Kerala State Electricity Board Ltd (KSEBL). The normal feeding of electric supply to the campus is from a 315 KVA distribution transformer. The campus includes A,B,C and D blocks, workshops, laboratories, men's hostel, ladies hostel, library, auditorium, pump house, sewage treatment plant, incubation centre and startup hub. The total connected load in the campus is 842.906 kW.

The main KSEB supply is supported by a standby power supply system consisting of 100 KVA, 200 KVA and 320 KVA Diesel Generator(DG) sets. 200 KVA DG set is in AMF mode and others are in manual mode. A 50 kWp solar system is connected to the LT grid and the works of an additional 200 kWp solar project are in progress.

The consumption of energy in the campus is found to be on an increasing trend resulting in huge electricity bills. Hence a detailed study was required on the connected load and consumption patterns exploring possibilities for energy savings and subsequent reduction in bills.



II

PRELIMINARY STUDIES

As part of preliminary works, the electricity bills for the preceding 12 months were collected and peripheral scrutiny was done followed by a campus visit to all locations where there is electric connection. The electrical installations and equipments were inspected with respect to the connected load, operational features and hours of operation. The visit included 315 KVA transformer station, Main Switch Board(MSB), DG sets, workshops, canteen, sewage treatment plant, pumping stations, auditorium, , ladies hostel, men's hostel and A,B,C,D blocks(staff rooms, class rooms, offices, library, laboratories etc).

Based on the visit, observations and preliminary data collected from records and discussions with relevant personnel, an attempt was made to identify the potential areas where the peak loads and energy consumption could be reduced.

Accordingly, the following areas were identified where there was significant consumption of energy and potentials for improvement and reduction in peak demand and energy consumption which could give immediate results with minimum expenditure.

1. Air conditioning system
2. Lighting system
3. Pumping system

The above three areas were revisited for detailed inspections, measurements of various parameters, identification of defects and for gathering additional data for analysis and recommendations leading to savings in consumption and cost.

There is scope for improvements and savings with respect to other connected loads but the investments are high and the payback periods are expected to be more and hence proposed to be taken up in a phased manner as per availability of funds.



III

BILL ANALYSIS

Tariff

The present tariff of VJCET is HT II(B) General with Consumer No 1355910001283. The billing is done on a two part tariff, one part for capacity (demand) drawn in KVA and the other part for actual energy drawn in KWh. The structure of billing is as follows,

There is a fixed rate for the maximum demand in KVA (Rs 400/KVA, now revised to Rs 440 KVA with effect from 8.7.2019). Maximum Demand (MD) is the average (time integrated) of the peak load (MD) for a time interval of half an hour registered during the month which is dependent on the real time loads (KVA). This MD is reset at the end of every billing cycle. The consumer is to pay for this MD even if it has occurred only once in a recording cycle of 30 minutes during the whole month. The energy charges (in KWh or units) are based on the actual consumption of energy which is $KW \times \text{time (hours)}$. The hours of operation has been categorized into three zones in a day of 24 hours,

Zone	Time	Tariff	Rate (Rs/ unit)
1	6 am to 6 pm	Normal	7.2
2	6 pm to 10 pm	150% of normal	10.8
3	10 pm to 6 am	75% of normal	5.4

There is another element 'power factor' dependent upon the reactive power in the system, which is the ratio of KW (active power) to KVA (apparent power). The desired ideal power factor is 1. As per existing tariff, there is incentive for power factor (pf) > 0.90 (revised to > 0.95 with effect from 8.7.2019) at the rate of 0.5% of the energy charge for each 0.01 unit increase in power factor from 0.90 (revised to 0.95 with effect from 8.7.2019) onwards. A penalty of 0.5% of the energy charges is imposed for each 0.01 unit fall in power factor from 0.90 (revised to 0.95). Besides, electricity duty @ 10% is being levied with respect to energy charges and electricity surcharge @ 0.025% on actual energy consumption.



The consumer enters into an agreement with the supplier (KSEBL) on the anticipated maximum demand which is known as contract demand. Consumer is to pay penalties if the MD exceeds this contract demand at half the rate of fixed charge for additional KVA besides payment for actual KVA. The consumer need pay only for the recorded MD if it is within 75% of the contract demand and if below, for 75% of contract demand.

Demand notices received from KSEBL for the months from July 2018 to June 2019 were scrutinized in detail to assess the peak demands, energy consumptions, power factor status, incentives and penalties based on power factor, zone wise (time of day) consumption pattern, the active loads during the various time zones and the deviation in MD from the Contract Demand (as per HT agreement), MD and energy charges as per the tariff rates. The details of demand notices from KSEBL are given below;

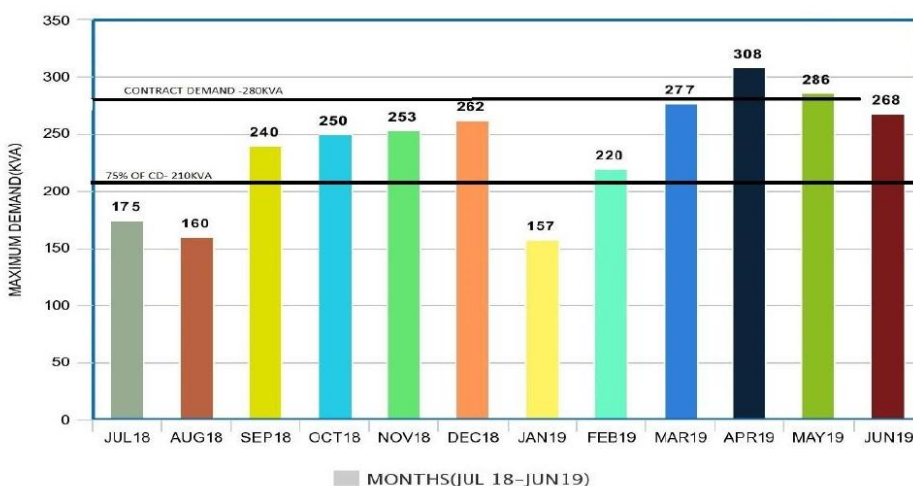
Month	Demand Zone wise (kVA)	MD (kVA)	Units consumed (KWh)	Total kWh	Power factor	Bill amount (Rupees)
July 2018	Z1-175 Z2-67.4 Z3-60	175	Z1-18696 Z2-5516 Z3-9752	33964	0.99	344130
Aug 2018	Z1-160 Z2-65.73 Z3-58	160	Z1-19992 Z2-5872 Z3-9432	35296	0.99	357381
Sep 2018	Z1-240 Z2-122 Z3-71.65	240	Z1-21844 Z2-6776 Z3-10756	39376	0.98	401844
Oct 2018	Z1-250 Z2-143 Z3-117	250	Z1-36480 Z2-9736 Z3-14860	61076	0.99	583379
Nov 2018	Z1-253 Z2-121 Z3-98	253	Z1-34688 Z2-9164 Z3-14692	58544	0.99	563050
Dec 2018	Z1-262 Z2-125 Z3-93	262	Z1-35780 Z2-8852 Z3-13988	58620	0.99	567392



Energy conservation at VJCET | 2019

Jan 2019	Z1-157 Z2-113 Z3-79	157	Z1-21372 Z2-7592 Z3-12764	41728	0.99	406604
Feb 2019	Z1-220 Z2-97 Z3-76	220	Z1-22560 Z2-7504 Z3-12728	42492	0.97	419353
Mar 2019	Z1-277 Z2-116 Z3-105	277	Z1-36352 Z2-9336 Z3-19592	60584	0.90	601547
Apr 2019	Z1-308 Z2-143 Z3-111	308	Z1-40652 Z2-10720 Z3-17664	69036	0.98	664613
May 2019	Z1-286 Z2-128 Z3-89	286	Z1-35304 Z2-8232 Z3-14332	57868	0.98	565708
Jun 2019	Z1-268 Z2-130 Z3-98	268	Z1-35964 Z2-9752 Z3-16648	62364	0.99	591615

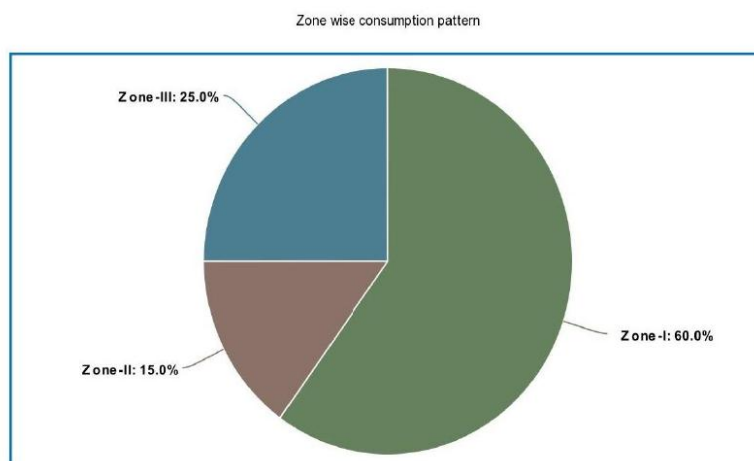
In the case of VJCET, the total connected load is 842.906 kW. The contract demand is 280 KVA, 75% of contract demand is 210 KVA. On scrutiny of the bills MD has exceeded Contract Demand(CD) in the months of April and May 2019.





MD is below 75% of CD in the month of July and Aug 2018. Average monthly energy consumption is 56757 units. Average monthly consumption pattern for three zones is given below,

Zone 1	60% (6am to 6pm)
Zone 2	15% (6 pm to 10 pm)
Zone 3	25% (10pm to 6am)



The identified major loads in the three zones are,

Z-I --- A/C, computer systems, lighting, fan, STP, water coolers, pump, projectors,

UPS etc

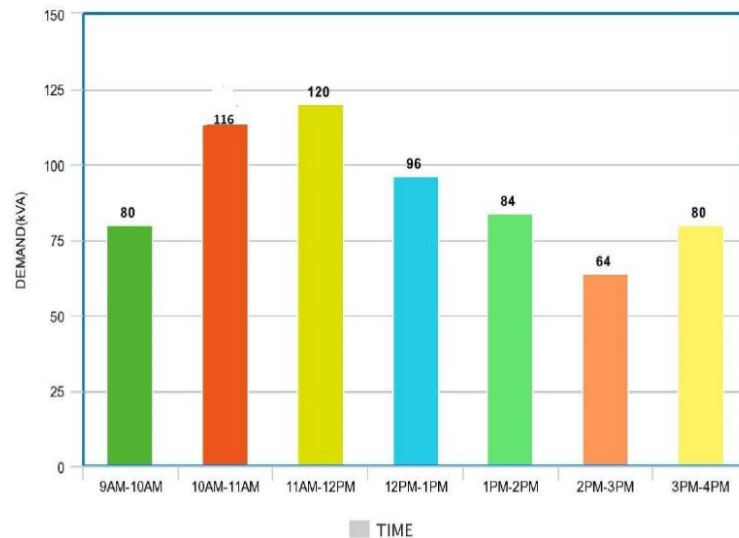
Z-2 --- Fans, lighting, STP, UPS, A/C (part) etc

Z-3 --- Fans, street lighting, STP, UPS, A/C etc

The MD is seen to occur during zone 1 (6 am to 6 pm) all throughout the year. Power factor is maintained all throughout between 0.98 and 0.99 except during the month of March 2019 (0.9).



The exact time duration of the MD in zone 1 could not be ascertained since no such recordings are available. Readings were taken on 02/07/2019 to assess the period with the present operating loads and the MD is seen to be between 11 am and 12 noon.

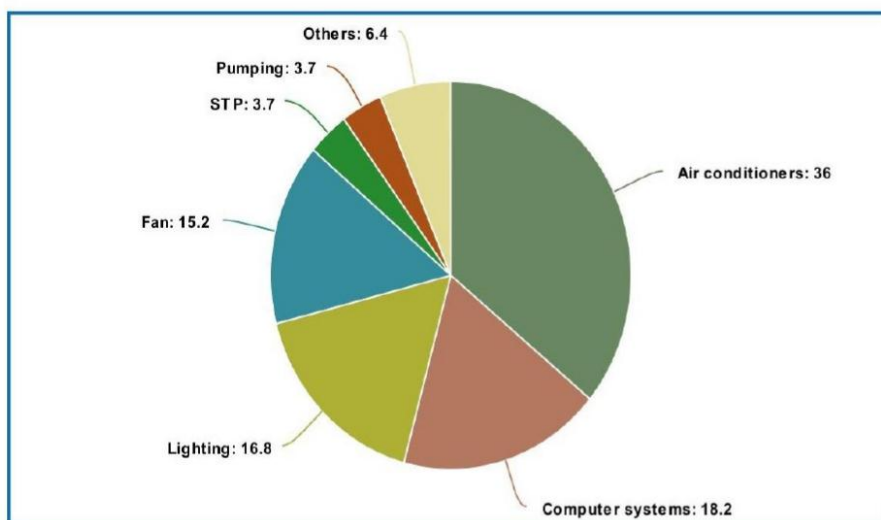


But more accurate assessment can be made only once the institution is fully functional. Since both MD and consumption fall in zone 1, it is suggested to take hourly readings of KVA and KWh recorded in the HT meter between 9am and 4pm to monitor the peak loads and energy consumption so as to take possible controls to minimize MD and consumption.

Maintaining the MD without exceeding the contract demand as well as reducing the MD to 75% of CD will be beneficial to the institution by way of savings in MD charges. Further, reduction in MD will contribute to reduced energy charges over hours of consumption.



Connected load



Air conditioning system constitutes 36% of the total connected.

About 18.2% of the total connected load is computer systems.

Lighting system (142 kW) is 16.8% of the total connected load.

Fans contribute 15.2 % of the total connected load.

STP which works most of the hours contribute 3.7% of the connected load

Other 6.4% includes printers, photo copiers, projectors etc



IV

AIR CONDITIONING SYSTEM

There are 86 nos of air conditioners in the whole campus with a total tonnage of 241.5T equivalent to 301.875 kW. This is around 36% of the total connected load. The average monthly energy consumption is estimated to be 22500 units amounting to Rs 162000/- which is 39% of the total consumption. Tonnage of A/Cs varies from 1 ton to 8.5 ton. It is gathered that 66 nos of A/Cs with 209 ton (261.25 kW) are in regular use. Block wise details are furnished below,

Block A

Location	No of A/Cs with make	Tonnage	Total kW
A304 Network system lab	2 - Carrier (duct)	8.5 ton and 5.5 ton	17.5 kW
A303 Micro processor lab	1 - carrier (duct)	5.5 ton	6.8 kW
A302 Multimedia lab	2-Panasonic (tower)	3.5 ton	8.7 kW
A204 Hardware lab	3-Blue star (tower)	3.5 ton	13 kW
A202 Programming lab IT	1-Blue star (split) 1-Blue star (tower)	3.5 ton and 3 ton	8.1 kW

Block B

Location	No of A/C with make	tonnage	Total kW
B104 DBMS Lab	2-Blue star (spilt)	3 ton	7.5 kW
B 303 Computer lab	2-Blue star (split)	3 ton	7.5 kW
B 302 Systems lab	3-Blue star (split)	3 ton	11.25 kW
B308 Communication lab 1	2-Blue star (tower)	4.5 ton	11.25 kW
B309 Communication lab 2	2 units of Blue star tower	4.5 ton	11.25 kW



Energy conservation at VJCET | 2019

B 208 Circuit lab 1	1-Hitachi (split)	3.5 ton	4.3 kW
B 209 Circuit lab 2	1-Hitachi (split)	3.5 ton	4.3 kW
B 205 IC lab	1-Hitachi (split)	3.5 ton	4.3 kW
FAB LAB	1-Blue star (tower)	4 ton	5 kW
R&D computer lab	1-Blue star (tower)	4 ton	5 kW

Block C

Location	No of A/C with Make	tonnage	Total kW
C315 Common computing center	2-Blue star (tower) 2-Blue star (split)	3.5 ton 3 ton	15 kW
C 315A Project lab	2-Blue star (tower)	3.5 ton(2)	8.7 kW
C214 Language lab	2-Panasonic (tower)	3.5 ton(2)	8.7 kW
C PTC Seminar hall	3-Blue star (tower)	4 ton(3)	15 kW
C303 Computer lab	2-Blue star (tower)	4 ton(2)	14 kW
C202 Principal room	1-Samsung (split) 1-Mitsubishi(split)	1.5 ton each	3.7 kW
Director room	2-General (split) 1-Hair (split)	2 ton(2), 1 ton	6.25 kW
Manager room	1-Samsung (window)	1.5 ton	2.5 kW

Block D

Location	No A/C with make	tonnage	Total kW
D113 MBA Computer lab	2-Panasonic (tower)	3.5 ton each	8.7 kW
D306 VLSI Lab	1-Blue star (tower)	4.5 ton	5.6 kW
D407 Computer Application lab	2-Panasonic (tower)	3.5 ton each	8.75KW



Energy conservation at VJCET | 2019

D 402 Project lab CSE	2-Blue star (tower)	4.5 ton each	11.25 kW
D 304 PG lab CSE	2-Blue star (tower)	4.5 ton each	11.25 kW
D404 Embedded systems lab	1-Blue star (tower)	4.5 ton	5.6 kW
D419 Software lab	1-Voltas (split)	2 ton	2.5 kW
D116 GD Room	1-Samsung split 1-Mitsubishi split	2.5 ton 1 ton	4.3 kW

Startup Hub

Location	No of AC with make	Tonnage	Total kW
Room 01,02	1-Mitsubishi(split)	2 ton	2.5 kW
Room 03,04	1- Mitsubishi(split)	2 ton	2.5 kW
Room 06	1-voltas (split) 1-carrier(split)	1.5 ton, 2 ton	4.3 kW
Room 05	1- Voltas (split)	1.5 ton	1.8 kW
Room 07	1-Voltas(split)	1.5 ton	1.875 kW
Room 08,09	1-Voltas(split)	1.5 ton	1.875 kW

Other 20 nos. of A/Cs with 32 ton (40kW) are occasionally used,

<u>Location</u>	<u>Nos with ton</u>
1. KTU Exam center	4 - 7 ton (C block)
2. Suite rooms	6 - 7 ton (B and D blocks)
3. Library	1 - 3.5 ton (C block)
4. Treasurer room	1 - 2 ton (C Block)
5. Conference hall	1 - 4 ton(C block)
6. Joint secretary	1- 1.5 ton (D block)
7. Hostels	6-9 ton
Total -----	20 Nos—32 ton



66 nos of A/Cs in regular use are only considered for detailed study. Most of the A/Cs are seen to be not properly maintained. Heavy infiltration of heat is noticed in all air conditioned spaces due to poor thermal insulations. The outdoor units of A/Cs are clogged with heavy dust and the compressors are heavily loaded. The thermal insulations on the suction pipes are either fully or partially damaged. The set temperature in most of the A/Cs is very low (say 18°C) and without remote controls. Heavy dust deposits were seen on the indoor air filters as well as on air blowers. There was no thermal cutoff in most of the cases. The above factors have contributed to excessive peak demands and energy consumption.

The details of **observations** are given below,

1. The cooling fins, air filters, blowers condensers etc covered with heavy deposit of dust
2. The refrigerant pipes and end caps are not properly insulated
3. No thermal cutoff is seen even at higher temperatures in most of the air conditioned rooms.
4. The indoor air filters as well as air blowers and the outdoor units are clogged with heavy dust
5. No proper thermal insulations for the lab rooms.
6. All glass windows are not properly heat insulated
7. Remote controls are not properly maintained.
8. The curtains provided in AC rooms are corrugated/vertical blinds, not effective for AC rooms.
9. Non standard placement of outdoor units on sloping sun shades where proper maintenance cannot be carried out
10. Openings, opened doors and windows, removed curtains etc are noticed in many AC rooms.
11. Set temperatures are seen very low (18°C) in many rooms
12. The Carrier make duct unit 5.5 ton in A304 is not working
13. Door closer is not provided for A204
14. The outdoor unit Carrier 8.5t (duct) unit in A304 is exposed to rain water from the roof (corrosion and formation of large hole in the bottom part of outdoor unit)
15. Two nos of LG split A/Cs in the programming lab are not functional.
16. The air filter of A/C in D 402 is clogged with heavy dust
17. Broken glass windows in D 402 and D419
18. 1 no A/C (split) in CCC is not working



19. Neither sun control film nor curtains are provided on the glass partitions of Common Computing Centre(CCC)
20. 1 no Blue star(3.5 ton) tower A/C in CCC is delivering hot air
21. Water precipitation is noticed on the outdoor pipes of A/C in the server room
22. The A/C in C 221 is old window type
23. The outdoor unit of AC near the office room is air congested
24. No door closer is provided in PTC seminar hall
25. Heavy corrosion is noticed on the outdoor units of A/Cs in the PTC seminar hall which is located on the ground
26. The A/C in B 209 is not working properly.
27. The condensate water from the unit is not properly drained out in DBMS lab
28. Insufficient cooling in B 303

The above defects and shortfalls lead to increased energy consumption by way of continuous working of A/C units and contributing to high peak loads.

Recommendations

1. Cleaning and overhauling of indoor and outdoor units to be carried out periodically
2. Top up refrigerant if required on checks
3. Provide plain white curtains with no corrugation for all windows of A/C rooms.
4. Proper covering is to be provided for the 8.5 ton outdoor unit near the network system lab. The hole is to be plugged with a water proofing material.
5. Set temperature for air conditioned space to 24°C and above preferably
6. Provide sun control films to glass doors, glass partitions wherever air conditioned
7. It is proposed to replace the existing spilt A/C(2 ton) in server room with a 1 ton inverter A/C for better efficiency
8. Provide door closers to A/C rooms wherever not provided.
9. The refrigerant pipes of A/Cs are to be properly insulated wherever damages noticed.
10. Replace the outdoor unit of A/C(General make) near office to the open area for better air circulation



11. Proper covering is to be provided for the outdoor unit of A/Cs in PTC seminar hall.
12. The condensate water from the A/C Unit in DBMS lab is to be properly drained
13. Consider re arrangement of A/C labs, if feasible, for an even distribution in FN and AN to flatten the load curve.
14. Replace broken glasses in D402 and D419
15. Provide remote controls to get a better control over A/C working temperature.
16. Provide sufficient spacing and structure for outdoor units to facilitate proper maintenance
17. Never keep windows and doors open and curtains removed when AC is in use
18. Replace the window A/C with 1 ton split A/C
19. Reposition the outdoor units of 6 nos of A/Cs in A and B blocks, to free open areas for better performance and reductions in load.
20. Maintain proper asset register and maintenance register for A/Cs
21. Feasibility of reducing the working hours of CCC by 2 hours to 6 pm can be thought of in order to reduce the peak energy charges
22. Wherever no computer systems are in use and minimal internal heat generation, avoiding A/Cs can be thought of by providing fans, if not.

The notified locations are,

1. A303- Microprocessor lab(1 no 5 ton)
 2. B208 – Circuits lab I (1 no 3.5 ton)
 3. B 209 – Circuit lab(1 no 3.5 ton)
 4. B 205- IC lab (1 no 3.5 ton)
 5. C 112 –PTC seminar hall (3 nos 4 ton)
 6. D 306 –VLSI lab (1 no 4.5 ton)
- 23) Check the effectiveness of thermal insulations for rooms and refrigerant pipings, thermal cutoff of A/C units, dust deposition on air filters, temperature settings, positioning of curtains once in three months and carryout routine maintenance at least once in six months which includes cleaning of outdoor units and pressure checks on refrigerant pipes.



24) On completion of rectification works, reducing the number of AC units can be considered in the following locations based on the cooling results obtained in CCC.

1. Hardware lab A 204- one out of three units ($3 \times 3.5T$)
2. B 202- Systems lab-one out of 3 units($3 \times 3T$)
3. B 309-communication lab I- one out of 2 units($2 \times 4.5T$)
4. B 208-Communication lab II- one out of two units($2 \times 3.5T$)
5. C 315-Common computing center- one out of four units($2 \times 3.5 + 2 \times 3$)

Sample rectification works were carried out in the Common Computing Centre in consultation with the management to evaluate the performance and the results are highly encouraging. The major works carried out are cleaning of indoor and outdoor units of AC's, providing thermal insulation in the suction pipes, providing heat retardant white curtains without corrugations for windows, closing of openings on walls, replacing the existing lighting system with less wattage LED sets etc



DUST DEPOSITS ON AIR BLOWER(CCC)



DUST DEPOSITS ON AIR FILTER(CCC)



DUST DEPOSITS ON OUTDOOR COOLING FINS



TYPICAL INSULATION FAIL(NEAR OFFICE)



Calculations on savings and paybacks

Active tonnage of A/Cs for 66 nos = 209 T

Proposed reduction in tonnage for 13 nos = 50.5 T

Assuming 0.98 power factor, equivalent KVA = 64

Taking 36% of contract demand as contribution of A/C loads to MD,

A/C contribution to MD = 100 KVA

Reduction in MD on account of 63 KW reduction in A/C LOAD = $100 \times (64/266)$
= 24.5 KVA

24 KVA is taken as savings in MD

a) Savings in MD charges = 24×440 = Rs 10560/-

Contribution of A/C loads (261 KW) towards monthly energy consumption
= 22500 units (estimated based on consumption pattern)

Reduction in energy charges for 63 KW = $22500 \times (63/261)$
= 5431 units

b) Savings in energy charges = 5431×7.2 = Rs 39009/-

Assuming 20% savings in MD and energy consumption for the balance 76 KVA (100 KVA-24 KVA) on carrying out proper maintenance in A/Cs,
Reduction in MD = $76 \times 20/100$ = 15.2 KVA

Taking 15 KVA as reduction,

c) Savings in MD charges = 15×440 = Rs 6600/-

For an active load of 198 KW (266-63)

Estimated consumption = $(198/261) \times 22500$
= 17068 units

Taking 17068 units for 198 KW units as the monthly consumption

d) Savings in energy charges = $17068 \times 0.2 \times 7.2$
= Rs 24579/-

Total savings (a+b+c+d) = Rs 80748/-

Anticipated expenditure for implementation of proposals is approximated to
Rs 2 lakhs

Payback period = $200000/80748$
= **2.47 months**

Payback period (without disconnecting the 13 nos A/Cs) = $200000/31179$
= **6.47 months**



V

LIGHTING SYSTEM

Lighting is identified as a potential area to achieve energy efficiency and energy savings by replacing the existing lamps with energy efficient lamps, rearrangements and through good operational practices.

There are altogether 2482 fluorescent tubes and 1694 CFLs besides a few nos of LED lamps with a total connected load of 142 KW which approximates to 16.8% of the connected load. Based on the survey and data collected, the most frequently used and more consuming areas with an average hours of operation of six and above are laboratories, staffrooms, office, hostels, library, common lighting, sewage treatment plant, startup hub etc.

A detailed study of the lighting system in the above areas has shown that most of the lamps in use are T12 fluorescent tubes (40 W tube + 5 W choke) and a less no. of double CFL sets. The average illuminance in most of the areas is around 100 lux(measured). The operational practices are also seen poor, with many lights ON without any use. High efficiency, low power consumption for the same illuminance and long life of LED tubes and bulbs make them good substitute for the above.

Luminous performance characteristics

Type of lamps	Average lumens/ watt	Typical life(hours)
FTL tubes	50	5000
CFL	60	8000-10000
LED lamps	90	30000-60000

Even though there are many Fl. Tubes and CFLs in the lighting system inside the campus, the number of lamps with daily operating hours of six and above are considered for detailed analysis.

The details of the existing ones and the retrofit proposals are tabulated below,



Block	No of Fl. Tubes (40W+5W)	No of CFL (18W)	Location	Proposed No. of LED tubes (18W)
A	105	Nil	- A 202 Programming lab IT - A 205 Hardware lab - A 302 Multimedia lab - A 303 Microprocessor lab - A 305 Network systems lab	67
B	91	42(21 Double units)	- B 104 DBMS lab - B 204 Data communication lab - B 205 I C lab - B 208 Circuits lab 1 - B 209 Circuits lab 2 - B 212 R & D Computer lab - B 212 A FAB lab	112
C	27	100(50 double unit)	- C 112 PTC Seminar hall - C 124 Language lab - C 303 ME CAD lab - C 215 Common computing center - C 315 A Project lab - C 315 B Server room	80
D	35	84(42 double units)	- D 113 Computer lab MBA - D 304 P G lab CSE - D 419 Software lab - D 407 Computer applications lab - D 116 G D room	77
Staff rooms	121		All staff rooms in 4 blocks	121



Men's hostel	125		• Rooms • Mess hall • Kitchen • Other common lighting areas •	125
Ladies hostel	210		• Rooms • Mess hall • Kitchen • Other common lighting areas	210
Library	20		Common reading areas	20
office	16			13
Hub	50			50
STP	13			13
others	12		Street lighting and other common lightings	12

From the above, it is seen that 825 nos (40W tube+ 5W choke) of Fl. Tubes and 226 nos of CFLs(18W, 113 sets) can be replaced with 900 LED tubes as retrofits for the same area. Replacement of the present lamps with LED sets will also result in less heat dissipation in the air conditioned rooms which will reduce the A/C loads.

General observations are;

- 1) The general lighting system is not energy efficient and the performance is poor.
- 2) Many lights are seen kept ON without any use
- 3) Day lighting is restricted in most of the rooms by closed windows and curtains.



Recommendations

- 1) Replace the existing Fl. Tubes and CFLs as per tabulation with LED tubes without delay for immediate paybacks
- 2) Replace the balance nos with LED tubes and bulbs in a phased manner
- 3) Insist on forced switch offs in hostels especially during class hours.
- 4) Insist on switching off all lights when not in use through better operational practices.
- 5) Replace existing lamps in bathrooms, corridors, and other public areas with low wattage LED lamps.
- 6) All street lights and other common lightings are to be replaced with 18W LED lamps.
- 7) Garden lighting and other illuminations are to be minimized.
- 8) Promote day lighting in offices, staffrooms, classrooms etc by keeping windows open and curtains removed.
- 9) Conduct awareness program among all staff and students on energy conservation and better operational practices and review its effectiveness periodically
- 10) Keep proper registers for the installation and replacement of lighting fixtures with date of purchase, date of installation, location etc for proper follow ups and claiming warranties. Assign the job to somebody who will be responsible and accountable for all the activities.
- 11) Maximize the use of day light by using transparent roof sheets in workshops and labs near canteen area.
- 12) Replace all fluorescent tubes and CFLs which become faulty with low wattage LED sets.

Inorder to arrive at the benefits towards MD and energy charges, the following calculations on savings are made.

Calculations on savings and paybacks

$$\begin{aligned}\text{Total wattage of existing lamps} &= (825 \times 45) + (226 \times 18) \\ &= 37125 + 4068 \\ &= 41.193 \text{ KW}\end{aligned}$$

Based on the consumption pattern and on summation of consumptions of lightings in the above areas, the monthly consumption is approximated to 6600 units.



No of retrofit LED tubes = 900

Total wattage = $900 \times 18 = 16.2 \text{ KW}$

Estimated energy consumption = $6600 \times (16.2/41.93) = 2596 \text{ units}$

Anticipated contribution of lighting loads

towards Contract Demand = $280 \times 16.8 = 47.04 \text{ KW}$

Savings in KW = $41.2 - 16.2 = 25 \text{ KW}$

For reduction in MD, only half of savings in KW is considered since lighting loads pertaining to hostels, STP, common lighting and street lighting are only during non peak hours.

Half of 25 = 12.5 KW

Anticipated savings in MD = $47 \times (12.5/41.193) = 14.26 \text{ KW}$

At 0.98 power factor = 14.55 KVA

14 KVA is taken as the anticipated savings in MD

a) Monthly savings on MD charges = $14 \times 440 = \text{Rs } 6160/-$

Savings in consumption = $6160 - 2596$

= 4004 units

b) Monthly savings in energy charges = $4004 \times 7.2 = \text{Rs } 28828.8/-$

c) **Total monthly savings = Rs 34988.80**

Paybacks

Anticipated cost for LED = 900×260

= Rs 234000/-

Payback period = $\frac{234000}{34989} = 6.7 \text{ months.}$

The balance no of Fl. Tubes and CFLs with less hours of operation can be replaced with LED tubes and bulbs in a phased manner as per availability of funds and the payback period is estimated to be around 3 years.



VI

PUMPING SYSTEM

The main pumping station in the campus is located near auditorium adjacent to the ground water well. The motor pump sets in operation are,

- 1) 10 HP
- 2) 20 HP
- 3) 12.5 HP

A waste water pumping system near canteen consist of a 5 HP pump with a standby of 5 HP (which is installed but not energized).

Another pumping station is located outside the campus at Vallikada. Pumping is done from the river side well using a 12.5 HP submersible pump with a standby of another 12.5 HP pump.

Normal operation

As long as sufficient water is available in the ground water well near auditorium, pumping is done from the well to the 2.5 lakhs litres capacity main OH tank near ladies hostel and to the $5000 \times 3 = 15000$ litres capacity tanks at men's hostel. The tanks as listed below are fed by gravity flow from the main OH tank.

Ladies hostel $5000 \times 6 = 30,000$ litres

Men's hostel $\begin{cases} 5000 \times 4 \\ 1500 \times 1 \end{cases} = 21500$ litres

B,C and D blocks $5000 \times 4 = 20,000$ litres

Canteen $= 5000 \times 1 = 5000$ litres

The total pumped water is approximated to 3,41,500 litres/day. The $3 \times 5000 = 15000$ litres capacity tanks at Men's hostel (new block) are filled through diversions at the time of pumping.

As and when no sufficient water is available in the ground water well, pumping is done from the Vallikada (mainly during summer season) to feed a ground level tank near the ground water well and then pumped to the overhead tanks. Provision



is also there to use the ground water well as a storage tank during summer season diverting the pumped water through valve operations.

At times of pumping from the ground water well, 20 HP and 12.5 HP pumps are operated to fill the OH tanks. Normal pumping is done for 8 hours from 8am to 4pm to fill the OH tanks.

When pumping is done from Vallikada to the ground level open tank (3 lakhs litre capacity) near the main pumping station, 10 HP is operated on the suction from the ground level tank to fill the OH tanks and simultaneously the other 12.5 HP submersible pump from the ground water well (used as storage tank). 20 HP is used to fill the tanks at the men's hostel (new block) for about an hour.

All the three pumps could be operated in various combinations through valve controls from a common header pipe. The pumping efficiency of the pumps are noticed to be poor based on the discharge and operating hours.

There is a waste water pumping station near canteen consisting of 1 no 5 HP solid handling pump with 24 M head and 8 LPS discharge and a standby pump of same capacity but not energized. There are two collection pits, one for the canteen(3000 litre capacity) and the other for academic blocks (A,B,C and D) of 1 lakh litre capacity. Pumping is normally done for 6 hours from 8am which falls in zone1. The pumping outlet is to the STP. The collection pits are seen almost full in the morning and the pits overflow when pumping is delayed. The quantity of flow to the collection pits is seen huge.

Observations

The major observations are briefed below;

- 1) The pumping efficiency of all the pumps at the main pumping station is noticed to be poor based on the operating hours and flow rates.
- 2) The hours of operation are in zone1, when MD occurs
- 3) Prolonged overflows are noticed from the main OH tank and other Sintex tanks located at men's hostel (new block) resulting in wastage of pumped water.
- 4) Leakages are observed at various locations on the lines, control valves, taps etc resulting in wastage of water.
- 5) Misuses like keeping taps open for cleaning purposes



- 6) Pumping station at Valliakda is a separate LT consumer under LT-4A tariff with connected load of 9915 Watts. The average monthly consumption is 2487 units and the monthly bill amount is around Rs 15000/- (Rs 15165 for the month of June 2019).
- 7) Leakage is noticed on the suction flange of the 10 HP vertical pump
- 8) Leakage from gland packages is noticed on the 20 HP horizontal mono block pump
- 9) The overnight collection in the waste water pits near canteen are seen huge (around 1 lakh litres)
- 10) The overall daily consumption is around 3.5 lakh litres of water and wastages are suspected.

Recommendations

- 1) Replace the existing 20 HP mono block pump with a new 20 HP 4 stage, mixed flow vertical submersible pump with a discharge of 20 LPS which could be extended for pumping throughout the year.
- 2) Float switches are to be provided to prevent overflows from the over head tanks
- 3) Pumping from Vallikkada is to be avoided to save energy charges if sufficient water is available in the ground water well
- 4) Shift the pumping time from zone 1 to zone 3 to reduce MD and energy charges.
- 5) If at all any additional pumping is required, opt for pumping from 6am to 10am and from 4pm to 6pm so that MD is not affected.
- 6) Mobile switching can be done for ON and OFF in the pumping stations.
- 7) It is proposed to install water meters at hostels and college blocks (block wise) to ascertain the consumption, misuses, defects etc
- 8) Introduce proper cleaning arrangement procedure for toilets and bathrooms to optimize the water consumption.
- 9) Repair defective water lines, control valves, taps, flush controls to prevent wastages.
- 10) The inputs to the waste water pits are to be monitored. All misuses and wastage are to be prevented so as to reduce the pumping hours as well as to reduce the input to the STP
- 11) All overflow pipes are to be extended for clear visibility to effect immediate controls.



- 12) Provide individual capacitors to those water pumps at the main pumping station. The suggested KVAR for 10 HP, 12.5 HP and 20 HP are 4 KVAR, 5 KVAR and 6 KVAR respectively to reduce voltage drop and power loss across the cables.
- 13) Complete overhauling of 10 HP and 12.5 HP pumps for improving performance.
- 14) Carry out proper checks on the gland packages, valves, water seals discharge etc to ensure performance.
- 15) Practice good water conservation measures to minimize pumping charges.
- 16) Energize the already installed 5 HP waste water pump with a change over provision to operate as a standby pump.
- 17) It is suggested to maintain log books at pumping stations for recording daily events like starting, stopping, selection of pump, hours of operation etc for proper monitoring.

Calculations on savings in MD and Energy charges and paybacks

- A) Replacement of 20 HP existing mono block horizontal pump with a 20 HP submersible vertical mixed flow 4 stage pump with 70% efficiency and 20 LPS discharge(62 meter head)

$$\text{Time taken by the existing pump at the discharge rate of 11 LPS to fill total capacity of 3,41,500 litres} = \frac{341500}{11 \times 3600} = 8.6 \text{ hrs}$$

$$\begin{aligned} \text{Monthly energy consumption for 8.6 hours} &= 15 \times 8.6 \times 30 \\ &= 3870 \text{ units} \end{aligned}$$

$$\begin{aligned} \text{Time taken by the proposed pump to fill 3,41,500 litres on a discharge of 20 LPS} &= \frac{341500}{20 \times 3600} = 4.76 \text{ hours} \\ &\cong 5 \text{ hours} \end{aligned}$$

$$\begin{aligned} \text{Monthly energy consumption of the proposed pump for 5 hours} &= 15 \times 5 \times 30 \\ &= 2250 \text{ units} \end{aligned}$$

$$\text{Savings in consumption} = 3870 - 2250 = 1620 \text{ units}$$

$$\begin{aligned} \text{Monthly savings in cost @ 7.2/unit} &= 1620 \times 7.2 \\ &= \text{Rs 11664/-} \end{aligned}$$



The estimated replacement cost is Rs 90,000/-

$$\text{Payback period} = \frac{90000}{11664} = 7.7 \text{ months, say 8 months}$$

B) Additional savings on shifting of operation from Zone 1 to Zone 3

Assuming 20 HP pump in operation,

a) Monthly savings in MD charges = $15 \times 440 = \text{Rs } 6600/-$

b) Monthly savings in energy charges = $15 \times 5 \times 30(7.2-5.4) = \text{Rs } 4050/-$

Total monthly savings = a+b = Rs 10650/-

C) Savings on shifting of operation of 5HP waste water pump from zone 1 to zone 3

Monthly savings in MD = $3.7\text{KW} \cong 3.7 \text{ KVA}$

a) Monthly savings in MD charges = $3.7 \times 440 = \text{Rs } 1628/-$

b) Monthly savings in energy charges = $3.7 \times 6 \times (7.2-5.4) = \text{Rs } 1198/-$

Total monthly savings = a+b = Rs 2826/-

Total monthly savings on shifting of time zones = $10650+2826 = \text{Rs } 13476/-$



VII

OTHER CONNECTED LOADS

Fans

There are altogether 2144 nos ceiling fans with a connected load of 128 KW.
Average operating hours is 8 hours.

Observations

- 1) Heavy deposits of dust are noticed on the fan blades offering high air friction resulting in increased energy consumption
- 2) Many fans are seen not switched off even when not in use

Recommendations

- 1) Clean all the fan blades periodically for better energy efficiency (5% saving is anticipated)
- 2) Rewinding of fan motors is discouraged to avoid likely excess energy consumption
- 3) All replacements are suggested with 5 star rated fans for energy savings
- 4) Promote natural air ventilation by opening windows wherever possible.

Exhaust fans

The installations of exhaust fans at various locations are seen non standard (without circular casings). The blades are coated with heavy dust

Recommendation

- 1) It is proposed to clean the fan blades periodically
- 2) Enclose the exhaust fan in metallic casings for better axial displacements

Computer systems

There are 1023 systems in the campus which is around 18.2% of the connected load. Even though its contribution to the maximum demand is considerable, scope for reductions is limited.



There are 3 labs with an average of 60 systems

1. Common computing centre
2. MBA computer lab
3. Language lab

The number of systems in other computer labs are on an average of 30

Recommendations

1. Switch off systems when not in use.
2. Re schedule the computer labs, if feasible, in the for FN and AN evenly inorder to reduce the maximum demand.
3. New procurement of monitors can be of LED type to reduce the power consumption

LCD Projectors

There are 59 numbers of LCD projectors distributed mainly in class rooms and are used as a teaching aid. **It is recommended to minimize the use if not required and to switch off when not in use.**

Printers

There are 53 numbers of printers which are spread over in various departments and offices. **It is recommended to restrict taking printouts during peak hours**

Photocopiers

There are 9 nos of photocopiers at various locations in the academic blocks. **It is recommended to avoid taking photocopies during peak hours.**

UPS

The UPSs normally feed the Computer systems, Cameras, Servers, Wi-Fi system and LCD projectors in the campus. Since the DG sets come into operation within 15 seconds (at present) whenever there is a KSEB supply interruption, the effective loading of UPS is limited.



Observations

- 1) Batteries of 20 KVA UPS located in A block are not properly placed and a few battery terminals are seen corroded. The inverter unit is without front cover and is deposited with dust. **It is recommended to place the batteries on racks. Proper cleaning and re-doing of terminals, providing cover to the inverter etc can be done.**
- 2) One among the rectifier units of 40 KVA UPS located in C block is not working, which **is to be repaired.**
- 3) The UPSs which are not connected to servers (40 KVA in C block ground floor, 30 KVA and 20 KVA in D block 1st floor) can be kept in by pass mode during non office hours on an experimental basis for energy savings on account of internal losses.
- 4) It is suggested to feed the LCD projector and sound systems located at mini auditorium (presently fed from the 20 KVA UPS in A block) from the 20 KVA UPS in R&D block through a Twin core 2.5 sq.mm PVC cable to minimize losses.

Sewage Treatment Plant

STP is normally under 24 hours operation. The total connected load is 32 KW. There is a continuous load of 17KW.

Through proper water conservation measures (minimization of waste water, misuses and leakages) the input load to the STP can be reduced marginally which can result in reduced pumping hours of clear water from STP as well as reduction in operational hours of STP. Once the input quantity of waste water to STP reduces, the consumption of chemicals will also come down.

The feasibility of shifting of operation of STP during peak hours (6pm to 10pm) to zone 3 (10pm to 6am) based on the inputs to STP can be considered which will result in reduced energy charges.



Water coolers

There are 17 nos of water coolers with a total connected load of 8.5 KW. The details are given below

LOCATION	MAKE	OBSERVATIONS
Block A Ground floor near A 104	VOLTAS	Float valve defective Dusty deposit on condenser cooling fins
Block B (At ground floor near.DBMS lab)	Blue star	Not working
Block C (1.Near KIOSK 2. Ground floor 3. near PTC seminar hall)	Blue star	Damaged control knob for unit near KIOSK
Block D (3 nos)	Blue star	Dust deposits on cooling fins
Men's hostel (2 in old block, 2 in new block)	Blue star(2) Voltas (2)	Dust deposits on cooling fins
Ladies hostel (1 in mess hall, 1 in second floor)	Blue star(2)	Water leak in the unit near mess hall Dust deposits on cooling fins
Mechanical work shop (2 units)	Blue star	Dust deposits on cooling fins Water filter leakages
Auditorium (near entrance)	Blue star	Dust deposits on cooling fins The unit is exposed to weather conditions which is electrically not safe



Recommendations

1. Carry out overhauling including cleaning
2. Reset to higher temperature levels, so that cutoff can be achieved
3. Restrict the operating hours to office hours in academic blocks
4. Install water coolers in weather proof condition and follow standard wiring practices
5. Rectify defects and leakages
6. Repair the unit near DBMS lab.



VIII

DEISEL GENERATORS

There are 3 nos of DG sets as back up to the KSEB supply

1. 100 KVA
2. 200 KVA
3. 320 KVA

The 200 KVA DG set is connected in AMF (Automatic Mains Failure) mode which automatically takes over the supply within 15 seconds.

The 100 KVA is under maintenance for acoustic works

320 KVA DG set is operated manually as and when required.

A 20 KVA DG set located at ladies hostel is kept idle.

Observations

- 1) 100 KVA DG set is without acoustic chamber and not in operation
- 2) 200 KVA DG set comes to operation in AMF mode within 15 seconds on failure of KSEB supply
- 3) 320 KVA DG set comes to operation through a manual change over from KSEB supply.
- 4) The turbo inter cooling radiator of 200 KVA is covered with dust and oil.
- 5) Frequent starting and stopping of DG sets occur which results in carbon deposits on turbo charger blades.
- 6) The flexible coupling (muffler) of 320 KVA DG is partially broken through which exhaust gas escapes in to the acoustic chamber.
- 7) The jacket water radiator of 320 KVA DG set seen dirty with dust.

Recommendation

- 1) Clean the turbo inter cooler radiator of 200 KVA DG set
- 2) Check the performance of thermostat valve of radiator of 100 KVA, 200KVA, 320 KVA DG sets and set the thermostat valve to a temperature as per the running standards of diesel engines (85-95 degree centigrade)
- 3) Change the air cleaner of all the three DG sets if the air flow indication is poor



- 4) Top up the engine lubricant oil and replace if, contaminated
- 5) Complete the work of acoustics in 100 KVA DG before operation.
- 6) Clean the turbochargers of 100 KVA, 200 KVA, 320 KVA DG sets at least once in a year.
- 7) Clean the jacket water radiator of 320 KVA.
- 8) Replace the flexible coupling of 320 KVA.
- 9) Change the setting of time delay of AMF operation of 200 KVA from 15 seconds to 4 minutes, if tolerable, considering the possibility of restoration of supply by KSEB within 3 minutes on temporary faults and to avoid frequent starts and stops of DG sets which result in fuel wastages and wear and tear.
- 10) It is suggested to maintain log book for all the three DG sets with details of daily generation, hours of operation, fuel level, consumption of fuel etc
- 11) It is proposed to check the fuel consumption and units generated with 75% load on the DG sets after carrying out the maintenance works as recommended for assessing the performance.

Performance evaluation based on available records

200 KVA,

Period taken from records : 01/06/2018 to 30/5/2019

Units generated = 22584 kWh

Running hours = 462.5 hours

Diesel consumed = 9700 liters

Diesel consumption per hour = $9700/462.5 = 20.97$ litres/hour

Units generated per litre = $22584/9700 = 2.3$ units

Cost per unit generated @ Rs 70/litre = $70/2.3 = \text{Rs } 30.43$

320 KVA,

Period taken from records : 01/06/2018 to 30/05/2019

Units generated = 9744 kWh



Diesel consumed = 3135 litres

Running hours = 64.4 hours

Diesel consumption per hour = $3135/64.4 = 48$ litres

Units generated per litre = $9744/3135 = 3.1$ units/litre

Cost per unit generated @ Rs 70/litre = $70/3.1 = \text{Rs } 22.60$

100 KVA,

Period from records : 12/06/2015 to 12/11/2016

Diesel consumed = 5600 liters

Units generated = 12320 kWh

Running hours = 367 hours

Diesel consumption per hour = $5600/367 = 15.26$ litres

Units per litre = $12320/5600 = 2.2$ units

Cost per unit generated @ Rs 70 per litre = $70/2.2 = \text{Rs } 31/\text{unit}$

As per the test run conducted on 10/07/2019, the following results are obtained;

200 KVA

Loading condition = 50%

Running duration = 30 minutes

Units generated = 40 kWh

Fuel consumed = 19.61 litres

Fuel consumption per hour = $19.61/0.5 = 39.2$ litres

Units generated per litre = $40/19.61 = 2.03$ units

320 KVA

Loading condition = 35% load



Running duration = 30 minutes

Units generated = 48 KWh

Fuel consumed = 20.42 litres

Units generated per litre = $48/20.42 = 2.35$ units

Fuel consumption per hour = $20.42/0.5 = 40.8$ litres

The above results are not truly indicative on the performance since the machines are inadequately loaded and poorly maintained. **It is suggested** to evaluate the performance of the DG sets after completion of the maintenance works as recommended and under 75% loading condition.

Check list for DG sets

- 1) Temperature of coolant at inlet and outlet of engine (to assess the heat loss from the engine cylinder)
- 2) Flow rate at the air flow indicator(to assess the air cleaner performance)
- 3) Air temperature in the acoustic chamber(to assess the engine performance)
- 4) Condition of turbo charger with respect to carbon deposits on turbine blades(to assess engine performance)
- 5) Level and condition of lubricant oil(to assess the engine performance)
- 6) Condition of thermostat valve in the cooling water circuit (to ascertain the opening of valve at the set high temperature.)

Boilers

While conducting equipment survey it is noticed that the chimney of Boilers at both hostels are choked with soot, resulting in more consumption of fire wood. It is suggested to clear the soot on the boiler and chimney.

Solar water heaters

The solar water heaters installed at both hostels are shaded by roof sheets and are to be relocated for better efficiency.



IX

CONCLUSION

The whole attempt is made for reducing the electricity bills through conservation measures. The implementation of these conservation measures is to be carried out within one month positively.

It is desirable to assign responsibilities to selected personnel for effective supervision of the above works and for successful implementations so as to result in substantial reductions in maximum demand and energy consumption.

The results on implementation of the recommendations are to be reviewed for the effectiveness and sustenance.

The capital cost on implementation of the recommendations is estimated to be around Rs 6 lakhs and the monthly savings is approximated to a minimum of Rs 90,000/-. The payback is expected within 7 months.

As and when the 200 KWp solar project is commissioned and connected to the grid, a study on its impact on the systems and a total review of then Maximum Demand and energy consumption is to be carried out for better energy conservation and management.



VISWAJYOTHI
COLLEGE OF ENGINEERING & TECHNOLOGY
Approved by AICTE New Delhi & Affiliated to APJ Abdul Kalam Technological University

Vazhakulam P.O., Muvattupuzha
Ernakulam Dist., Kerala - 686 670
Tel: 0485 2262211 / 44
Email: vjcet@vjcet.org
www.vjcet.org



GREEN AUDITING REPORT



**Viswajyothi college of Engineering and
Technology, Vazhakulam.**

July 2019



Executive Summary

Environmental auditing is essentially an environmental management tool for measuring the effects of certain activities on the environment against set criteria or standards. Environmental auditing helps improve existing human activities, with the aim of reducing the adverse effects of these activities on the environment.

The rapid environmental degradation at local, regional and global level is leading us to global "Environmental poverty". As an Institution of higher learning and research, VJCET is deeply concerned and unconditionally believes that there is an urgent need to address these fundamental problems and reverse the trends of environment degradation.

Environment plays an important role in healthy living and the existence of life on planet earth. It is very important to conserve our mother earth and the environment. It is very necessary for us humans to act in a way that ensures the conservation environment is maintained. Therefore, it is important for every individual to save and protect our environment. Being a premier institution of higher learning, VJCET is aware of its responsibilities towards environmental issues and therefore has resolved to play a major role in the education, research, policy formation and information exchange necessary for a sustained environmental campaign.

The audit was conducted by a team of faculty and students with support from various experts. It is indeed the reflection of VJCET's endeavour to exercise leadership in promoting sustainability and an institutional obligation to instill among all students and each of us, and those in the broader community a sense of environmental stewardship. This commitment of VJCET has lead to actions whose reflection is visible remarkably on ground.

Our experts from various departments and the students of National Service Scheme in VJCET decided to conduct a green auditing. Green Auditing means, it is a process of systematic identification, quantification, recording, reporting and analysis of components of environmental diversity of various establishments. It aims to analyze environmental practices within the campus, which will have an impact on the eco-friendly ambience. For this we considered the trees in the college.

The electricity expenditures of Viswajyothi College of Engineering and Technology (VJCET) are on the rise and the monthly demand notice from KSEBL is seen to have crossed Rs 6 lakhs. The management wants to adopt cost saving measures to reduce the above expenses which has necessitated this study.

A detailed study on the above was conducted in the campus. The study included scrutiny of electricity bills for the preceding twelve months, detailed load survey, consumption pattern, operations and operating hours of equipment and devices, status of maintenance etc. The major potential areas identified for energy savings are Air Conditioning, Lighting and Pumping systems.

The available data from offices, measured data and other primary data gathered through personal interviews with the concerned personnel have been used for analysis. Based on the analysis, a set of recommendations has been given for each of the key energy saving potential areas.

Sample rectification works with respect to Air Conditioning and lighting systems were carried out at the Common Computing Centre and the results noted are highly encouraging.



The current green audit represents the first stage in our efforts to build environmental sustainability on the campus.

Aneesh Kurian
Assistant Professor &
BEE Certified Energy Auditor (EA-17246)
Department of Electrical Engineering
VJCET, Vazhakulam.

Tintu Shine A L
Assistant Professor
Dept. of Civil Engineering
VJCET, Vazhakulam.



Contents

1. Introduction	1
2. Need for Green Audit	1
3. Objectives	2
4. Location Map of Vjcet	2
5. About the Vjcet	2
6. Audit Process	4
7. Target Areas of Auditing	4
7.1 Auditing for Water Management	5
7.2 Auditing for Energy Management	5
7.3 Auditing for Waste Management	5
7.4 Auditing for Green Campus Management	5
7.5 Auditing for Carbon Footprint	6
8. Methodology Adopted	6
8.1 Field Study	6
8.2 Group Discussion	6
8.3 Energy, Waste Management and Carbon Foot Print Analysis Survey	6
9. Findings	6
9.1 Water Quality Assessment	6
9.2 Water Management	11
9.3 Energy Audit Report	16
9.4 Waste Management	29
9.5 Green Campus	30
9.6 Carbon Foot Print Analysis	32
10. Future Action Plans	33
11. Conclusions	34



1. Introduction

The environment where we live within is of utmost concern since it is directly related to the survival. Environmental and Green audit is a general term that reflects various kinds of evaluations intended to identify environmental compliance and management system, implementation gaps, along with related corrective actions. Keeping it healthy is the responsibility of each and every individual. It aims to analyze environmental practices within and outside of the concerned sites, which will have an impact on the eco friendly ambience. Green audit is a useful tool to determine how and where the most energy or water resources are being used; and can then considerations be given on how to implement changes and make savings. It can also be used to determine the type and volume of waste, which can be used for a recycling project or to improve waste minimization plan. It can create health consciousness and promote environmental awareness, values and ethics. It imparts a better understanding of Green impact on campus to staff and students.

The Green audit process was began in the 1970s with an intention of identifying the activities carried out in a given institution or company. This was initiated against the background of growing concern over changing climate and related aspects. Green audit is a tool to identify the range of environmental impacts and assess the compliance of the operations on the development and regular activities within an organization. It may also assess the compatibility of the operations within an organization or a company with existing applicable laws and regulations and the expectations of their various stakeholders. It further assesses the possible implications and effect of pollution due to the operations within the organization. The audit also seeks to identify possible means and methods to save investments, enhance work quality, improve health and safety of their employees, reduce liabilities and reduce the rate of environmental pollution. A continuous process of such audit might result in maintaining the quality of these aspects within the premises of any institution.

2. Need for green audit

If self enquiry is a natural and necessary outgrowth of a quality education, it could also be stated that institutional self enquiry is a natural and necessary outgrowth of a quality educational institution. Thus, it is imperative that VJCET evaluates its own contributions toward 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.

The rapid urbanization and economic development at local, regional and global level has led to several environmental and ecological crises. On this background, it becomes imperative to adopt the system of the "Green Campus" for the Institutes which will lead to sustainable development and at the same time reduces a sizable amount of atmospheric carbon dioxide from the environment.

The process of green audit based on operational activities within an institution happens not necessarily based on laws and regulations. It might be largely based on awareness and concerns on environmental performances within and outside the institute's premises. This further strengthens the fact regarding social responsibilities of the organization. Majority of the institutions that conducted green audits in the recent past has realized the importance of the same as they could easily manage their operational costs and provide good atmosphere to their stakeholders. The green audit also provides opportunities to identify full range of operations within an organization, the impacts of maintaining and functioning of its operational goods and services, the actual source of raw materials for different activities within the organization, the costs of operations of its offices, functional units, and other facilities. It also provides chances to understand the relationship with employees, material suppliers, stakeholders, etc. The recommendations, findings and suggestions that emerge during green audit would certainly help the management of the organization to set up future action plan that best suits to them.



3. Objectives

Concern about environmental degradation and realization of values of environment are logical consequences of scholarly research, teaching and learning process. In its pursuit for improving environmental quality and to maintain a pristine environment for the future generations of students, VJCET has made a self-inquiry on environmental quality of the campus with the following objectives to achieve:

- Improve the environmental performance in the college by protecting the trees.
- Make college eco-friendly
- To reduce the emission of carbon dioxide.
- Create awareness about green auditing.
- Provide opportunities to students to interact with nature.
- To study the performance of solar power plant.
- To study the scope of implementation automatic system for water pumping.
- To study the scope of implementation of sensor based water conservation system.
- To assess the quality of the water and soil in the VJCET college campus
- To monitor the energy consumption pattern of the college
- To quantify the liquid and solid waste generation and management plans in the campus.
- To assess whether the measures implemented by VJCET College have helped to reduce the Carbon Footprint.
- To impart environment management plans to the college
- Providing a database for corrective actions and future plans.
- To identify possible ways to reduce expenditure and running costs on equipment, appliances etc. or try enhance revenue income.

4. Location map of VJCET



Latitude: 9.951415903541301, Longitude: 76.63039389029888

Fig 1 location map of VJCET

5. About the VJCET

Viswajyothi College of Engineering and Technology, Vazhakulam was established in the year 2001 and run under the aegis of the Syro Malabar Catholic eparchy of Kothamangalam christened, the Diocesan Technical Educational Trust. VJCET is affiliated to APJ Abdul Kalam Technological University, Thiruvananthapuram, Kerala. As an engineering institution it has always strived to educate engineers and scientists to the next level through innovative activities. It has and is playing



a major role for the upliftment of the people living in the neighbourhood. Scholars from all Kerala and abroad seek admissions here because of its excellent infrastructure, well experienced faculty, separate hostel facility for ladies and gents, connectivity and apt learning environment. Today, Viswajyothi College has grown in name and fame as an NBA accredited engineering institution with its Alumni as brand ambassadors working globally. It trains undergraduate engineers in seven disciplines and conducts four post graduate courses as well. Presently around 2250 students undergo trainings in all, with a keen intention to open up more branches as to customise to the taste and needs of the time.

The skill of the artisan marks the quality of the product. Viswajyothi has an excellent team of faculty members well-experienced, committed and devoted in imparting holistic training as to make students industry fit. Their innate desire to learn and develop before they share, has helped many to secure their Ph.D and motivated many others to enrol taking the cue.

Viswajyothi College has state of the art infrastructure with an area of 45945 sq.m., in a sprawling campus of 26 acres with panoramic landscapes -is a coveted venue for even film makers, well-planned class rooms, cutting edge Labs, Workshops, updated Library with latest national/international journals and E journals, R&D block, hostels, playgrounds and gym on the pristine hillock overlooking Ernakulam - Thodupuzha state highway marking them as the hallmarks of this modern 'Shantiniketan.'

Viswajyothi aspires to bring out the extraordinary from the ordinary students coming from rural background. The Placement and Training Cell, makes it a point to pool in training resources as to improve the students' employability. Soft Skill and Technical Training is spread through the academic year utilizing even vacations. In addition, a regular hour in a week is allotted for aptitude training creating a platform that prepares for a successful career. To whet the taste for engineering application among undergraduate engineers, opportunities for hands own experience is provided through arranged internship, in house incubation centre, Fab lab and Start-Ups. Besides, interested scholars are encouraged to undergo various training programmes at the in-house internationally recognized examination centre for German language, industry relevant add on courses- Python, Java and bridge courses available. Around 50 reputed companies regularly visit our campus apart from the off campus drives every year, of which Infosys lifts the major haul! "Knock and the door shall be opened", is the living faith of Viswajyothi placement team that keeps scanning industries nationally and internationally for possible openings. Around 85% of all eligible students of the current year have already secured placement in reputed companies adding to the Alumni-the brand Ambassadors of Viswajyothi.

PG Programmes offered:

- Computer Science & Engineering
- Electronics and Communication Engineering with specialization VLSI & Embedded Systems.
- Industrial Engineering and Management
- MBA

B-Tech Programmes offered:(All programs Accredited by NBA)

- Artificial Intelligence and Data Science
- Civil Engineering
- Computer Science and Engineering
- Electronics and Communication engineering
- Electrical and Electronics Engineering
- Information Technology



- Mechanical Engineering

6. Audit Process

1. Selection of area/activities/parts of the campus.
2. Planning and discussion about the audit process.
3. Scope of audit process was identified in consultation with the experts.
4. A meticulous plan of action was designed.
5. A team consisting of teachers, non-teaching staff and students was constituted with specific tasks and a proper time schedule.
6. Data pertaining to identified parameters for auditing of the campus were collected directly from different sources.
7. Available background information on the identified activities and other parameters were collected from different sources.
8. The role of each stakeholder in green related activities has been collected.
9. Details of green activities in the campus including flora fauna, water usage and waste generation, etc. were collected.
10. Details of total energy consumption and energy produced by solar power plants.
11. A questionnaire based on the preliminary walk-through audit and other evaluations was communicated to the different authorities/in charges, who are involved in the data collection.
12. Data collection based on questionnaire.
13. Tree auditing and identification in campus.
14. Data analysis and evaluation.
15. Discussion on the findings.
16. Report preparation.

7. Target Areas of Auditing

Green audit is a part of resource management process. Although they are individual events, the real value of green audit is the fact that they are carried out, at defined intervals, and their results can illustrate improvement or change over time. Eco-campus concept mainly focuses on the efficient use of energy and water; minimize waste generation or pollution and also economic efficiency.

Green auditing in **VJCET** began with the assessment of the status of the green cover of the Institution followed by waste management practices and energy conservation strategies etc. The team monitored different facilities at the college, determined different types of appliances and utilities (lights, fans, toilet taps, etc.) as well as measuring the usage per item (Watts indicated on the appliance or measuring water from a tap) and identifying the relevant consumption patterns (such as how often an appliance is used) and their impacts. The staff and learners were interviewed to get details of usage, frequency or general characteristics of certain appliances. Also the analysis of performance and operation of solar power plant and generation of electricity and the scope of water conservation was also included.



Data collection was done in the sectors such as Energy, Waste, Greening, Carbon footprint and Water use. College records and documents were verified several times to clarify the data received through survey and discussions.

All these indicators are assessed in the process of “Green Auditing of this educational institute”. Eco-campus focuses on the reduction of contribution to emissions, procures a cost effective and secure supply of energy, encourages and enhances energy use conservation, promotes personal action, reduce the institute’s energy and water consumption, reduce wastes to landfill, and integrate environmental considerations into all contracts and services considered to have significant environmental impacts. Target areas included in this green auditing are water, energy, waste, green campus and carbon footprint.

7.1 Auditing for Water Management

Water is a natural resource; all living organisms depend on water. While freely available in many natural environments, in human settlements potable (drinkable) water is less readily available. Groundwater depletion and water contamination are taking place at an alarming rate. Hence it is essential to examine the quality and usage of water in the college. 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.

7.2 Auditing for Energy Management

Energy conservation is an important aspect of campus sustainability which is also linked with carbon foot print of the campus. Energy auditing deals with the conservation and methods to reduce its consumption related to environmental degradation. It is therefore essential that any environmentally responsible institution examine its energy use practices.

7.3 Auditing for Waste Management

Human activities create waste, and it is the way these wastes are handled, stored, collected and disposed of, which can pose risks to the environment and to public health. Pollution from waste is aesthetically displeasing and results in large amounts of litter in our communities which can cause health problems. Solid waste can be divided into three categories: bio-degradable, non-biodegradable and hazardous waste. Bio-degradable wastes include food wastes, canteen waste, wastes from toilets etc. Non-biodegradable wastes include what is usually thrown away in homes and schools such as plastic, tins and glass bottles etc. Hazardous waste is waste that is likely to be a threat to health or the environment like cleaning chemicals, acids and petrol. Unscientific management of these wastes such as dumping in pits or burning them may cause harmful discharge of contaminants into soil and water supplies, and produce greenhouse gases contributing to global climate change respectively. Special attention should be given to the handling and management of hazardous waste generated in the college. Bio-degradable waste can be effectively utilized for energy generation purposes through anaerobic digestion or can be converted to fertilizer by composting technology. Non-biodegradable waste can be utilized through recycling and reuse. Thus the minimization of solid waste is essential. The auditor diagnoses the prevailing waste disposal policies and suggests the best way to combat the problems.

7.4 Auditing for Green Campus Management

Trees play an important ecological role within the urban environment, as well as support improved public health and provide aesthetic benefits to cities. In one year, a single mature tree will absorb up to 25 kg of carbon dioxide from the atmosphere, and release it as oxygen. The amount of oxygen released by the trees of the campus is good for the people in the campus. So, while people are busy studying and working on earning those good grades, all the trees in campus are also working hard to make the air cleaner for us.



7.5 Auditing for Carbon Footprint

Burning of fossil fuels (such as petrol) has an impact on the environment through the emission of greenhouse gases into the atmosphere. The most common greenhouse gases are carbon dioxide, water vapour, methane, nitrous oxide and ozone. Of all the greenhouse gases, carbon dioxide is the most prominent greenhouse gas, comprising 402 ppm of the Earth's atmosphere. The release of carbon dioxide gas into the Earth's atmosphere through human activities is commonly known as carbon emissions. Vehicular emission is the main source of carbon emission in the campus, hence to assess the method of transportation that is practiced in the college is important.

A carbon footprint is the amount of carbon dioxide released into the atmosphere as a result of the activities of a particular individual, organization or community. The world emits about 43 billion tons of CO₂ a year.

8. Methodology Adopted

The methodology adopted to conduct the green audit of the Institution had the following components

8.1 Field study

One week field study was conducted by the Audit Team. The key focus of the visit was on assessing the status of the green cover of the Institution, their waste management practices and energy conservation strategies etc. The sample collection was carried out. The water samples from the major water sources were taken and analysed. The sample collection, preservation, and analysis were done in the scientific manner as prescribed by the standard procedures.

8.2 Group Discussion

The Group discussions were held with the nature club, NSS Volunteers, staff members and the various experts focusing various aspects of the Audit. The discussion was focused on identifying the attitudes and awareness towards environmental issues at the institutional and local level.

8.3 Energy, waste management and Carbon foot print analysis Survey

With the help of teachers and students, the audit team has assessed the energy consumption pattern and waste generation, disposal and treatment facilities of the college. The monitoring was conducted with the help of NSS volunteers, experts, staffs from various data available and also assessing the remaining.

9. Findings

9.1 Water Quality assessment

Water samples from different locations were collected and analyzed for its quality parameters. The samples includes the main water source of the college campus, water samples which is used for canteen and drinking water cum cooler systems. The samples were collected and analyzed for various physio-chemical parameters in the environment laboratories of civil engineering department. The major parameters analyzed include dissolved oxygen, acidity, alkalinity, chloride, hardness, pH, conductivity, total dissolved solids and salinity. The results are presented in the Table 1. The results are comparable with the values of drinking water standards prescribed by different agencies.

Table 1. Results of tests for water quality



VISWAJYOTHI COLLEGE OF ENGINEERING & TECHNOLOGY

Vazhakulam, Muvattupuzha, Kerala- Pin 686 670.
Ph 0485-2262211, 2262244

CONSULTANCY SERVICES DIVISION

No. **43**

Date: 16/01/19

To: V.V.R.T. College, Sankarale

Ref No. CO-40

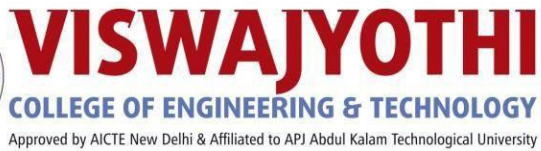
Following are the results of the tests conducted on the sample supplied by you on 16/01/19

Sl. No	Parameter	Unit	Methods used	Results obtained	Desirable limit
Drinking water					
1.	Turbidity	NTU	Turbidity Meter	0.49	5
2.	Taste	---		-	Agreeable
3.	pH	--	pH Meter	7.03	6.5 to 8.5
4.	Total Hardness	mg/l	Titrimetric	37.05	300
5.	Total dissolved solids(TDS)	mg/l	Titrimetric	82.3	500
6.	Salinity	mg/l	Titrimetric	---	<180
7.	Iron	mg/l	Colorimetric	0.0002	0.3
8.	Chloride	mg/l	Titrimetric	31.8905	250
9.	Residual Free Chlorine*	mg/l	Colorimetric	---	0.2
10.	Fecal Coliform	MPN/ CFU	MPN/MF method	<2000/100ml	Must not be detectable
Waste water					
11.	BOD	mg/l	Incubation/ Titrimetric	/	<20mg/l
12.	COD	mg/l	Titrimetric	/	<200mg/l

Staff in Charge

HOD

PRINCIPAL



The logo is a circular emblem with a teal border. Inside the border, the text "B.TECH PROGRAMMES ACCREDITED BY" is written in white, uppercase letters, following the curve of the top half. In the center, the letters "NBA" are prominently displayed in a large, bold, teal font. Below "NBA", the words "NATIONAL BOARD OF ACCREDITATION" are written in a smaller, teal, uppercase font. At the bottom of the circle, there is a decorative row of small white stars.



No. 44

Date: 8/10/19

To VICKY Nadubharu Sample

Ref No. 62-41

Following are the results of the tests conducted on the sample supplied by you on 10/21/12

Sl. No	Parameter	Unit	Methods used	Results obtained	Desirable limit
Drinking water					
1.	Turbidity	NTU	Turbidity Meter	1.1	5
2.	Taste	---		---	Agreeable
3.	pH	--	pH Meter	7.29	6.5 to 8.5
4.	Total Hardness	mg/l	Titrimetric	175.5	300
5.	Total dissolved solids(TDS)	mg/l	Titrimetric	34.5	500
6.	Salinity	mg/l	Titrimetric	---	<180
7.	Iron	mg/l	Colorimetric	Nil	0.3
8.	Chloride	mg/l	Titrimetric	6.8736	250
9.	Residual Free Chlorine*	mg/l	Colorimetric	---	0.2
10.	Fecal Coliform	MPN/ CFU	MPN/MF method	LRNes/100ml	Must not be detectable
Waste water					
11.	BOD	mg/l	Incubation/ Titrimetric		<20mg/l
12.	COD	mg/l	Titrimetric		<200mg/l

Staff in Charge

HGD

PRINCIPAL



VISWAJYOTHI COLLEGE OF ENGINEERING & TECHNOLOGY

Vazhakulam, Muvattupuzha, Kerala- Pin 686 670.
Ph 0485-2262211,2262244

CONSULTANCY SERVICES DIVISION

No. **41**

Date: **27/11/2018**

To: **VJCET, Vazhakulam, Vazhakulam sample**

Ref No. **KJ-38**

Following are the results of the tests conducted on the sample supplied by you on **20/11/2018**

Sl. No	Parameter	Unit	Methods used	Results obtained	Desirable limit
Drinking water					
1.	Turbidity	NTU	Turbidity Meter		5
2.	Taste	---			Agreeable
3.	pH	--	pH Meter		6.5 to 8.5
4.	Total Hardness	mg/l	Titrimetric		300
5.	Total dissolved solids(TDS)	mg/l	Titrimetric		500
6.	Salinity	mg/l	Titrimetric		<180
7.	Iron	mg/l	Colorimetric		0.3
8.	Chloride	mg/l	Titrimetric		250
9.	Residual Free Chlorine*	mg/l	Colorimetric		0.2
10.	Fecal Coliform	MPN/ CFU	MPN/MP method	2 No./100ml	Must not be detectable
Waste water					
11.	BOD	mg/l	Incubation/ Titrimetric		<20mg/l
12.	COD	mg/l	Titrimetric		<200mg/l

Staff in Charge

CENTRE FOR RESEARCH & INNOVATION
NEW JYOTHI COLLEGE OF ENGINEERING & TECHNOLOGY
Vazhakulam P.O. Muvattupuzha, Ernakulam Dist. Kerala - 686 670
Phone: 0485-2262211, 2262244, 2262245, 2262246

HOD

PRINCIPAL



VISWAJYOTHI COLLEGE OF ENGINEERING & TECHNOLOGY

Vazhakulam, Muvattupuzha, Kerala- Pin 686 670.
Ph 0485-2262211, 2262244

CONSULTANCY SERVICES DIVISION

No. **40**

Date: **27/11/19**

To: Viswajyothi college of Engineering & Technology, Vazhakulam

Ref No. **CO-37**

Following are the results of the tests conducted on the sample supplied by you on **30/11/19**

Sl. No	Parameter	Unit	Methods used	Results obtained	Desirable limit
Drinking water					
1.	Turbidity	NTU	Turbidity Meter		5
2.	Taste	---			Agreeable
3.	pH	--	pH Meter		6.5 to 8.5
4.	Total Hardness	mg/l	Titrimetric		300
5.	Total dissolved solids(TDS)	mg/l	Titrimetric		500
6.	Salinity	mg/l	Titrimetric		<180
7.	Iron	mg/l	Colorimetric		0.3
8.	Chloride	mg/l	Titrimetric		250
9.	Residual Free Chlorine*	mg/l	Colorimetric		0.2
10.	Fecal Coliform	MPN/ CFU	MPN/MF method	Less than 3 No./100ml	Must not be detectable
Waste water					
11.	BOD	mg/l	Incubation/ Titrimetric		<20mg/l
12.	COD	mg/l	Titrimetric		<200mg/l

Staff in Charge

CENTRE FOR RESEARCH & DEVELOPMENT
VISWAJYOTHI COLLEGE OF ENGINEERING & TECHNOLOGY
Vazhakulam P.O., Muvattupuzha, Ernakulam Dist. Kerala - 686 670
Phone: 0485-2262211, 2262244, 2262211

HOD

PRINCIPAL



9.2 Water Management

VJCET is located in a water scarcity area due to geographic complexity. In summer days the source of sufficient water is met by pumping water from pond near Thodupuzha river using two submersible pumps to a intermediate storage tank and to a natural pond. The pumping distance is approximately 2.5 km. In monsoon season natural pond existing in the campus is able to provide sufficient water.

From the intermediate storage tank which has a capacity of 3 lakh liter and from natural pond water is again pumping to overhead tank with capacity of 2.5 lakh liter. From this overhead tank water is distributed to sub tanks placed over all buildings. Every sub tank has sensor based solenoid valve mechanical system in order to avoid the overflow and the tank never be emptied.

Drain water is collected from different buildings and pumping to sewage treatment plant in the campus and treated and is used for the gardening of the entire campus.

Table 2 Monthly pumping quantity of water, 2018

Month	kL
JANUARY	6550
FEBRUARY	5540
MARCH	7450
APRIL	7160
MAY	7730
JUNE	7560
JULY	7710
AUGUST	7850
SEPTEMBER	7520
OCTOBER	7500
NOVEMBER	7600
DECEMBER	7740

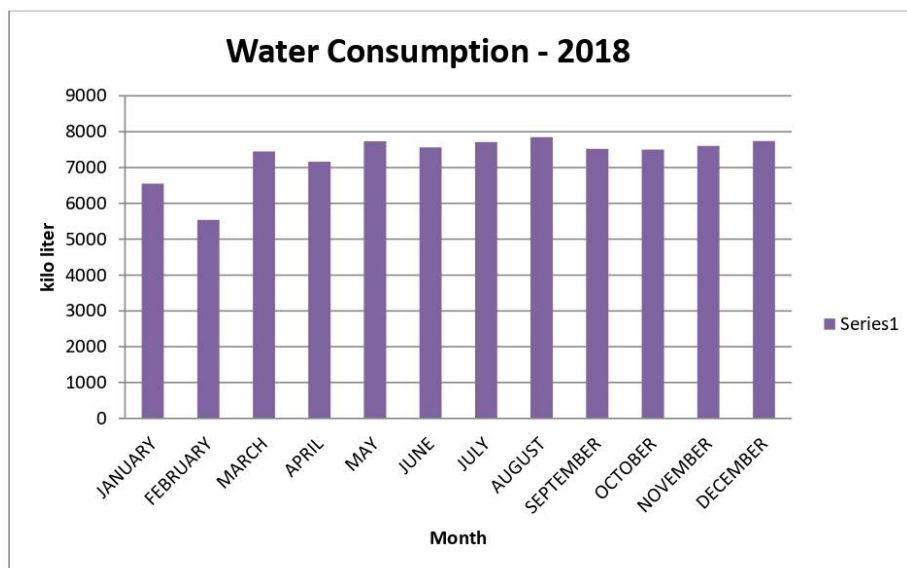


Fig 2 Bar chart of monthly pumping quantity of water , 2018



Table 3 Average Category Wise Water Consumption

Category Wise Water Consumption	
USAGE /Place	Consumption (kL/day)
GARDENING	36.8
HOSTEL BOYS	57.5
HOSTEL GIRLS	59.8
CANTEEN	11.5
COLLEGE TOILETS	46
STP	18.4

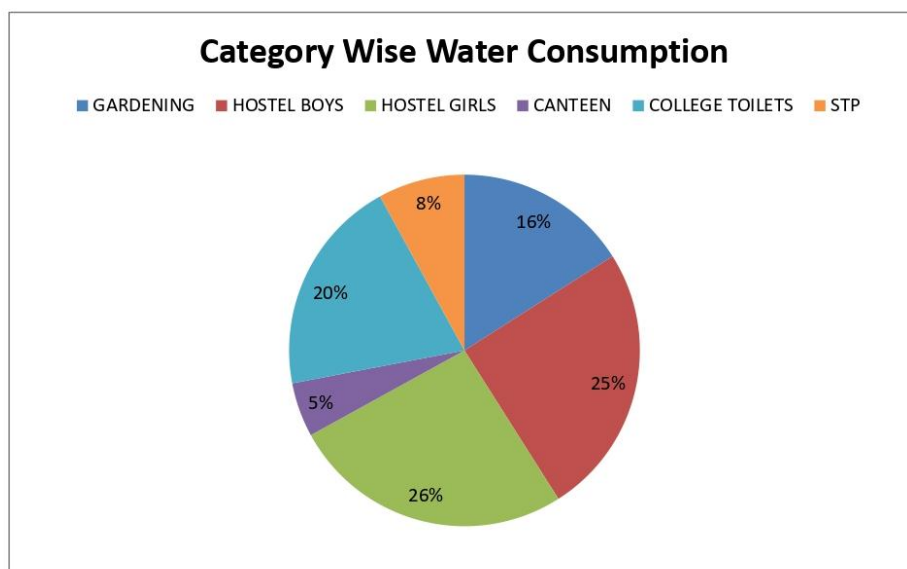


Fig 3 Pie chart of Average Category Wise Water Consumption

With the ardent desire to preserve natural resources, especially water, the following effective measures are taken in this line in the Institution.

The rain water harvested from a roof of area of 1700 m², yielding about 15 m³ of water per cm of rainfall is charged to a dug well after filtration in a vertical sand filter of 2.5 x 2.5 m² area and 1 m depth. The dug well with a diameter of 3 m and depth 3 m (volume 21.2 m³) is provided with good sanitary protection to avoid any contamination with surface water. The filtered rain water stored in the dug well will recharge the groundwater. This facility is especially useful from August middle to January end during which the ground water flows to the nearby natural pond (12 x 17.6 x 7. cm) will be augmented. This natural pond is one of the sources well for the campus in which the water level depletes due to the termination of intense south western monsoon by the end of August. A rainfall of 2 - 4 cm/hr of 20 - 30 minutes duration occurs at a frequency of 5 – 10 times every month from September to December.

The development and constructional activities in the campus are made without disturbing the natural ghat terrain. All the buildings are constructed adopting terraced construction concepts and mostly done along the contour of the terrace. This prevents loss of storm water through heavy surface



runoff. Water collected from a total roof area of 4800 m² is permitted to flood in level courtyards of each building. This helps in percolation of rain water through soil thus recharging the groundwater.

Out of the total possible campus population of around 3100, four hostels accommodate 820 students. The wastewater generated by this population is approximately 170 m³/day (IS 1172-1993). The campus has a full-fledged Sewage Treatment Plant (STP) with an installed capacity of 200 m³/day. The treated wastewater emanating from this plant well conforms to the effluent Standards of KSPCB for disposal into natural water bodies. This treated wastewater is used for irrigating the entire vegetation in the campus of 25 acres area.

The STP encompasses preliminary treatment like screen, grit chamber, oil separator etc followed by physicochemical treatment. The effluent is then subjected to secondary treatment employing Activated Sludge Process (ASP) ensuring substantial BOD removal. The following tertiary treatment consists of a second level physicochemical process followed by double filtration and then disinfection. The SS, COD, BOD, pH etc of the final treated effluent is routinely assessed in the Environmental Engineering Lab of the Civil Engineering Department of the College.

For the campus population of 3100, including 820 hostel inmates, the total water requirement is 220 m³/day (IS 1172-1993). This demand is met with the help of two water sources developed and maintained with at most care.

The first source is a natural pond in the campus itself. All four sides of the pond are protected with dry rubble construction. Sufficient sanitary protection is ensured by providing solid parapet walls all around and required roof covering. This well of size 1200 x 1760 x 700 cm is capable of meeting the water demand of the campus from May middle to December of the year. The well is periodically cleaned and the water quality is regularly monitored in the Environmental Engineering Lab of the College.

Another water source is at Nadukkara, 2.5 km away from the campus. A dug well of 3 m diameter and 9 m depth is made by the side of the Thodupuzha river and required sanitary protection is provided with. Sufficient water is available in this well to meet the water requirement all through the year which is 30 m distant from the river. With the help of two 12.5 hp submersible pumps water is pumped to an intermediate concrete storage tank of 3 lakh liter capacity in the campus.

From the above storage tank or from the natural pond, water is pumped to an overhead tank of 2.5 lakh liter capacity from which water is supplied through gravity flow to the entire campus. Flow meters provided at appropriate locations in the distribution system help in practicing water auditing, as an effective means of water conservation. The water from both sources is of excellent quality and is in conformation with the drinking water quality standards specified by BIS and WHO.

The main pumping station in the campus is located near auditorium adjacent to the ground water well. The motor pump sets in operation are,

- 1) 10 HP
- 2) 20 HP
- 3) 12.5 HP

A waste water pumping system near canteen consist of a 5 HP pump with a standby of 5 HP (which is installed but not energized).

Another pumping station is located outside the campus at Vallikada. Pumping is done from the river side well using a 12.5 HP submersible pump with a standby of another 12.5 HP pump.

Normal operation



As long as sufficient water is available in the ground water well near auditorium, pumping is done from the well to the 2.5 lakhs litres capacity main OH tank near ladies hostel and to the $5000 \times 3 = 15000$ litres capacity tanks at men's hostel. The tanks as listed below are fed by gravity flow from the main OH tank.

Ladies hostel $5000 \times 6 = 30,000$ litres

Men's hostel $5000 \times 4 + 1500 \times 1 = 21500$ litres

B, C and D blocks $5000 \times 4 = 20,000$ litres

Canteen $= 5000 \times 1 = 5000$ litres

The total pumped water is approximated to 3,41,500 litres/day. The $3 \times 5000 = 15000$ litres capacity tanks at Men's hostel (new block) are filled through diversions at the time of pumping.

As and when no sufficient water is available in the ground water well, pumping is done from the Vallikada (mainly during summer season) to feed a ground level tank near the ground water well and then pumped to the overhead tanks. Provision is also there to use the ground water well as a storage tank during summer season diverting the pumped water through valve operations.

At times of pumping from the ground water well, 20 HP and 12.5 HP pumps are operated to fill the OH tanks. Normal pumping is done for 8 hours from 8am to 4pm to fill the OH tanks.

When pumping is done from Vallikada to the ground level open tank (3 lakhs litre capacity) near the main pumping station, 10 HP is operated on the suction from the ground level tank to fill the OH tanks and simultaneously the other 12.5 HP submersible pump from the ground water well (used as storage tank). 20 HP is used to fill the tanks at the men's hostel (new block) for about an hour.

All the three pumps could be operated in various combinations through valve controls from a common header pipe. The pumping efficiency of the pumps are noticed to be poor based on the discharge and operating hours.

There is a waste water pumping station near canteen consisting of 1 no 5 HP solid handling pump with 24 M head and 8 LPS discharge and a standby pump of same capacity but not energized. There are two collection pits, one for the canteen (3000 litre capacity) and the other for academic blocks (A, B, C and D) of 1 lakh litre capacity. Pumping is normally done for 6 hours from 8am which falls in zone 1. The pumping outlet is to the STP. The collection pits are seen almost full in the morning and the pits overflow when pumping is delayed. The quantity of flow to the collection pits is seen huge.

Observations

The major observations are briefed below;

- 1) The pumping efficiency of all the pumps at the main pumping station is noticed to be poor based on the operating hours and flow rates.
- 2) The hours of operation are in zone 1, when MD occurs
- 3) Prolonged overflows are noticed from the main OH tank and other Sintex tanks located at men's hostel (new block) resulting in wastage of pumped water.
- 4) Leakages are observed at various locations on the lines, control valves, taps etc resulting in wastage of water.



- 5) Misuses like keeping taps open for cleaning purposes
- 6) Pumping station at Valliakda is a separate LT consumer under LT-4A tariff with connected load of 9915 Watts. The average monthly consumption is 2487 units and the monthly bill amount is around Rs 15000/- (Rs 15165 for the month of June 2019).
- 7) Leakage is noticed on the suction flange of the 10 HP vertical pump
- 8) Leakage from gland packages is noticed on the 20 HP horizontal mono block pump
- 9) The overnight collection in the waste water pits near canteen are seen huge (around 1 lakh litres)
- 10) The overall daily consumption is around 3.5 lakh litres of water and wastages are suspected.

Recommendations

- 1) Replace the existing 20 HP mono block pump with a new 20 HP 4 stage, mixed flow vertical submersible pump with a discharge of 20 LPS which could be extended for pumping throughout the year.
- 2) Float switches are to be provided to prevent overflows from the over head tanks
- 3) Pumping from Vallikkada is to be avoided to save energy charges if sufficient water is available in the ground water well
- 4) Shift the pumping time from zone 1 to zone 3 to reduce MD and energy charges.
- 5) If at all any additional pumping is required, opt for pumping from 6am to 10am and from 4pm to 6pm so that MD is not affected.
- 6) Mobile switching can be done for ON and OFF in the pumping stations.
- 7) It is proposed to install water meters at hostels and college blocks (block wise) to ascertain the consumption, misuses, defects etc
- 8) Introduce proper cleaning arrangement procedure for toilets and bathrooms to optimize the water consumption.
- 9) Repair defective water lines, control valves, taps, and flush controls to prevent wastages.
- 10) The inputs to the waste water pits are to be monitored. All misuses and wastage are to be prevented so as to reduce the pumping hours as well as to reduce the input to the STP
- 11) All overflow pipes are to be extended for clear visibility to effect immediate controls.
- 12) Provide individual capacitors to those water pumps at the main pumping station. The suggested KVAR for 10 HP, 12.5 HP and 20 HP are 4 KVAR, 5 KVAR and 6 KVAR respectively to reduce voltage drop and power loss across the cables.
- 13) Complete overhauling of 10 HP and 12.5 HP pumps for improving performance.
- 14) Carry out proper checks on the gland packages, valves, water seals discharge etc to ensure performance.
- 15) Practice good water conservation measures to minimize pumping charges.



16) Energize the already installed 5 HP waste water pump with a change over provision to operate as a standby pump.

17) It is suggested to maintain log books at pumping stations for recording daily events like starting, stopping, selection of pump, hours of operation etc for proper monitoring.

9.3 Energy Audit Report

VJCET is a High Tension (HT) consumer of Kerala State Electricity Board Ltd (KSEBL). The normal feeding of electric supply to the campus is from a 315 KVA distribution transformer. The campus includes A,B,C and D blocks, workshops, laboratories, men's hostel, ladies hostel, library, auditorium, pump house, sewage treatment plant, incubation centre and start up hub. The total connected load in the campus is 842.906 kW.

The main KSEB supply is supported by a standby power supply system consisting of 100 KVA, 200 KVA and 320 KVA Diesel Generator (DG) sets. 200 KVA DG set is in AMF mode and others are in manual mode. A 50 kWp solar system is connected to the LT grid and the works of an additional 200 kWp solar project are in progress.

The consumption of energy in the campus is found to be on an increasing trend resulting in huge electricity bills. Hence a detailed study was required on the connected load and consumption patterns exploring possibilities for energy savings and subsequent reduction in bills.

As part of preliminary works, the electricity bills for the preceding 12 months were collected and peripheral scrutiny was done followed by a campus visit to all locations where there is electric connection. The electrical installations and equipments were inspected with respect to the connected load, operational features and hours of operation. The visit included 315 KVA transformer station, Main Switch Board(MSB), DG sets, workshops, canteen, sewage treatment plant, pumping stations, auditorium, , ladies hostel, men's hostel and A,B,C,D blocks(staff rooms, class rooms, offices, library, laboratories etc).

Based on the visit, observations and preliminary data collected from records and discussions with relevant personnel, an attempt was made to identify the potential areas where the peak loads and energy consumption could be reduced.

Accordingly, the following areas were identified where there was significant consumption of energy and potentials for improvement and reduction in peak demand and energy consumption which could give immediate results with minimum expenditure.

1. Air conditioning system
2. Lighting system
3. Pumping system

The above three areas were revisited for detailed inspections, measurements of various parameters, identification of defects and for gathering additional data for analysis and recommendations leading to savings in consumption and cost.

There is scope for improvements and savings with respect to other connected loads but the investments are high and the payback periods are expected to be more and hence proposed to be taken up in a phased manner as per availability of funds.

Energy Consumption at VJCET

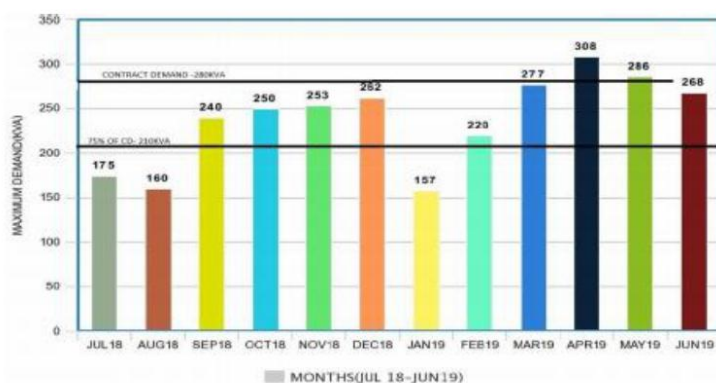


Month	Demand Zone wise (kVA)	MD (kVA)	Units consumed (KWh)	Total kWh	Power factor	Bill amount (Rupees)
July 2018	Z 1-175 Z2-67.4 Z3-60	175	Z1-18696 Z2-5516 Z3-9752	33964	0.99	344130
Aug 2018	Z1-160 Z2-65.73 Z3-58	160	Z1-19992 Z2-5872 Z3-9432	35296	0.99	357381
Sep 2018	Z1-240 Z2-122 Z3-71.65	240	Z1-21844 Z2-6776 Z3-10756	39376	0.98	401844
Oct 2018	Z1-250 Z2-143 Z3-117	250	Z1-36480 Z2-9736 Z3-14860	61076	0.99	583379
Nov 2018	Z1-253 Z2-121 Z3-98	253	Z1-34688 Z2-9164 Z3-14692	58544	0.99	563050
Dec 2018	Z1-262 Z2-125 Z3-93	262	Z1-35780 Z2-8852 Z3-13988	58620	0.99	567392
Jan 2019	Z2-113	157	Z1-21372 Z2-7592 Z3-12764	41728	0.99	406604
Feb 2019	Z1-220 Z2-97 Z3-76	220	Z1-22560 Z2-7504 Z3-12728	42492	0.97	419353
Mar 2019	Z1-277 Z2-116 Z3-105	277	Z1-36352 Z2-9336 Z3-19592	60584	0.90	601547
Apr 2019	Z1-308 Z2-143 Z3-111	308	Z1-40652 Z2-10720 Z3-17664	69036	0.98	664613
May 2019	Z1-286 Z2-128 Z3-89	286	Z1-35304 Z2-8232 Z3-14332	57868	0.98	565708



Jun 2019	Z1-268 Z2-130 Z3-98	268	Z1-35964 Z2-9752 Z3-16648	62364	0.99	591615
----------	---------------------------	-----	---------------------------------	-------	------	--------

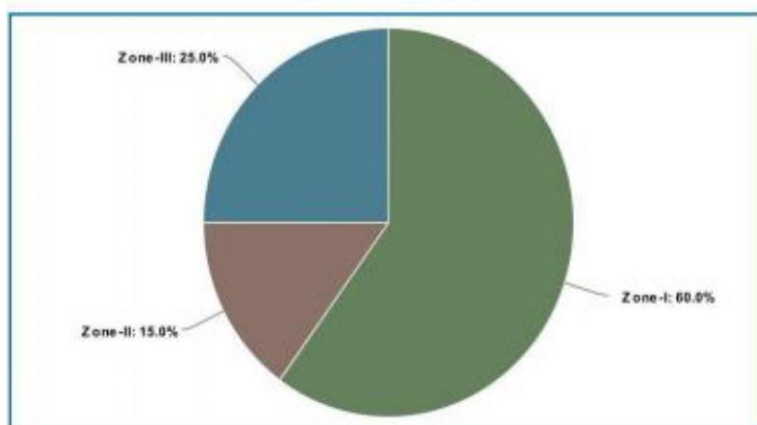
In the case of VJCET, the total connected load is 842.906 kW. The contract demand is 280 KVA, 75% of contract demand is 210 KVA. On scrutiny of the bills MD has exceeded Contract Demand (CD) in the months of April and May 2019.



MD is below 75% of CD in the month of July and Aug 2018. Average monthly energy consumption is 56757 units. Average monthly consumption pattern for three zones is given below,

Zone 1	60% (6am to 6pm)
Zone 2	15% (6 pm to 10 pm)
Zone 3	25% (10pm to 6am)

Zone wise consumption pattern



The identified major loads in the three zones are,
Z-I --- A/C, computer systems, lighting, fan, STP, water coolers, pump, projectors, UPS etc

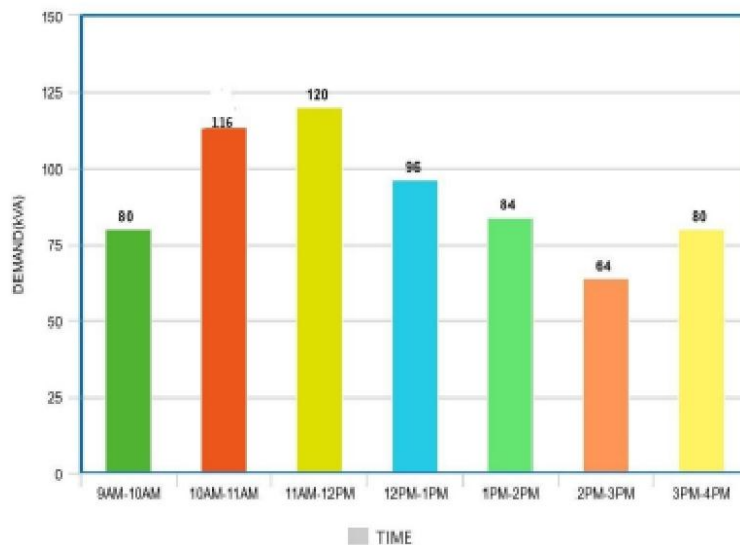
Z-2 --- Fans, lighting, STP, UPS, A/C (part) etc



Z-3 --- Fans, street lighting, STP, UPS, A/C etc

The MD is seen to occur during zone 1 (6 am to 6 pm) all throughout the year. Power factor is maintained all throughout between 0.98 and 0.99 except during the month of March 2019 (0.9).

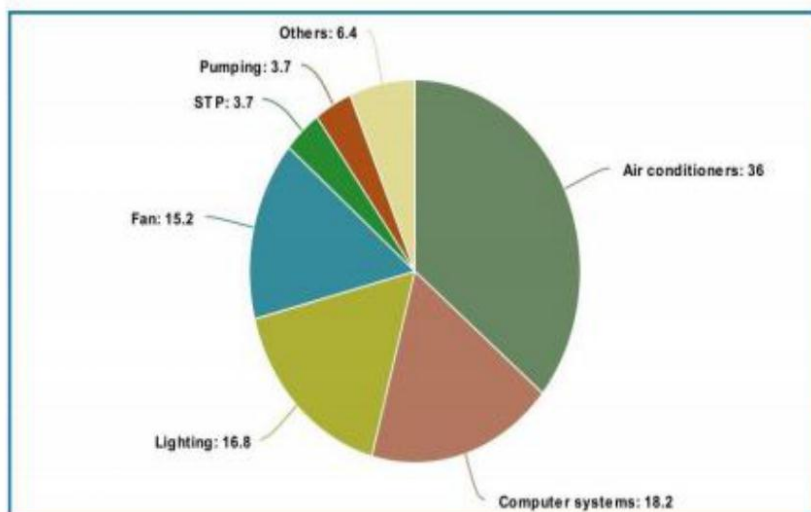
The exact time duration of the MD in zone 1 could not be ascertained since no such recordings are available. Readings were taken on 02/07/2019 to assess the period with the present operating loads and the MD is seen to be between 11 am and 12 noon.



But more accurate assessment can be made only once the institution is fully functional. Since both MD and consumption fall in zone 1, it is suggested to take hourly readings of KVA and KWh recorded in the HT meter between 9am and 4pm to monitor the peak loads and energy consumption so as to take possible controls to minimize MD and consumption.

Maintaining the MD without exceeding the contract demand as well as reducing the MD to 75% of CD will be beneficial to the institution by way of savings in MD charges. Further, reduction in MD will contribute to reduced energy charges over hours of consumption.

Connected load



Air conditioning system constitutes 36% of the total connected. About 18.2% of the total connected load is computer systems. Lighting system (142 kW) is 16.8% of the total connected load. Fans contribute 15.2 % of the total connected load.

STP which works most of the hours contribute 3.7% of the connected load. other 6.4%

includes printers, photo copiers, projectors etc

There are 86 air conditioners in the whole campus with a total tonnage of 241.5T equivalent to 301.875 kW. This is around 36% of the total connected load. The average monthly energy consumption is estimated to be 22500 units amounting to Rs 162000/- which is 39% of the total consumption. Tonnage of A/Cs varies from 1 ton to 8.5 ton. It is gathered that 66 of A/Cs with 209 ton (261.25 kW) are in regular use. Block wise details are furnished below,

Block A

Location	No of A/Cs with make	Tonnage	Total kW
A304 Network system lab	2 - Carrier (duct)	8.5 ton and 5.5 ton	17.5 kW
A303 Micro processor lab	1 - carrier (duct)	5.5 ton	6.8 kW
A302 Multimedia lab	2-Panasonic (tower)	3.5 ton	8.7 kW
A204 Hardware lab	3-Blue star (tower)	3.5 ton	13 kW
A202 Programming lab IT	1-Blue star (split) 1-Blue star (tower)	3.5 ton and 3 ton	



Block B

Location	No of A/C with make	tonnage	Total kW
B104 DBMS Lab	2-Blue star (split)	3 ton	7.5 kW
B 303 Computer lab	2-Blue star (split)	3 ton	7.5 kW
B 302 Systems lab	3-Blue star (split)	3 ton	11.25 kW
B308 Communication lab 1	2-Blue star (tower)	4.5 ton	11.25 kW
B309 Communication lab 2	2 units of Blue star tower	4.5 ton	11.25 kW
B 208 Circuit lab 1	1-Hitachi (split)	3.5 ton	4.3 kW
B 209 Circuit lab 2	1-Hitachi (split)	3.5 ton	4.3 kW
B 205 IC lab	1-Hitachi (split)	3.5 ton	4.3 kW
FAB LAB	1-Blue star (tower)	4 ton	5 kW
R&D computer lab	1-Blue star (tower)	4 ton	5 kW

Block C

Location	No of A/C with Make	tonnage	Total kW
C315 Common computing center	2-Blue star (tower) 2-Blue star (split)	3.5 ton 3 ton	15 kW
C 315A Project lab	2-Blue star (tower)	3.5 ton(2)	8.7 kW
C214 Language lab	2-Panasonic (tower)	3.5 ton(2)	8.7 kW
C PTC Seminar hall	3-Blue star (tower)	4 ton(3)	15 kW
C303 Computer lab	2-Blue star (tower)	4 ton(2)	14 kW
C202 Principal room	1-Samsung (split) 1-Mitsubishi(split)	1.5 ton each	3.7 kW



Director room	2-General (split) 1-Hair (split)	2 ton(2), 1 ton	6.25 kW
Manager room	1-Samsung (window)	1.5 ton	2.5 kW

Block D

Location	No A/C with make	tonnage	Total kW
D113 MBA Computer lab	2-Panasonic (tower)	3.5 ton each	8.7 kW
D306 VLSI Lab	1-Blue star (tower)	4.5 ton	5.6 kW
D407 Computer Application lab	2-Panasonic (tower)	3.5 ton each	8.75KW
D 402 Project lab CSE	2-Blue star (tower)	4.5 ton each	11.25 kW
D 304 PG lab CSE	2-Blue star (tower)	4.5 ton each	11.25 kW
D404 Embedded systems lab	1-Blue star (tower)	4.5 ton	5.6 kW
D419 Software lab	1-Voltas (split)	2 ton	2.5 kW
D116 GD Room	1-Samsung split 1-Mitsubishi split	2.5 ton 1 ton	4.3 kW

Startup Hub

Location	No of AC with make	Tonnage	Total kW
Room 01,02	1-Mitsubishi(split)	2 ton	2.5 kW
Room 03,04	1- Mitsubishi(split)	2 ton	2.5 kW
Room 06	1-voltas (split) 1-carrier(split)	1.5 ton, 2 ton	4.3 kW
Room 05	1- Voltas (split)	1.5 ton	1.8 kW



Room 07	1-Voltas(split)	1.5 ton	1.875 kW
Room 08,09	1-Voltas(split)	1.5 ton	1.875 kW

Other 20 nos. of A/Cs with 32 ton (40kW) are occasionally used,

Location Nos with ton

1. KTU Exam center 4 - 7 ton (C block)
2. Suite rooms 6 - 7 ton (B and D blocks)
3. Library 1 - 3.5 ton (C block)
4. Treasurer room 1 - 2 ton (C Block)
5. Conference hall 1 - 4 ton (C block)
6. Joint secretary 1 - 1.5 ton (D block)
7. Hostels 6-9 ton
- Total ----- 20 Nos—32 ton

66 nos of A/Cs in regular use are only considered for detailed study. Most of the A/Cs is seen to be not properly maintained. Heavy infiltration of heat is noticed in all air conditioned spaces due to poor thermal insulations. The outdoor units of A/Cs are clogged with heavy dust and the compressors are heavily loaded. The thermal insulations on the suction pipes are either fully or partially damaged. The set temperature in most of the A/Cs is very low (say 18°C) and without remote controls. Heavy dust deposits were seen on the indoor air filters as well as on air blowers. There was no thermal cutoff in most of the cases. The above factors have contributed to excessive peak demands and energy consumption.

The details of **observations** are given below,

1. The cooling fins, air filters, blowers condensers etc covered with heavy deposit of dust
2. The refrigerant pipes and end caps are not properly insulated 3. No thermal cutoff is seen even at higher temperatures in most of the air conditioned rooms.
4. The indoor air filters as well as air blowers and the outdoor units are clogged with heavy dust
5. No proper thermal insulations for the lab rooms.
6. All glass windows are not properly heat insulated
7. Remote controls are not properly maintained.
8. The curtains provided in AC rooms are corrugated/vertical blinds, not effective for AC rooms.
9. Non standard placement of outdoor units on sloping sun shades where proper maintenance cannot be carried out
10. Openings, opened doors and windows, removed curtains etc are noticed in many AC rooms.
11. Set temperatures are seen very low (18°C) in many rooms



12. The Carrier make duct unit 5.5 ton in A304 is not working
13. Door closer is not provided for A204
14. The outdoor unit Carrier 8.5t (duct) unit in A304 is exposed to rain water from the roof (corrosion and formation of large hole in the bottom part of outdoor unit)
15. Two nos of LG split A/Cs in the programming lab are not functional. 16. The air filter of A/C in D 402 is clogged with heavy dust
17. Broken glass windows in D 402 and D419
18. 1 no A/C (split) in CCC is not working
19. Neither sun control film nor curtains are provided on the glass partitions of Common Computing Centre (CCC)
20. 1 no Blue star (3.5 ton) tower A/C in CCC is delivering hot air 21. Water precipitation is noticed on the outdoor pipes of A/C in the server room 22. The A/C in C 221 is old window type
23. The outdoor unit of AC near the office room is air congested 24. No door closer is provided in PTC seminar hall
25. Heavy corrosion is noticed on the outdoor units of A/Cs in the PTC seminar hall which is located on the ground
26. The A/C in B 209 is not working properly.
27. The condensate water from the unit is not properly drained out in DBMS lab 28. Insufficient cooling in B 303

The above defects and shortfalls lead to increased energy consumption by way of continuous working of A/C units and contributing to high peak loads.

Lighting is identified as a potential area to achieve energy efficiency and energy savings by replacing the existing lamps with energy efficient lamps, rearrangements and through good operational practices.

There are altogether 2482 fluorescent tubes and 1694 CFLs besides a few no's of LED lamps with a total connected load of 142 KW which approximates to 16.8% of the connected load. Based on the survey and data collected, the most frequently used and more consuming areas with an average hours of operation of six and above are laboratories, staffrooms, office, hostels, library, common lighting, sewage treatment plant, startup hub etc.

A detailed study of the lighting system in the above areas has shown that most of the lamps in use are T12 fluorescent tubes (40 W tube + 5 W choke) and a less no. of double CFL sets. The average illuminance in most of the areas is around 100 lux (measured). The operational practices are also seen poor, with many lights ON without any use. High efficiency, low power consumption for the same illuminance and long life of LED tubes and bulbs make them good substitute for the above.

Luminous performance characteristics

Type of lamps	Average lumens/ watt	Typical life (hours)
---------------	----------------------	----------------------



FTL tubes	50	5000
CFL	60	8000-10000
LED lamps	90	30000-60000

Even though there are many Fl. Tubes and CFLs in the lighting system inside the campus, the number of lamps with daily operating hours of six and above are considered for detailed analysis.

The details of the existing ones and the retrofit proposals are tabulated below,

Block	No of FL Tubes (40W+5W)	No of CFL (18W)	Location	Proposed No. of LED tubes (18W)
A	105	Nil	· A 202 Programming lab IT · A 205 Hardware lab · A 302 Multimedia lab · A 303 Microprocessor lab · A 305 Network systems lab	67
B	91	42(21 Double units)	· B 104 DBMS lab · B 204 Data communication lab · B 205 I C lab · B 208 Circuits lab 1 · B 209 Circuits lab 2 · B 212 R & D Computer lab · B 212 A FAB lab	112
C	27	100(50 double unit)	· C 112 PTC Seminar hall · C 124 Language lab · C 303 ME CAD lab · C 215 Common computing center · C 315 A Project lab · C 315 B Server room	80
D	35	84(42 double units)	· D 113 Computer lab MBA · D 304 P G lab CSE · D 419 Software lab · D 407 Computer applications lab · D 116 G D room	77
Staff rooms	121		All staff rooms in 4 blocks	121



Men's hostel	125		· Rooms · Mess hall · Kitchen · Other common lighting areas ·	125
Ladies hostel	210		· Rooms · Mess hall · Kitchen · Other common lighting areas	210
Library	20		Common reading areas	20
office	16			13
Hub	50			50
STP	13			13
others	12		Street lighting and other common lightings	12

From the above, it is seen that 825 nos (40W tube+ 5W choke) of Fl. Tubes and 226 nos of CFLs(18W, 113 sets) can be replaced with 900 LED tubes as retrofits for the same area. Replacement of the present lamps with LED sets will also result in less heat dissipation in the air conditioned rooms which will reduce the A/C loads.

General observations are;

- 1) The general lighting system is not energy efficient and the performance is poor.
- 2) Many lights are seen kept ON without any use
- 3) Day lighting is restricted in most of the rooms by closed windows and curtains.

Recommendations

1. Cleaning and overhauling of indoor and outdoor units to be carried out periodically
2. Top up refrigerant if required on checks



3. Provide plain white curtains with no corrugation for all windows of A/C rooms.
4. Proper covering is to be provided for the 8.5 ton outdoor unit near the network system lab. The hole is to be plugged with a water proofing material.
5. Set temperature for air conditioned space to 24°C and above preferably
6. Provide sun control films to glass doors, glass partitions wherever air conditioned
7. It is proposed to replace the existing split A/C(2 ton) in server room with a 1 ton inverter A/C for better efficiency
8. Provide door closers to A/C rooms wherever not provided.
9. The refrigerant pipes of A/Cs are to be properly insulated wherever damages noticed.
10. Replace the outdoor unit of A/C(General make) near office to the open area for better air circulation
11. Proper covering is to be provided for the outdoor unit of A/Cs in PTC seminar hall.
12. The condensate water from the A/C Unit in DBMS lab is to be properly drained
13. Consider re arrangement of A/C labs, if feasible, for an even distribution in FN and AN to flatten the load curve.
14. Replace broken glasses in D402 and D419
15. Provide remote controls to get a better control over A/C working temperature.
16. Provide sufficient spacing and structure for outdoor units to facilitate proper maintenance
17. Never keep windows and doors open and curtains removed when AC is in use
18. Replace the window A/C with 1 ton split A/C
19. Re position the outdoor units of 6 nos of A/Cs in A and B blocks, to free open areas for better performance and reductions in load.
20. Maintain proper asset register and maintenance register for A/Cs
21. Feasibility of reducing the working hours of CCC by 2 hours to 6 pm can be thought of in order to reduce the peak energy charges
22. Wherever no computer systems are in use and minimal internal heat generation, avoiding A/Cs can be thought of by providing fans, if not.



The notified locations are,

1. A303- Microprocessor lab(1 no 5 ton)
2. B208 – Circuits lab I (1 no 3.5 ton)
3. B 209 – Circuit lab(1 no 3.5 ton)
4. B 205- IC lab (1 no 3.5 ton)
5. C 112 –PTC seminar hall (3 nos 4 ton)
6. D 306 –VLSI lab (1 no 4.5 ton)

23) Check the effectiveness of thermal insulations for rooms and refrigerant pipings, thermal cutoff of A/C units, dust deposition on air filters, temperature settings, positioning of curtains once in three months and carryout routine maintenance at least once in six months which includes cleaning of outdoor units and pressure checks on refrigerant pipes.

24) On completion of rectification works, reducing the number of AC units can be considered in the following locations based on the cooling results obtained in CCC.

25) Replace the existing Fl. Tubes and CFLs as per tabulation with LED tubes without delay for immediate paybacks

26) Replace the balance nos with LED tubes and bulbs in a phased manner

27) Insist on forced switch offs in hostels especially during class hours.

28) Insist on switching off all lights when not in use through better operational practices.

29) Replace existing lamps in bathrooms, corridors, and other public areas with low wattage LED lamps.

30) All street lights and other common lightings are to be replaced with 18W LED lamps.

31) Garden lighting and other illuminations are to be minimized.

32) Promote day lighting in offices, staffrooms, classrooms etc by keeping windows open and curtains removed.

33) Conduct awareness program among all staff and students on energy conservation and better operational practices and review its effectiveness periodically



34) Keep proper registers for the installation and replacement of lighting fixtures with date of purchase, date of installation, location etc for proper follow ups and claiming warranties. Assign the job to somebody who will be responsible and accountable for all the activities.

35) Maximize the use of day light by using transparent roof sheets in workshops and labs near canteen area.

36) Replace all fluorescent tubes and CFLs which become faulty with low wattage LED sets.

9.4 Waste management

VJCET follows a healthy waste management system in the campus right from its generation to keep the campus clean and green.

Solid waste management

To practice “segregation at source”, designated buckets are kept for Biodegradable and Non-Degradable waste in each block and other key locations of waste generation like Hostels, Canteen, Office, Library etc. The solid waste generated is approximately 300 kg/day. Out of this, 200 kg is biodegradable, 60 kg is combustible, 30 kg is recyclable and the remaining is mostly dust and silt. The biodegradable waste is used to charge two biogas plants each having 15 m³ holding capacity. The bio gas generated is used in the hostel kitchen. The slurry after digestion from the biogas plant is used for the vegetable garden. A portion of the kitchen waste generated is disposed of by vermin composting and is used for organic farming. Combustible items are collected in separate steel grill bin. The major portion, paper, is separated and sold to external agencies. The other rubbish is incinerated in a very efficient incinerator of 3 m³ holding capacity. The exhaust gas is driven out with a chimney of 12 m height. A ventilation space of 1 m³ provided below the waste holding chamber separated by a SS grill provides good air entry to the combustion chamber and effects complete burning. The ash generated is stored in an ash pit and is used as manure.

Liquid waste management

For treating the liquid wastes generated, a Sewage Treatment Plant (STP) of 3 lakh liter capacity with physicochemical, biological and multi stage filtration units are installed in the campus. A well-equipped water testing laboratory has been set up by the Civil Engineering Department along with the Sewage Treatment Plant. The performance of STP is assessed regularly by testing parameters like COD, BOD, Suspended Solids, pH etc. are tested in the environmental engineering laboratory of the Civil Engineering department. The entire treated water is used for watering the gardens, lawns and agricultural purposes. The sludge from the STP is dried and used as manure for the gardens. Therefore, the entire waste water generated in the campus is treated and reused effectively.

Biomedical waste management

Biomedical waste, the sanitary napkins and waste from the first aid room are disposed of by the incinerator installed in the campus.



E-waste management

Sellable, recyclable, non-recyclable electronic waste is separated at the source itself and sent to respective recycling units directly or through authorized agencies. All the scrap materials from different engineering laboratories have been collected frequently.

Waste recycling system

The items like plastics, metals, glasses etc. collected in separate bins kept in each block, are taken by authorized agencies and recycled.

Hazardous chemicals and radioactive waste management

Hazardous wastes such as dangerous chemicals are packed appropriately, transported and handed over to authorized agencies for safe disposal. No radioactive waste is generated on campus.

STP is normally under 24 hours operation. The total connected load is 32 KW. There is a continuous load of 17KW.

Through proper water conservation measures (minimization of waste water, misuses and leakages) the input load to the STP can be reduced marginally which can result in reduced pumping hours of clear water from STP as well as reduction in operational hours of STP. Once the input quantity of waste water to STP reduces, the consumption of chemicals will also come down.

The feasibility of shifting of operation of STP during peak hours (6pm to 10pm) to zone 3 (10pm to 6am) based on the inputs to STP can be considered which will result in reduced energy charges.

9.5 Green Campus

In this program all the trees in the college then identified the common name and scientific name of each trees. Mahogany (Swietenia), Fox tail palm (Wodyetia bifurcata), Spanish cherry (Mimusops elengi) are some of the examples of trees identified. The next process was board fixation. The boards of identified names of the trees are fixed accurately and eco- friendly, do not disturbing the growth of trees

List of trees in the campus

Common name of Tree	Scientific name of Tree	Number of Trees
1. Mahogany	Swietenia	17
2. Fox tail palm	Wodyetia bifurcata	8
3. Naga Linga	Couroupita guianensis	1
4. Pine tree	Pinus	11
5. Spanish cherry	Mimusops elengi	4
6. Indian gooseberry	Phyllanthus emblica	2
7. Almond tree	Prunus dulcis	5
8. Red palm	Cyrtostachys renda	19
9. Orchid tree	Bauhinia variegata	1
10. Mango tree	Mangifera Indica	1
11. Golden shower tree	Cassia fistula	8



12.Cocount tree	Cocos nucifera	7
13.Kindal tree	Terminalia Paniculata	1
14.Cheese tree	Glahidion ferdinandi	1
15.Ashoka tree	Sarca asoca	62
16.moringa tree	Moringa oleifera	3
17.Australian pine tree	Casuarina equisetifolia	1
18.Banyan tree	Ficus benghalensis	1
19.Bottle palm	Hyophrobe lagenicaulis	1
20.Barbados pride	Caesalphina pulcherrima	1
21.Mussenda	Mussaenda erythrophylla	1
22.Ficus tree	Ficus benjamina	3
23.cycas tree	Cycas revoluta	2
24.Divi-divi	Libidia coriaria	1
25.Java plum	Syzygium cumini	4
26.Beech tree	Fagus	11
27.Royal palm	Roystonea regia	1
28.Guava tree	Psidium guajava	1
29.khirini-tree	Manilkara hexandra	1
30.Teak	Tectona grandis	1
31.Red cotton tree	Bombax ceiba	1
32.Austalian Ficus	Ficus macrophylla	1
33.Pride of India	Lagerstroemia speciosa	1

Total 184 trees

Proper protection of the trees helps to reduce the content of carbon dioxide and other poisonous gases in the atmosphere. Students were able to gain new information about trees like their scientific names, their structures etc.

Protection and prevention of trees helped to make campus more eco-friendly.

When trees grow, they convert CO₂ to carbohydrates (sugar). They do this by photosynthesis, and this process forms building blocks of the tree. The oxygen that is produced is actually a side effect of this carbon sequestering. While the tree grows it keeps converting CO₂ in order to grow tall and strong. A young tree is still small and converts less, but as the tree grows bigger it also absorbs more Co₂.

Every year college celebrates World Environment Day, World Water Day and Ozone Day in the campus. The main focus of these programs was to provide awareness to the students about the importance of the environment, its conservation and sustainable use of environmental resources. The programs are conducted through seminars, poster presentation, quiz competition debates etc.

9.6 Carbon Foot Print Analysis

The most common greenhouse gases are carbon dioxide, water vapor, methane, nitrous oxide and ozone. Of all the greenhouse gases, carbon dioxide is the most prominent



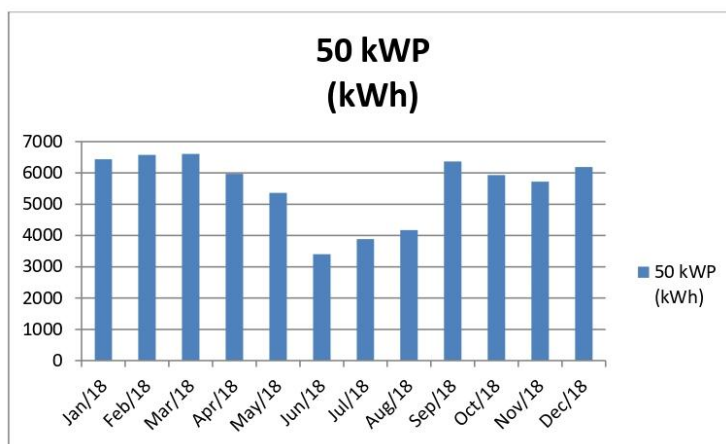
greenhouse gas, comprising 402 ppm of the Earth's atmosphere. Each human being is contributing towards adding green-house gases to the atmosphere depending upon his day to day activities and usage of instruments and machineries for different purpose.

Release of carbon dioxide gas into the Earth's atmosphere through human activities is commonly known as carbon footprint. An understanding about the same of any institute where large number of anthropogenic activities are happening is important to assess the contribution of emission of gases that are responsible for Green House Effect.

A young tree absorbs about 5.9 kilo gram CO₂ per year, while a 20 year old tree absorbs almost 30kilogram per year. By taking these numbers we can calculate the average CO₂ that is absorbed by the entire trees in the campus. And considering an average age of 20 years

So the carbon absorption will be in the order of 5520 kg annually.

SOLAR POWER PLANT GENERATION	
MONTH & YEAR	50 kWP (kWh)
Jan-18	6435
Feb-18	6574
Mar-18	6606
Apr-18	5969
May-18	5362
Jun-18	3402
Jul-18	3880
Aug-18	4172
Sep-18	6367
Oct-18	5928
Nov-18	5717
Dec-18	6187



Total energy generated = 66599kWh

15526 kg Carbon dioxide (and equivalent gasses) emission is reduced by the solar power plant

10. Future Action Plans

1. Year wise internal audit on green, water and energy to be conducted by respected teachers.
2. Proper management and month wise mapping of water and energy usage to be conducted by monitoring the same in the records.
3. Department wise awareness programs to be organised by department staff representative to each committee.
4. Improve the existing waste water management
5. Proper monitoring and disposal of waste discharge from chemical laboratories
6. Implementation of sign boards and indications of water and energy usage.
7. Energy maintenance by proper usage of electrical appliances.
8. Vegetable and agriculture crop planting has to be increased using advanced technologies.
9. Promotion of visit to agriculture farm lands and processing centres.
10. Marketing of vegetables and crops cultivated in the campus.

The students and staff who are active in green related activities have a clear vision about how and what should be planned for a greener campus. They think that planting of more saplings during the world environment day would cater more awareness and enthusiasm in students who join afresh each year. The college is also planning to initiate plant a tree/adopt a tree program where each student will be planting a sapling and taking care of it during his or her stay in the college. Although the college follows a university curriculum by implementing several such awareness programs in their academic and non-academic activities promote more students turn to green activities.



11. Conclusions

1. The management and other authorities are keen to make the campus a green campus
2. VJCET is making learning process by practical approach. This is fulfilled by setting different types of gardens, arboretum concept based garden and conservation of water and energy.
3. Staff and students are aware about the commitment of the institute towards the society.
4. Green audit at times makes the campus authority to understand the effect of implications towards greenness and conservation of water and energy.
5. The evaluation process proved that the authorities have applied implications suggested in the previous audit.
6. The campus community functions are oriented with an eco-friendly approach that enables the student community to develop a genuine approach on conservation of nature, and natural resources.
7. The results presented in the present report would be helpful for the authorities to make future action plans to develop more sophisticated ideas in bringing more values in future efforts towards conservation of biodiversity, water and energy.
8. We, hope the audit finding would help them implement better management plan to achieve a complete green campus, save maximum water and energy for a better future.
9. The whole attempt is made for reducing the electricity bills through conservation measures. The implementation of these conservation measures is to be carried out within one month positively.
10. It is desirable to assign responsibilities to selected personnel for effective supervision of the above works and for successful implementations so as to result in substantial reductions in maximum demand and energy consumption.
11. The results on implementation of the recommendations are to be reviewed for the effectiveness and sustenance.
12. The capital cost on implementation of the recommendations is estimated to be around Rs 6 lakhs and the monthly savings is approximated to a minimum of Rs 90,000/-. The payback is expected within 7 months.
13. As and when the 200 kWp solar project is commissioned and connected to the grid, a study on its impact on the systems and a total review of then Maximum Demand and energy consumption is to be carried out for better energy conservation and management

The green auditing was a successful program lead by our team. The event was highly informative for students and beneficial for our nature and it was a grand success.



VISWAJYOTHI

COLLEGE OF ENGINEERING & TECHNOLOGY

Approved by AICTE New Delhi & Affiliated to APJ Abdul Kalam Technological University

Vazhakulam P.O., Muvattupuzha
Ernakulam Dist., Kerala - 686 670
Tel: 0485 2262211 / 44
Email: vjcet@vjcet.org
www.vjcet.org



Energy Audit Report

1

ENERGY AUDITING REPORT

Conducted at

**VISWAJYOTHI COLLEGE OF
ENGINEERING AND TECHNOLOGY
VAZHAKULAM**

On

10/07/2017


ANEESH KURIAN ME, MIE
Chartered Engineer (Electrical)
BEE Certified Energy Auditor
Reg. No: EA-17246

VJCET Vazhakulam



CHAPTER 1

INTRODUCTION

The demand for energy is increasing day by day. So it is important for us to find newer means of energy that are both efficient as well as economical. It is also important for us to undertake take necessary measures to control the consumption of energy as well. So the major step that we should take while controlling the consumption is to understand the amount of consumption. The easiest and efficient way to understand that is by doing energy audit

An Energy Audit is an inspection, survey and analysis of energy flows, for energy conservation in a building, process or system to reduce the amount of energy input into the system without negatively affecting the outputs. In commercial and industrial real estates, an energy audit is the first step in identifying opportunities to reduce energy expenses and carbon foot prints. The major steps in conducting an energy audit are

- Pre Audit Phase
- Audit Phase
- Post Audit Phase



1.1 OBJECTIVE OF ENERGY AUDIT EXERCISE

The objective of Energy Audit is to promote the idea of Energy Conservation in the Campus of VJCET. The purpose of the energy audit is to identify, quantify, describe and prioritize cost saving measures relating to energy use in the Hostels, Departments and Institute Central Facilities.

The work eligible for Energy Audit Study should be directed towards:

- Identification of areas of energy wastage and estimation of energy saving potential in Hostels, Departments and Institute Central Facilities.
- Suggesting cost-effective measures to improve the efficiency of energy use.
- Estimation of implementation costs and payback periods for each recommended action.
- Documenting results & vital information generated through these activities.
- Identification of possible usages of co-generation, renewable sources of energy (say Solar Energy) and recommendations for implementation, wherever possible, with cost benefit analysis.

1.2 ANALYSIS OF AREA OF USE

Identifying where energy is used is useful because it identifies which areas the audit should focus on and raises awareness of energy use and cost. The results of the analysis can be used in the review of management structures and procedures for controlling energy use.

Analysis of energy use can be done by installing sub meters in different plant locations to pin point actual energy usage per area. This is a good sourced at a for allocating energy use. The plant manager can also list all equipment used and the corresponding operating hours. With this information, spread sheet can be created and charts useful for analysis may be generated.

Important Points to Consider When Collecting Load Data:

a. USAGE

The usage of the equipment in terms of hours per day and days per year can be collected from key persons in Hostels, departments etc. It is important to



ensure the accuracy of this data because much of the potential for energy savings lies on wise allocation of the equipment's operating hours.

b. ACTUAL POWER CONSUMED

Actual power consumption is measured by Wattmeter or Power analyser installed in the campus

c. SUPPLEMENTARY INFORMATION

Some other supplementary information is also collected such as state of insulation in case of ACs or availability of natural light etc.

1.3 IDENTIFICATION OF TARGET AREAS

Opportunities for energy savings can range from the simplest, such as lighting retrofits, to the most complex such as the installation of a sewage treatment plant. After the preliminary identification of opportunities, more time should be spent on those which have shorter payback periods.

1.4 COST BENEFIT ANALYSIS

The identified energy conservation opportunities should be analysed in terms of the costs of implementing the project versus the benefits that can be gained. Say for example, if we wish to install a heat plate exchanger to recover waste heat, we must calculate the total cost of installation and compare that with the savings derived from recovering waste heat.

1.5 ACTION PLAN TO SET IMPLEMENTATION PRIORITY

After passing the cost benefit test, an action plan should be developed to ensure that the opportunities identified are implemented. The action plan should include all the major steps for implementing the opportunity as well as the people responsible. Furthermore, there should be a plan for monitoring the results.



CHAPTER 2

ENERGY AUDIT METHODOLOGY

The methodology adopted for this audit was a three step process comprising of:

1. DATA COLLECTION

In preliminary data collection phase, exhaustive data collection was performed using different tools such as observation, interviewing key persons and measurements.

2. DATA ANALYSIS

Detailed analysis of data collected was done by our selves

3. RECOMMENDATION

On the basis of results of data analysis and observations, some steps for reducing power consumption without affecting the comfort and satisfaction were recommended along with their cost analysis.

2.1 DATA COLLECTION

For suggesting any corrective measures to reduce power consumption, it is first necessary to know the power consumption pattern in detail. For this, the exhaustive data collection exercise was performed at all the departments, academic centres, hostels, and other supporting entities such as library, computer centre etc.

Following steps were taken for data collection:

- The team went to each department, computer centre, hostels, lab etc.
- Information about the general electrical appliances was collected by observation and interviewing the staff in charge.



Energy Audit Report

5

- The power consumption of appliances was measured using power analyser in some cases (such as fans) while in other cases, rated power was used (CFL for example).
- The details of usage of the appliances were collected by interviewing key persons e.g. Warden (in case of hostels), caretaker (in case of departments) etc.
- Approximations and generalizations were done at places with lack of information.

2.2 DATA ANALYSIS

In data analysis, the data collected is processed to draw significant conclusions to pin point loop holes and identify the areas to focus upon. Analysis of the power consumption observations obtained was used to obtain the power consumption pattern and also to get the information about the points where electric power is wasted.

2.3 RECOMMENDATION

Energy as well as cost analysis of different appliances were performed and recommendations were made based on the capital cost recovery time.

Following were the steps involved in this process:

- The capital cost involved in replacing an appliance and/or process was estimated.
 - The energy saving by the move was calculated in terms of price of energy per year.
 - These two costs were compared to calculate the capital cost recovery time which is defined as the total time by which the saving in energy bill balances the capital cost involved.
 - If capital cost recovery time is less than the product life, the move can be supported.
- Some other recommendations were also made which are based on lighting intensity, AC insulation etc.



CHAPTER 3

ANALYSIS OF POWER CONSUMPTION

By conducting the survey, we have analysed the power consumption by equipment, application as well as location. Here is the summary of the analysis presented in form of charts for better understanding.

3.1 OVERALL CAMPUS

There are 2 hostels, 6 academic departments, 1 academic centre, and supporting infrastructures like central library, computer centre, instrumentation centre, Administrative block (Main Building) in VJCET campus. The analysis implies that hostels in general, Main Building, Computer Centre power are relatively more power consuming unit of the campus. A point to note in the above chart is the higher consumption of AC as compared to departments which in itself explains how ACs and Computers affect the consumption distribution. Library has lower consumption in spite of having central AC due to steps such as use of CFL and wall fans which greatly reduce the consumption.

The college is basically classified into 4 different blocks namely A, B, C and D. The campus also include Men's and Ladies Hostel along with Laboratories and Auditoriums and other related buildings

3.2 BLOCK A

The details of A block of the VJCET campus is shown in table below.

ROOM NO.	FAN	TUBE	PROJECTOR	PRINTER	COMPUTER	CFL
A101		1				
A102	6	9		2	8	1
A103	3	5		1	1	1
A104	5	5	1			
A105	5	5	1			
A303		18				10
A304		28			42	
CORRIDOR		1				6
A204					35	20
A305		10			40	



Energy Audit Report

7

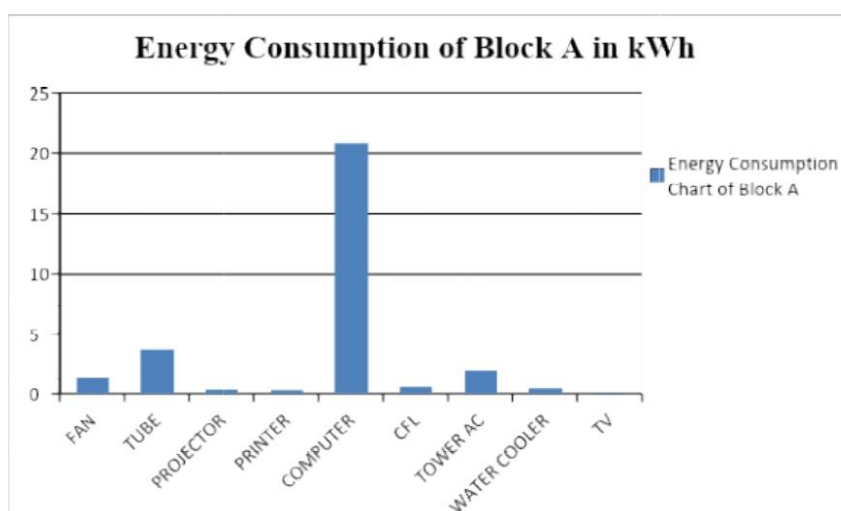
TOTAL	19	82	2	3	126	38
--------------	-----------	-----------	----------	----------	------------	-----------

Table 3.2.1 Audit data block A

ROOM NO.	TOWER AC	WATER COOLER	TV	SPEAKER	BULB	LED TUBE	LED BULB
A101							
A102							
A103							
A104							
A105							
A303							
A304	1						
CORRIDOR		1	1				
A204	2						
A305	2						
TOTAL	5	1	1	0	0	0	0

Table 3.2.2 Audit data block A

For the purpose of analysis of energy consumption what we did is we found out the total energy that is consumed by each of the components in one hour and we plotted a graph on the basis of the collected data.



VJCET Vazhakulam



Graph 3.2.1 Energy consumption of block A

3.3 BLOCK B

The block B of VJCET Campus is much larger than that of block A. It consists of so many class rooms as well as Laboratories. The list of electricity consuming components in block B is shown below.

ROOM NO.	FAN	TUBE	PROJECTOR	PRINTER	COMPUTER	CFL
B101		1				3
Ground floor						9
B102	5	3	1			
B203	5	3	1			
Corridor 1						10
B105	3	2		1	5	1
B104	7	11			43	
B301		1				
B304	5	3				
B305						
B001		2				
B002		1				
B003	10	5	1		2	
B004	1	1		1	3	1
B006	4	2			4	1
B005	4	2				
Corridor 0		7				
B115	4	2		1	2	1
B114	6	3	1			
B113	6	3	1			
B112	6	3	1			
B205	8	8			2	
B204	7	10			12	
B202	4	2		1	7	
B203	4	2		1		
B201		1				
B207	2	2		1	1	1
B208	8	12			1	
B209	8	12			2	
B308	4				1	20
B309	6				16	27
B303		10	1	1	33	
B302		18			40	



Energy Audit Report

9

B304	5	3		1		
B305	5	3		1		
B306		1				
TOTAL	127	139	6	9	174	74

Table 3.3.1 Audit data block B

ROOM NO.	TOWER AC	WATER COOLER	TV	SPEAKER	BULB	LED TUBE
B101						
Ground floor			1			
B102						
B203						
Corridor 1		1				
B105						
B104						
B301					3	
B304						
B305						
B001						
B002						
B003						
B004						
B006						
B005						
Corridor 0						
B115						
B114						
B113						
B112						
B205						
B204						
B202						
B203						
B201						
B207						
B208						
B209						

VJCET Vazhakulam



Energy Audit Report

10

B302	2					
B303	2					
B304						
B305						
B305						
B307						
B308						
TOTAL	4	1	1	0	3	0

Table 3.3.2 Audit data block B

ROOM NO.	LED BULB	SCANNER	EXHAUST	AC	PEDESTAL FAN
B101			1		
Ground floor					
B102					
B203					
Corridor 1					
B105					
B104				2	
B301					
B304					
B305					
B001					
B002					
B003					
B004					
B006					
B005					
Corridor 0					
B115					
B114					
B113					
B112					
B205					
B204					
B202					
B203					
B201					

VJCET Vazhakulam



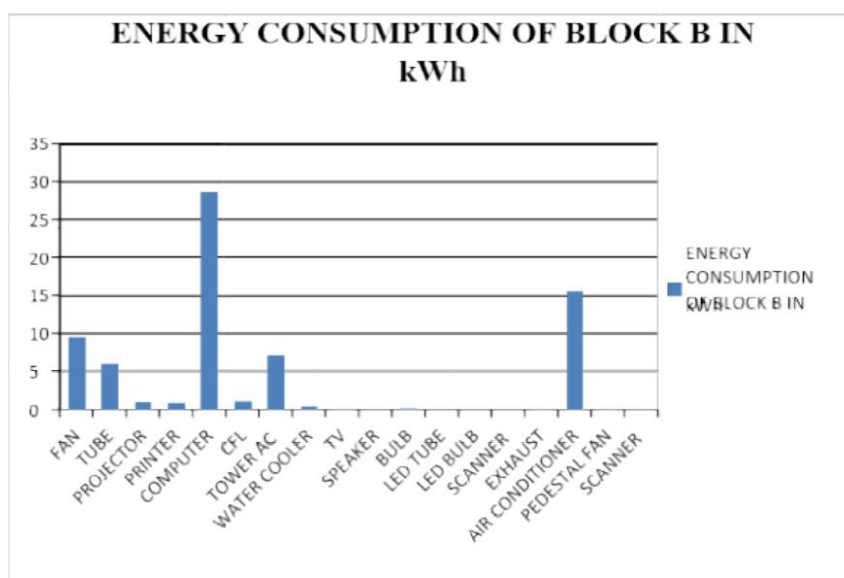
Energy Audit Report

11

B207					
B208				3	
B209				3	
B308					
B309					
B303		1		2	1
B302				3	1
B304					
B305					
B306					
TOTAL	0	1	1	13	2

Table 3.3.3 Audit data block B

So on the basis of power rating of each of these listed out components we have made a graph showing the consumption made by each device.



Graph 3.3.1 Energy consumption block B

VJCET Vazhakulam



3.4 BLOCK C

The block C of VJCET Campus is much larger than that of block A and B. It consists of so many class rooms as well as Laboratories. The list of electricity consuming components in block C is shown below.

ROOM NO.	FAN	TUBE	PROJECTOR	PRINTER	COMPUTER	EXHAUST
C101						
C102	5	5	1			
C103	2	2		1	1	
C104	5	4	1			
C105	5	1		1		
C107	1	1		1	1	
C108	2	2				
C109	1	1		1	1	
C110	1	1				
C111	1	1		1	1	
C112	12	12	1			
C115	1	1		1	2	
C116	1	1				
C117	1	1				
C118	1	1		1	1	
C119	1	1		1	1	
C121	1	2		1	1	
C122	1	1		1	1	
C123	4	1		1	2	
C124 LANGU AGE CLUB	6	6	1		60	
C126		2				
C128 REPRO GRAPH Y	4	6		1	3	
C170	2	2		1	1	
C201	15	15		6	11	
C206	4	2		7	7	
C207	5	2	1			
C208		1				1
C209	3	2		1	7	
C210	2	2			2	
C211	1	1			1	



Energy Audit Report

13

C212	6	10	1			
C213	6	5	1			
C214	6	5	1			
C215	6	5	1			
C216	5			7	5	
C217	5			7	5	
C218	6	6		1	7	
C219	2	2		1	1	
C220	1	1		1	1	
C222	5	5	1			
C223		1				
C223	6	6		1	10	
C302	5	5				
C303			1		34	
C304	5	3	1			
C304	5	6		1		
C305	5	3	1			
C306	5	3	1			
C307	5	3	1			
C308	4	4		1	1	
C313	6	6	1			
C314	6	6	1			
C316	3	5				
C317	2	5				
C318	8	8		1	9	
C319	1	1		1	1	
C320	2	2		1	4	
C321	2	3		1	3	
C323	5	5	1			
C324	5	5	1			
C325	15	18				
CCC					60	
CONFERENCE HALL						
LIBRARY	92	125		2	76	6
OFFICE CORRIDOR	3	1				
PRO	1	1		1	1	
TOTAL	327	344	19	54	322	7

Table 3.4.1 Audit data block C

ROOM NO.	CFL	LED BULB	AC	PHOTOSTAT MACHINE	BARCODE READER	TOWER AC
C101	2					

VJCET Vazhakulam



Energy Audit Report

14

C102						
C103	1					
C104		1				
C105						
C107						
C108						
C109						
C110						
C111						
C112						4
C115						
C116	1					
C117	1					
C118	1					
C119	1					
C121	1					
C122						
C123						
C124 LANGUAGE CLUB						
C126						
C128 REPROGRAP HY			1	4		
C170	1					
C201						
C206						
C207		1				
C208						
C209						
C210						
C211	1					
C212						
C213						
C214						
C215						
C216		1				
C217		1				
C218	1					
C219						
C220						
C222						
C223						
C223	1					
C302						
C303	32			1		2
C304						

VJCET Vazhakulam



Energy Audit Report

15

C304						
C305						
C306						
C307						
C308						
C313						
C314						
C316						
C317						
C318						
C319						
C320						
C321						
C323						
C324						
C325						
CCC	42		2			2
CONFERENCE HALL						
LIBRARY	62			1	4	1
OFFICE	1					
CORRIDOR						
PRO						
TOTAL	149	4	3	6	4	9

Table 3.4.2 Audit data block C

ROOM NUMBER	TELEVISION	LED TUBE	TV	TABLE FAN
C101				
C102				
C103				
C104				
C105				
C107				
C108				
C109				
C110				
C111				
C112				
C115				
C116				
C118				
C119				
C121				
C122				
C123				

VJCET Vazhakulam



Energy Audit Report

16

C124 LANGUAGE CLUB				
C126				
C128 REPROGRAPHY				
C170				
C201				
C206				
C207				
C208				
C209				
C210				
C211				
C212				
C213				
C214				
C215				
C216		6		
C217		6		
C218				
C219				
C220				
C222				
C223				
C223				
C302				
C303				
C304				
C304				
C305				
C306				
C307				
C308				1
C313				
C314				
C316				
C317				
C318				
C319				
C320				
C321				
C323				
C324				
C325				
CCC				

VJCET Vazhakulam

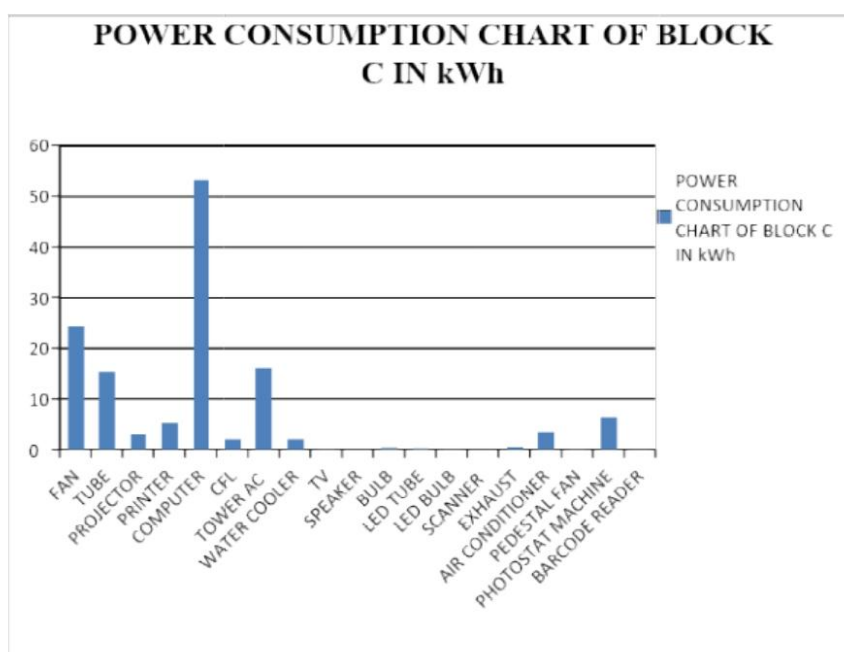


Energy Audit Report

17

CONFERENCE HALL				
LIBRARY	1			
OFFICE CORRIDOR			1	
PRO				
TOTAL	1	12	1	1

Table 3.4.3 Audit data block C



Graph 3.4.1 Energy consumption block C

3.5 BLOCK D

ROOM NO.	FAN	TUBE	PROJECTOR	PRINTER	COMPUTER	CFL
D401	6	6	1			
D402	6	6	1			
D403	6					
D404					25	10
D405						
D406 SEMINAR HALL	7	12	1			
D407	10	11	1	1	35	

VJCET Vazhakulam



Energy Audit Report

18

D408						
CORRIDOR						
D 301	4	4	1			
D 302	4	4		1	5	
D 303	4	4	1			
D 304					41	38
D 305	6	6	1		1	
D 306			1		18	18
D 307						
D 308	5	2	1			
D 309	9	2	1			
D 310	5	2	1			
D 311		1				
D 312		1				
D 313		1				
CORRIDOR						
D 201	3	6		1	1	
D 202	8	8	1			
D 203						
D 204	6	6	1			15
D 205	6	6				15
D 206	2	2				
D 207	4	4		1	7	1
D 208	5	6	1			
D 209	5	6	1			
D 210	2	2			5	
D 211						
D 212		1				
D 213	2	2			3	
D 214	2	4			2	
D 215	3	3			4	
D 216						
D 217	3	2		1	4	1
CAFETERIA	1	1				
D 101	1	1			1	
D 102	5	6				
D 103						
D 104	8	6	1			
D 105	2	2			1	1
D 106	4	4		1	9	1
CL101	11	20				
CL 201	11	16				
CL204	11	16				
CL301	10	14				
CL302	6	8				
CL303	6	9				
CL402	10	15				
CL209	11	7				

VJCET Vazhakulam



Energy Audit Report

19

TOTAL	220	245	16	6	162	100

Table 3.5.1 Audit data block D

ROOM NUMBER	TOWER AC	WATER COOLER	TV	SPEAKER	BULB	LED TUBE
D401						
D402						
D403						
D404	1					
D405						
D406				2		
SEMINAR HALL						
D407	2					
D408						
CORRIDOR						
D 301						
D 302						
D 303						
D 304	2					
D 305						
D 306	1					
D 307						
D 308						
D 309						
D 310						
D 311						
D 312						
D 313						
CORRIDOR						
D 201						
D 202						
D 203						
D 204						
D 205						
D 206						
D 207						
D 208						
D 209						
D 210						
D 211						
D 212						

VJCET Vazhakulam



Energy Audit Report

20

D 213						
D 214						
D 215						
D 216						
D 217						
CAFETERIA						
D 101						
D 102						
D 103						
D 104						
D 105						
D 106						
CL101						
CL 201						
CL204						
CL301						
CL302						
CL303						
CL402						
CL209						
TOTAL	6	0	0	2	0	0

Table 3.5.2 Audit data block D

ROOM NUMBER	LED BULB	SCANNER	EXHAUST	FRIDGE	FREEZER	COFFEE MAKER
D401						
D402						
D403						
D404						
D405						
D406 SEMINAR HALL						
D407						
D408						
CORRIDOR						
D 301						
D 302						
D 303						
D 304		1				
D 305						
D 306						
D 307						
D 308						

VJCET Vazhakulam

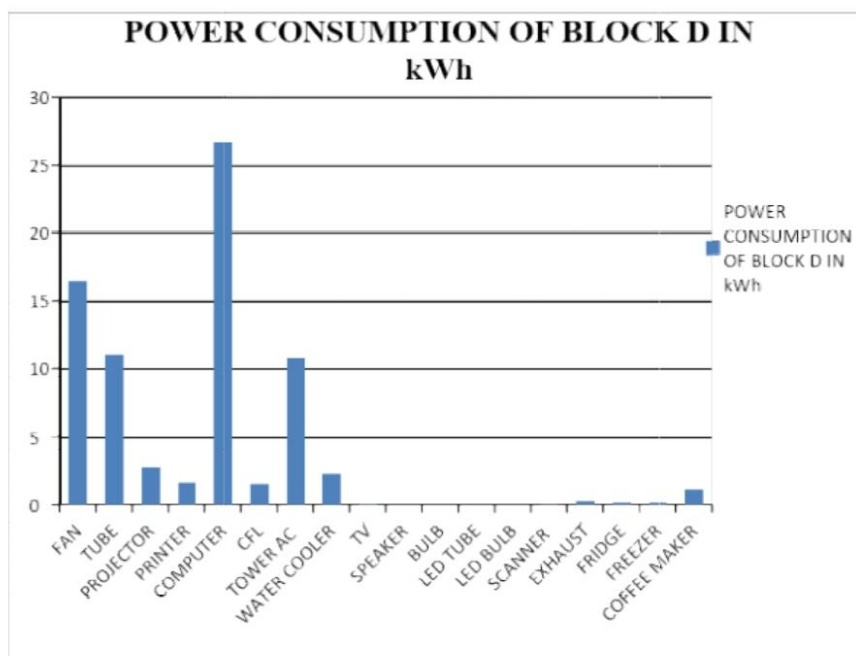


Energy Audit Report

21

D 309						
D 310						
D 311						
D 312						
D 313						
CORRIDOR						
D 201						
D 202						
D 203						
D 204						
D 205						
D 206						
D 207						
D 208						
D 209						
D 210						
D 211						
D 212						
D 213			1			
D 214			2			
D 215			1			
D 216						
D 217						
CAFETERIA				1	1	1
A						
D 101						
D 102						
D 103						
D 104						
D 105						
D 106						
CL101						
CL 201						
CL204						
CL301						
CL302						
CL303						
CL402						
CL209						
TOTAL	0	1	4	1	1	1

Table 3.5.3 Audit data block D



Graph 3.5.1 Energy consumption in block D

3.6 MBA BLOCK

ROOM NUMBER	FAN	TUBE	PROJECTOR	PRINTER	COMPUTER	CFL
D109	1	1				
D110 FACULTY SUITE						
D111 FACULTY SUITE						
D112		1				2
D113 COMPUTER LAB	8	18	1		64	1
D114	2	1		1	2	1
D115	4	4		1	1	1
D116	6	6	1			
CORRIDOR		2				4
D218	16	16	1			

VJCET Vazhakulam



Energy Audit Report

23

D219		1				1
D220	2					1
D221	10	10		1	7	2
D222	2	1				
D223	4	2	1			
D224	6	6	1			
CORRIDOR		2				4
D314	7	6	1			
D315	1	1				
D316						
D317	18	18			12	1
D318	12	12	1			
CORRIDOR						
D411	3			1	4	
D412	6	6	1			
D413	1	1			1	
D414						1
D415						1
D416	3	2		1	4	
D417	4	4				
D418	3	4				
D419	2				6	
D420	6	8	1			
D421	6	12				
TOTAL	133	145	9	5	101	20

Table 3.6.1 Audit data MBA block

ROOM NUMBER	TOWER AC	WATER COOLER	TV	SPEAKER	BULB	LED TUBE	LED BULB
D109							
D110							
FACULTY SUITE							
D111							
FACULTY SUITE							
D112							
D113	2						
COMPUTER LAB							
D114							
D115							
D116							
CORRIDOR		1	1				
D218							

VJCET Vazhakulam

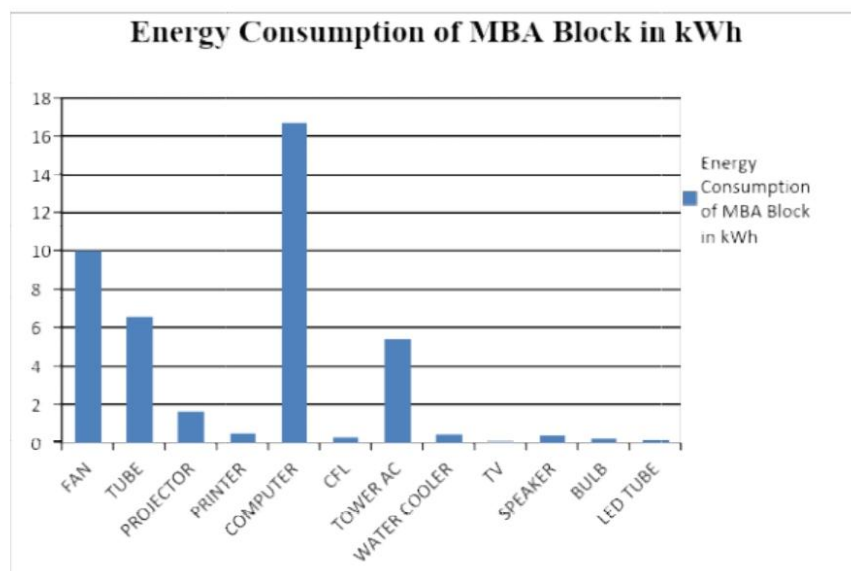


Energy Audit Report

24

D219							
D220							
D221							
D222							
D223							
D224							
CORRIDOR							
D314				2			
D315							
D316					1		
D317							
D318				2			
CORRIDOR							
D411						2	
D412							
D413							
D414							
D415							
D416							
D417							
D418							
D419	1					7	
D420							
D421							
TOTAL	3	1	1	4	1	9	0

Table 3.6.2 Audit data MBA block



Graph 3.6.1 Energy Consumption MBA block

3.7 R&D BLOCK

ROOM NUMBER	FAN	TUBE	PROJECTOR	COMPUTER	PRINTER	CFL
B001 T		2				
B002 T		1				
B003	10	5	1	2		
B004	1	1		3	1	1
B005	4	2				
B006	4	2		4		1
B111 T		1				
B112	6	3	1			
B113	6	3	1			
B114	6	3	1			
B115	4	2		2	1	1
STAFFROOM						
R&D COMPUTER RESEARCH LAB	22	10		59		
R&D SEMINAR HALL	20	10	1			
FACULTY	3					



Energy Audit Report

26

SUITE 1						
FACULTY SUITE 2	3					
TOTAL	89	45	5	70	2	3

Table 3.7.1 Audit data R&D block

ROOM NUMBER	LED TUBE	LED BULB	SPEAKER	WATER COOLER	WATER HEATER	EXHAUST	A/C	FRIDGE	T V
B001 T									
B002 T									
B003									
B004									
B005									
B006									
B111 T									
B112									
B113									
B114									
B115 STAFF ROOM									
R&D COMPUTER RESEARCH LAB	6		5						
R&D SEMINAR HALL	6	10	5						
FACULTY SUITE 1		20			1		2		1
FACULTY SUITE 2		20			1		2		1
TOTAL	12	50	10	0	2	0	4	0	2

Table 3.7.2 Audit data R&D block

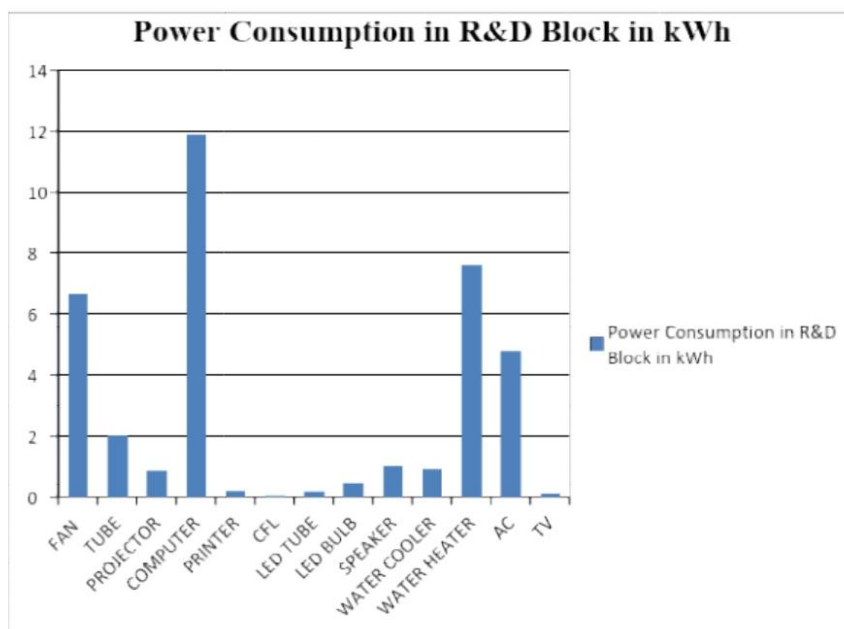


Table 3.7.1 Energy Consumption R&D block

3.8 MEN'S HOSTEL

ROOM NUMBER	FAN	TUBE	LAPTOP	ELECTRIC KETTLE	IRON BOX	PRINTER
100		5				
101	1	1				
102	1	1				
103	1	1				
104	2	2	1		1	1
105	1	1	1		1	
106	1	1				
107	1	1				
108	1	1	1			
109	1	1				
110	1	1	1			
111	1	1				
112		5				
113	1	1				
114	1	1	1		2	
115	1	1				
116	1	1		1		



Energy Audit Report

28

117	1	1	1			
118	1	1	1			
119	1	1				
120	1	1	1			
121	1	1	2			
122	1	1	2	1		
123	1	1	1	1		
124	1	1	3	1		
125	1	1				
200		5				
201	1	1				
202	1	1				
203	1	1				
204	1	1	1			
205	1	1	1		1	
206	1	1				
207	1	1				
208	1	1	1			
209	1	1				
210	1	1	1			
211	1	1				
212		5				
213	1	1				
214	1	1	1		2	
215	1	1				
216	1	1		1		
217	1	1	1			
218	1	1	1			
219	3	1				
220	1	1	1			
221	1	1	2			
222	1	1	2	1		
223	1	1	1	1		
224	1	1	3	1		
225	1	1				
300		5				
301	1	1				
302	1	1				
303	1	1				
304	1	1	1			
305	1	1	1		1	
306	1	1				
307	2	2			1	1
308	1	1	1			
309	1	1				
310	1	1	1			
311	1	1				
312		5				

VJCET Vazhakulam



Energy Audit Report

29

313	1	1				
314	1	1	1		2	
315	1	1				
316	1	1		1		
317	1	1	1			
318	1	1	1			
319	1	1				
320(CHAPPEL)	4	5	1			
321	1	1	2			
322	1	1	2	1		
323	1	1	1	1		
324	1	1	3	1		
325	1	1				
TERRACE		4				
CORRIDOR		16				
OFFICE	1	1				
MESS HALL	16	27				
400		2				
401	2	3	2			
402				1		
403						
404	1	1	2			
405	1	1	1	1		
406	1	1	2			
407	1	1	1			
408	1	1	1	1		
409	1	1	1			
410		2	2			
411	1	1	1	1		
412	1	1	2			
413	1	1	3			
414	1	1	1	1		
415	1	1	2			
416	1	1	1	1		
417	1	1	3	1		
418	1	1	3	1		
419	1	1	3			
420	1	1				
500		2				
501	1	1	1			
502	1	1		1		
503	1	1	2			
504	1	1	3	1		
505	1	1	2			
506	1	1		1		
507	1	1				
508	1	1	2	1		
509	1	1	3			

VJCET Vazhakulam



Energy Audit Report

30

510		2	2	1		
511	1	1				
512	1	1	2	1		
513	1	1	3	1		
514	1	1	2	1		
515	1	1	3	1		
516	1	1	1	1		
517	1	1		1		
518	1	1	1	1		
519	1	1	2			
520	1	1				
601	1		1			
602	1		2	1		
603	1		3			
604	1		1			
605	1		2			
606	1		2			
607	1		2	1		
608	1		1			
609	1		1			
610	1					
611	1		1			
612			2			
701	1			1		
702	1		1			
703	1		2			
704	1					
705	1		2			
706	1		2	1		
707	1		2			
708	1		2			
709	1					
710	1			1		
711	1					
712			2			
801	2					
802	1			1		
803	1					
804	1		3			
805	1					
806	1					
807	1			1		
808	1					
809	1		2			
810	1					
811	1					
812						
901	1		3	1		

VJCET Vazhakulam



Energy Audit Report

31

902	1					
903	1					
904	1					
905	1		2			
906	1					
907	1		2			
908	1					
909	1					
910	1		3			
911	1					
912	1		3			
913			3			
COURTYARD		15				
TOTAL	179	217	160	40	11	2

Table 3.8.1 Audit data Men's Hostel

ROOM NUMBER	WATER COOLER	SPEAKER	LED TUBE	LED BULB	AC	CFL
100						
101						
102						
103						
104					1	2
105						
106						1
107						
108						
109						
110						
111						
112						
113						
114						
115						
116						
117						
118						
119						
120						
121						
122						
123						
124						
125						
200						
201						

VJCET Vazhakulam



Energy Audit Report

32

202						
203						
204						
205						
206						1
207						
208						
209						
210						
211						
212						
213						
214						
215						
216						
217						
218						
219						
220						
221						
222						
223						
224						
225						
300						
301						
302						
303						
304						
305						
306						1
307					1	2
308						
309						
310						
311						
312						
313						
314						
315						
316						
317						
318						
319						
320(CHAPPEL)						5
321						
322						
323						

VJCET Vazhakulam



Energy Audit Report

33

324						
325						
TERRACE						
CORRIDOR	2	6				
OFFICE						
MESS HALL					6	
400						
401					3	
402						
403						
404						
405						
406						
407						
408						
409						
410						
411						
412						
413						
414						
415						
416						
417						
418						
419					1	
420					1	
500						
501					1	
502					1	
503						
504						
505						
506						
507						
508						
509						
510						
511						
512						
513						
514						
515						
516						
517						
518						
519					1	
520					1	

VJCET Vazhakulam



Energy Audit Report

34

601				1		
602				1		
603				1		
604				1		
605				1		
606				1		
607				1		
608				1		
609				1		
610				1		
611				1		
612						
701				1		
702				1		
703				1		
704				1		
705				1		
706				1		
707				1		
708				1		
709				1		
710				1		
711				1		
712						
801						
802				1		
803				1		
804				1		
805				1		
806				1		
807				1		
808				1		
809				1		
810				1		
811				1		
812						
901				1		
902				1		
903				1		
904				1		
905				1		
906				1		
907				1		
908				1		
909				1		
910				1		
911				1		
912				1		

VJCET Vazhakulam



Energy Audit Report

35

913						
COURTYARD						
TOTAL	2	6	0	44	2	27

Table 3.8.2 Audit data Men's Hostel

ROOM NUMBER	TV	SYSTEM	LED TUBE	UPS
100				
101				
102				
103				
104		1		
105				
106				
107				
108				
109				
110				
111				
112				
113				
114				
115				
116				
117				
118				
119				
120				
121				
122				
123				
124				
125				
200				
201				
202				
203				
204				
205				
206				
207				
208				
209				
210				
211				

VJCET Vazhakulam



Energy Audit Report

36

212				
213				
214				
215				
216				
217				
218				
219	1			
220				
221				
222				
223				
224				
225				
300				
301				
302				
303				
304				
305				
306				
307		1		
308				
309				
310				
311				
312				
313				
314				
315				
316				
317				
318				
319				
320(CHAPPEL)				
321				
322				
323				
324				
325				
TERRACE				
CORRIDOR				
OFFICE			1	
MESS HALL				
400				
401				
402				
403				

VJCET Vazhakulam



Energy Audit Report

37

404				
405				
406				
407				
408				
409				
410				
411				
412				
413				
414				
415				
416				
417				
418				
419				
420				
500				
501				
502				
503				
504				
505				
506				
507				
508				
509				
510				
511				
512				
513				
514				
515				
516				
517				
518				
519				
520				
601			1	
602			1	
603			1	
604			1	
605			1	
606			1	
607			1	
608			1	
609			1	
610			1	

VJCET Vazhakulam



Energy Audit Report

38

611			1	
612			2	
701			1	
702			1	
703			1	
704			1	
705			1	
706			1	
707			1	
708			1	
709			1	
710			1	
711			1	
712			2	
801			2	
802			1	
803			1	
804			1	
805			1	
806			1	
807			1	
808			1	
809			1	
810			1	
811			1	
812			2	
901			1	
902			1	
903			1	
904			1	
905			1	
906			1	
907			1	
908			1	
909			1	
910			1	
911			1	
912			1	
913			2	
COURTYARD			16	
TOTAL	1	2	71	0

Table 3.8.3 Audit data Men's Hostel



Energy Audit Report

39

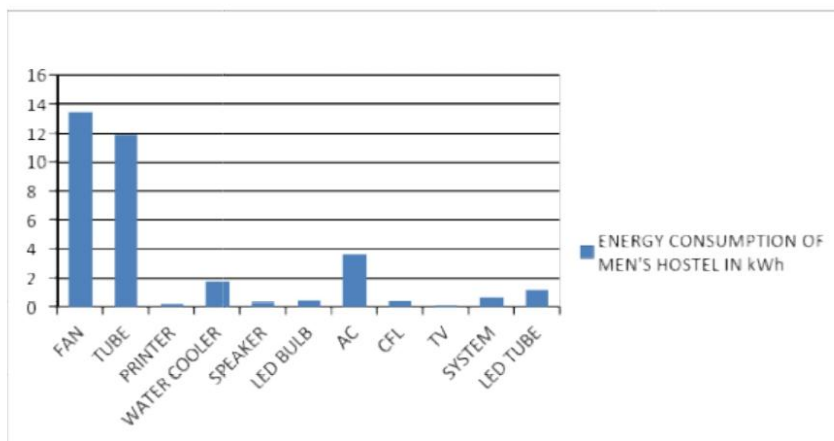


Table 3.8.1 Energy consumption Men's Hostel

3.9 LADIES HOSTEL

		FA N	TUB E		CF L	FANC Y	EXHAUS T
			Single	Doubl e			
GROUND FLOOR		1	6			2	
1	CHAPEL	3	7			4	
2	OFFICE	1	1		1		
3	COMPUTER LAB	2	3				
	FIRST FLOOR		7		1		
	KITCHEN (STAFF ROOM)	3	2		3		
4	KITCHEN	1	5		1		1
5	GENERATO R ROOM		1				
6	DINNING HALL	10	17		1		3
7	SISTER'S ROOM	1	1		1		
8	READING ROOM	2	2				
9	RECREATIO N ROOM	2	2				
10	COMMON ROOM	1	1				
11	TEACHER'S	2	1		2		

VJCET Vazhakulam



Energy Audit Report

40

	ROOM					
12	GUEST ROOM	1	1			
13	SISTER'S ROOM	1	1		1	
	STORE				1	
	SECOND FLOOR	1	14			
14	STUDENT'S ROOM	1	1		1	
15		1	1		1	
16		1	1		1	
17		1	1		1	
18		1	1		1	
19	TEACHER'S ROOM	1	2			
20		1	1		1	
21		1	1			
22		1	1			
23		1	1			
24	TOILET		1		1	
25	STUDENT'S ROOM					
26						
27		1	1			
28						
29		1	1		1	
30		1	1		1	
31		1	1		1	
32		1	1		1	
33		1	1		1	
34		1	1		1	
35		1	1		1	
36		1	1		1	
37		1	1		1	
38		1	1			
39		1	1		1	
40	SISTER'S ROOM	1	1		2	
41	STUDENT'S ROOM	1	1		1	
42	TOILET		5		5	4
43	STUDENT'S ROOM	1	1		1	
44	SISTER'S ROOM	1	1		1	
45	STUDENT'S ROOM	1	1		1	

VJCET Vazhakulam



Energy Audit Report

41

46		1	1		1		
47		1	1		1		
48		1	1		1		
49		1	1		1		
50		1	1		1		
51		1	1		1		
52		1	1				
53		1	1				
54		1	1				
55		2	2		1		
56		1	1		1		
57		1	1		1		
58		1	1		1		
	THIRDFLOOR		14				
59	STUDENT'S ROOM	1	1		1		
60		1	1		1		
61		1	1		1		
62		1	1		1		
63		1	1				
64		1	1		1		
65		1	1				
66		1	1				
67		1	1				
68		1	1		1		
69		1	1		1		
70		1	1		1		
71		1	1		1		
72		1	1		1		
73		1	1		1		
74		1	1		1		
75	TOILET		8				4
76	STUDENT'S ROOM	1	1		1		
77		1	1		1		
78		1	1				
79		1	1		1		
80		1	1		1		
81		1	1		1		
82		1	1		1		
83		1	1		1		
84		1	1		1		
85		1	1		1		
86		1	1		1		
87		1	1		1		
88		1	1		1		
89							
90		1	1		1		

VJCET Vazhakulam

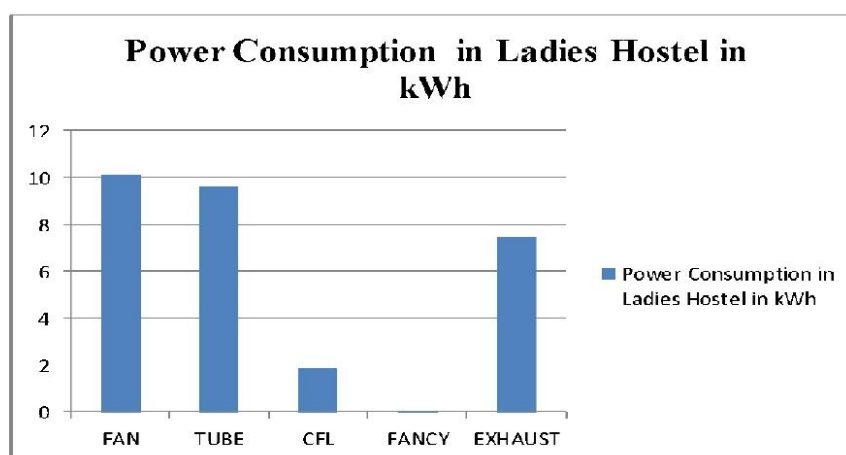


Energy Audit Report

42

91		1	1		2		
92		2	2		1		
	NEW BLOCK		8				
201	ROOM	1	1		2		
202	HALL	6	6				
203	STUDENT'S	1	1		2		
204		1	1		2		
205		1	1		2		
206		1	1		2		
207		1	1		2		
208		1	1		2		
209		1	1		2		
210		1	1		2		
211		1	1		2		
212		1	1		2		
213		1	1		2		
214		1	1				
215		1	1				
216	TOILET		3		5		
217	STUDENT'S	1	1		2		
218		1	1		2		
219		1	1		2		
220		1	1		2		
221		1	1		2		
222		1	1		2		
223		1	1		2		
224		1	1		2		
225		1	1		2		
	TOTAL	135	215	0	125	6	12

Table 3.9.1 Audit data Ladies Hostel



Graph 3.9.1 Energy Consumption Ladies Hostel

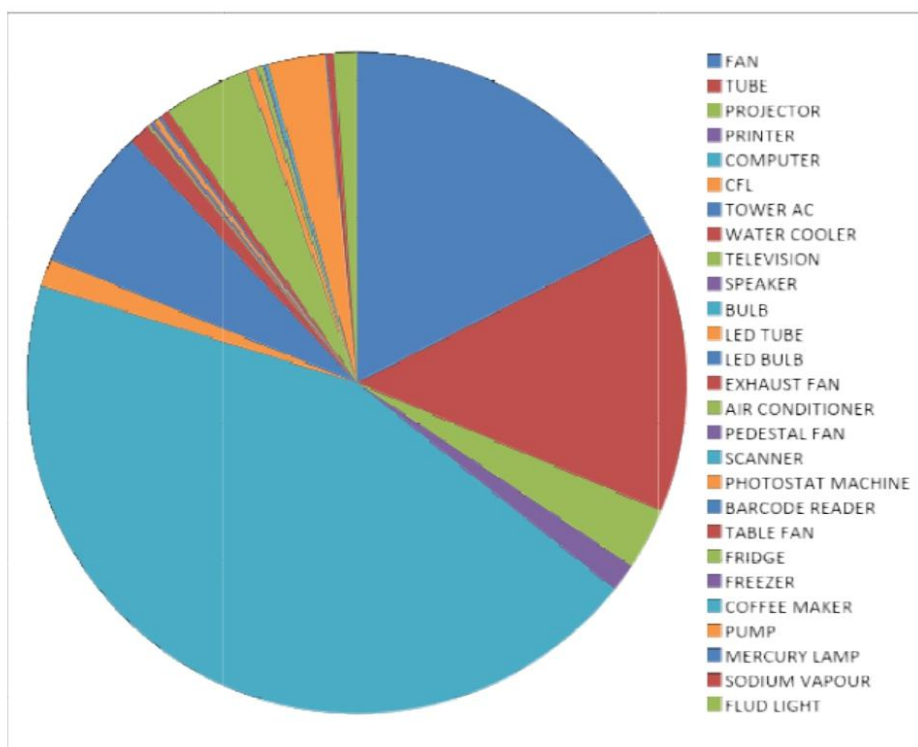
VJCET Vazhakulam



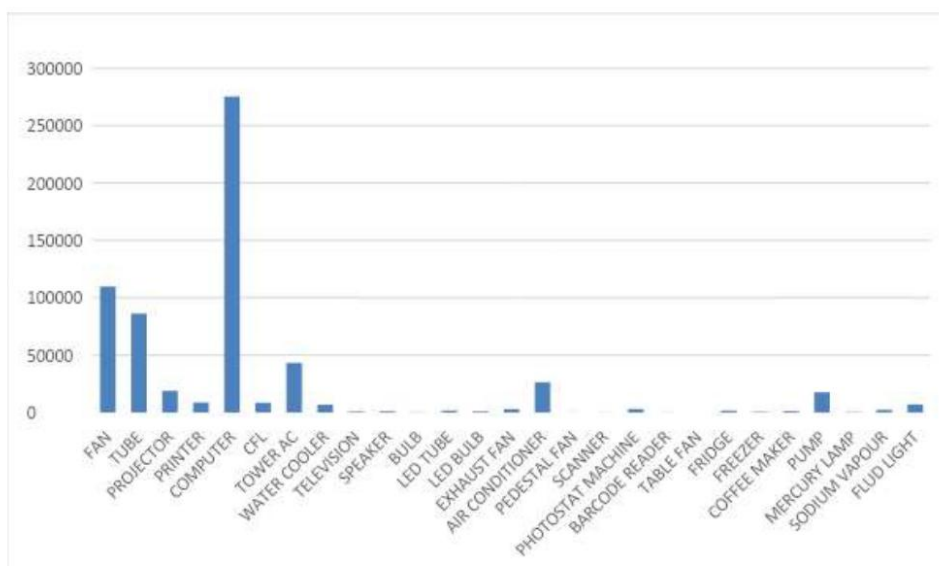
3.10 COMPLETE DATA OF ENERGY CONSUMING EQUIPMENTS IN COLLEGE CAMPUS

EQUIPMENTS	COLLEGE	LADIES HOSTEL	MENS HOSTEL	GRAND TOTAL	TOTAL LOAD (watts)
FAN	1149	135	179	1463	109725
TUBE	1137	213	217	1567	86185
PROJECTOR	63	0	0	63	18900
PRINTER	85	0	2	87	8700
COMPUTER	981	10	10	1001	275275
CFL	415	125	27	567	8505
TOWER AC	27	0	0	27	43200
WATER COOLER	10	2	3	15	6750
TELEVISION	7	1	1	9	823.5
SPEAKER	16	0	6	22	1100
BULB	4	0	0	4	240
LED TUBE	33	0	71	104	1664
LED BULB	54	0	44	98	980
EXHAUST FAN	26	12	10	48	2880
AIR CONDITIONER	20	0	2	22	26400
PEDESTAL FAN	2	0	0	2	110
SCANNER	2	0	0	2	110
PHOTOSTAT MACHINE	6	0	0	6	3000
BARCODE READER	4	0	0	4	160
TABLE FAN	1	0	0	1	55
FRIDGE	2	1	1	4	1600
FREEZER	2	1	1	4	600
COFFEE MAKER	1	0	0	1	1200
PUMP	16	0	0	16	17600
MERCURY LAMP	6	1	0	7	420
SODIUM VAPOUR	9	0	0	9	2250
FLUD LIGHT	14	0	0	14	7000

Table 3.10.1 Complete audit data



Graph 3.10.1 Total Energy Consumption of College in pie chart



Graph 3.10.2 Total Energy Consumption of College in bar diagram



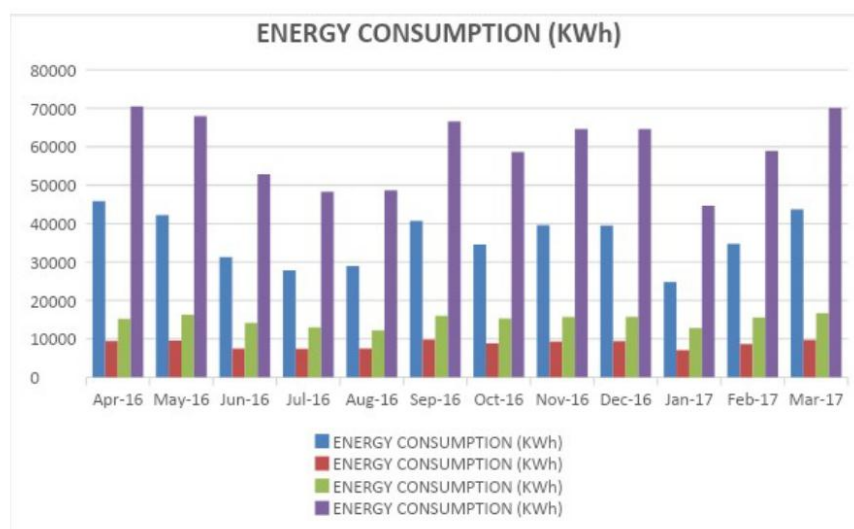
CHAPTER 4

ANALYSIS FROM ELECTRICITY BILL

Till now we have analysed the different loads that consume energy in the college. By considering the Kerala State Electricity Board (KSEB) invoices for one year that is from April 2016 to March 2017.

ENERGY CONSUMPTION (KWh)				
	ZONE 1	ZONE 2	ZONE 3	TOTAL
Apr-16	45856	9438	15236	70530
May-16	42184	9536	16272	67992
Jun-16	31278	7468	14152	52898
Jul-16	27846	7416	13000	48262
Aug-16	28934	7488	12234	48656
Sep-16	40750	9806	16000	66556
Oct-16	34510	8838	15302	58650
Nov-16	39612	9300	15696	64608
Dec-16	39528	9396	15732	64656
Jan-17	24792	7070	12820	44682
Feb-17	34706	8652	15562	58920
Mar-17	43750	9718	16700	70168

Table 4.1 Energy Consumption in kwh



Graph 4.1 Energy Consumption in kwh

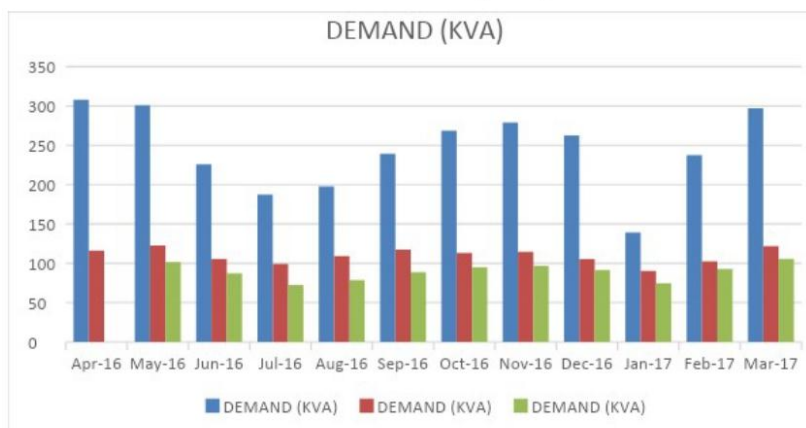


Energy Audit Report

46

DEMAND (KVA)			
	ZONE 1	ZONE 2	ZONE 3
Apr-16	308.08	116.2	0
May-16	301.12	122.62	101.62
Jun-16	225.76	105.56	87.26
Jul-16	187.4	99.22	72.42
Aug-16	197.9	109.2	78.6
Sep-16	239.1	117.38	88.76
Oct-16	268.4	113	94.8
Nov-16	279.16	114.56	96.8
Dec-16	262.6	105.44	91.36
Jan-17	139.17	90.25	74.69
Feb-17	237.64	102.55	92.81
Mar-17	296.98	121.73	105.74

Table 4.2 Demand (KVA)

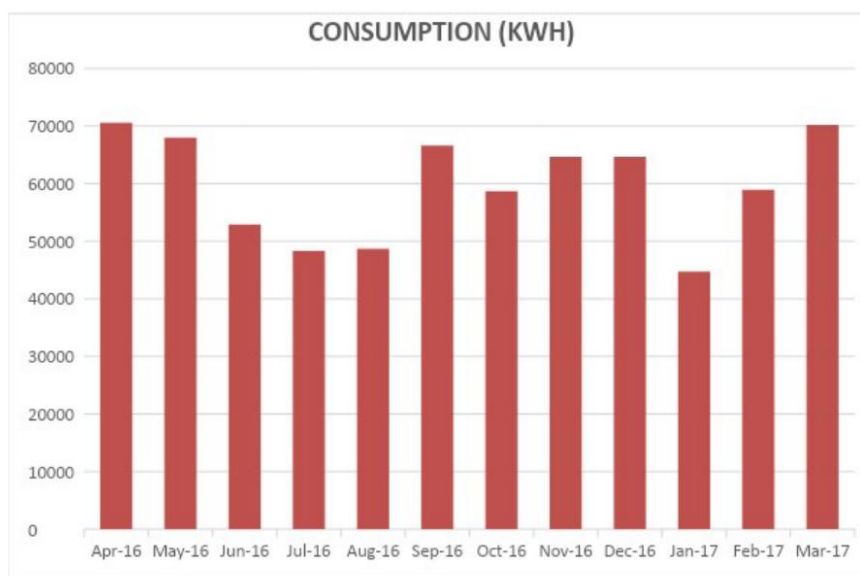


Graph 4.2 Demand Graph

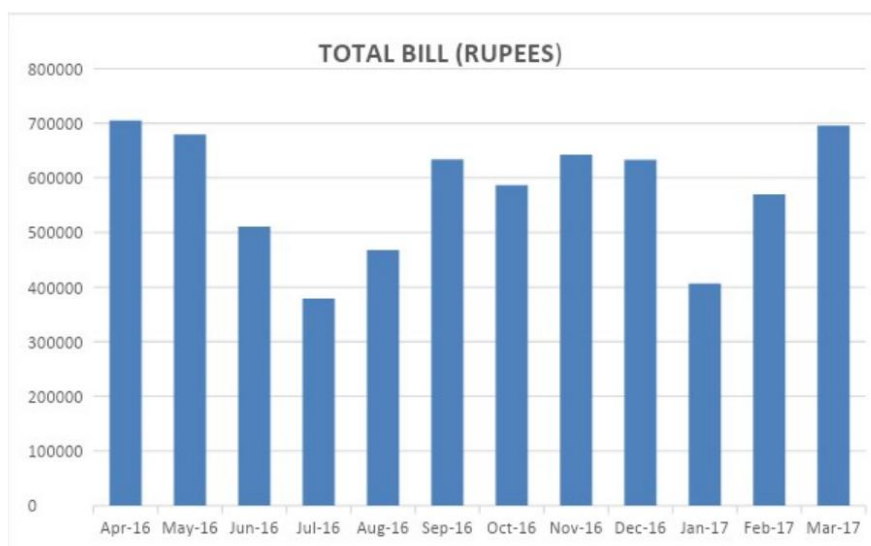
	TOTAL BILL (RUPEES)	CONSUMPTION(KWH)
Apr-16	704795	70530
May-16	679212	67992
Jun-16	510942	52898
Jul-16	379246	48262
Aug-16	467696	48656
Sep-16	633625	66556
Oct-16	586944	58650
Nov-16	642228	64608
Dec-16	633308	64656
Jan-17	406730	44682
Feb-17	569771	58920
Mar-17	695874	70168

Table 4.3 Bill Table

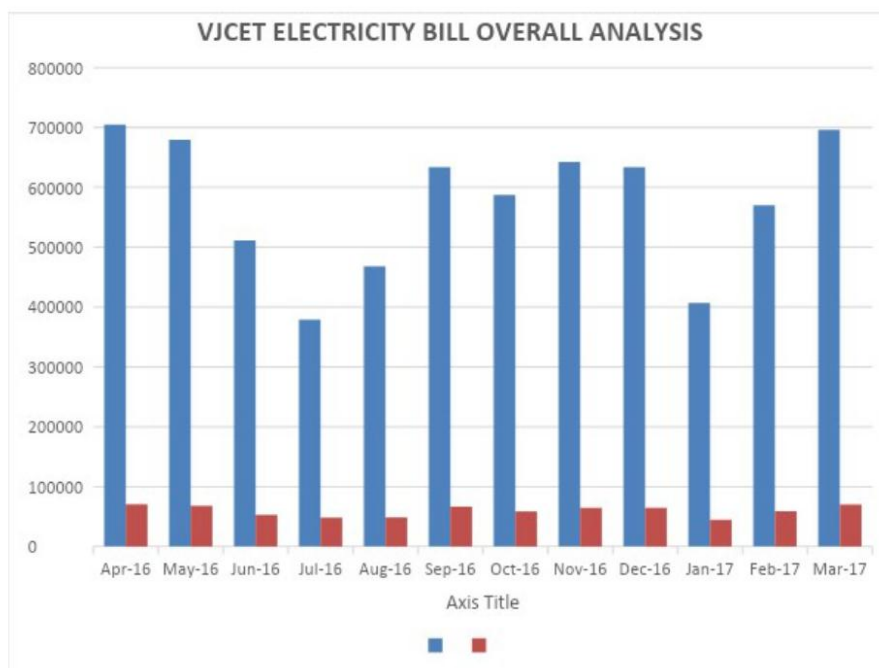
VJCET Vazhakulam



Graph 4.3 Consumption in kwh



Graph 4.4 Total Bill in rupees

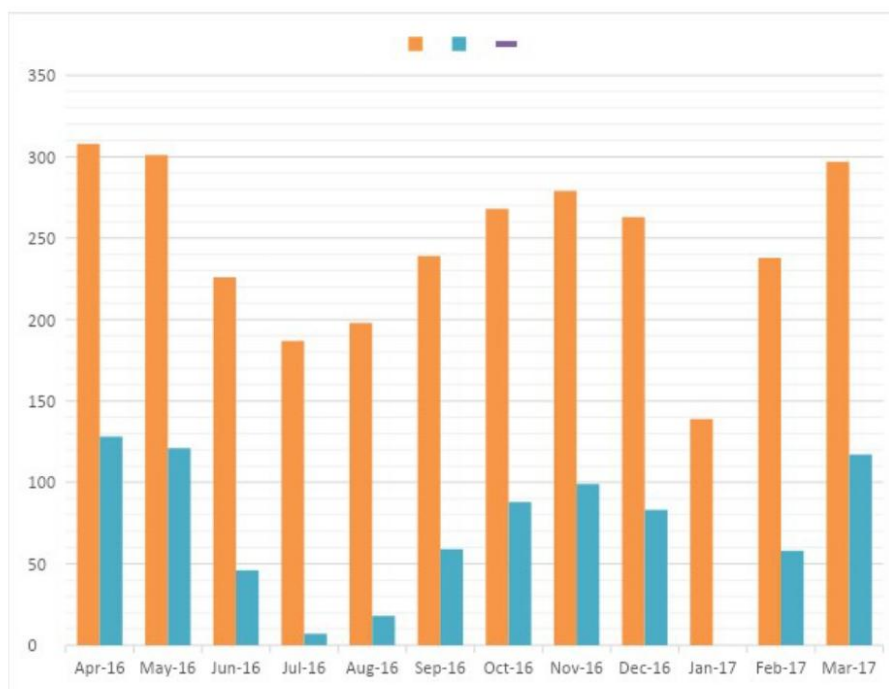


Graph 4.5 Bill Analysis

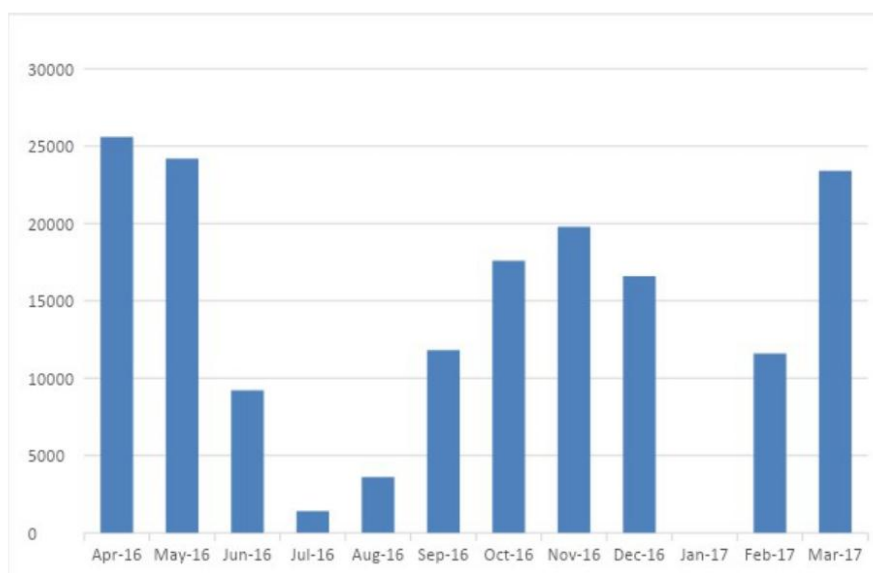
Table 4.4 load demand analysis

TOTAL LOAD DEMAND ANALYSIS			
	TOTAL DEMAND	EXCESS DEMAND	AVAILABLE DEMAND
Apr-16	308	128	180
May-16	301	121	180
Jun-16	226	46	180
Jul-16	187	7	180
Aug-16	198	18	180
Sep-16	239	59	180
Oct-16	268	88	180
Nov-16	279	99	180
Dec-16	263	83	180
Jan-17	139	0	180
Feb-17	238	58	180
Mar-17	297	117	180

VJCET Vazhakulam



Graph 4.6 Demand graph with cutoff



Graph 4.7 Excess Demand Charge

VJCET Vazhakulam



VISWAJYOTHI ELECTRIC BILL INVOICE								
		DEMAND CHARGE NORMAL	EXCESS DEMAND CHARGE (NORMAL)	ENERGY CHARGES NORMAL	ENERGY CHARGES PEAK	ENERGY CHARGES OFF PEAK	TOTAL ENERGY CHARGES	NET PAYABLE
Apr-16	UNIT	308	128	45856	9438	15236		
	RATE	400	200	7.2	10.8	5.4		
	AMOUNT	123200	25600	330163.2	101930.4	8227.4	502794.7	704795
May-16	UNIT	301	121	42184	9536	16272		
	RATE	400	200	7.2	10.8	5.4		
	AMOUNT	120400	24200	303724.8	102988.8	87868.8	483454.3	679212
Jun-16	UNIT	226	46	31278	7468	14152		
	RATE	400	200	7.2	10.8	5.4		
	AMOUNT	90400	9200	225201.6	80654.4	76420.8	373675.6	510942
Jul-16	UNIT	187	7	27846	7416	13000		
	RATE	400	200	7.2	10.8	5.4		
	AMOUNT	74800	1400	200491.2	80092.8	70200	346399.2	379246
Aug-16	UNIT	198	18	28934	7488	12234		
	RATE	400	200	7.2	10.8	5.4		
	AMOUNT	79200	3600	208324.8	80870.4	66063.6	348153.6	467696
Sep-16	UNIT	239	59	40750	9806	16000		
	RATE	400	200	7.2	10.8	5.4		
	AMOUNT	95600	11800	293400	105904.8	86400	475990.7	633625
Oct-16	UNIT	268	88	34510	8838	15302		
	RATE	400	200	7.2	10.8	5.4		
	AMOUNT	107200	17600	248472	95450.4	82630.8	418022.1	586944
Nov-16	UNIT	279	99	39612	9300	15696		
	RATE	400	200	7.2	10.8	5.4		
	AMOUNT	111600	19800	285206.4	100440	84758.4	462172.7	642228
Dec-16	UNIT	263	83	39528	9396	15732		
	RATE	400	200	7.2	10.8	5.4		
	AMOUNT	105200	16600	284601.6	101476.8	84952.8	462788.2	633308
Jan-17	UNIT	139	0	24972	7070	1280		
	RATE	400	200	7.2	10.8	5.4		
	AMOUNT	55600	0	178502.4	76356	69288	317604.7	406730
Feb-17	UNIT	238	58	34706	8652	15562		
	RATE	400	200	7.2	10.8	5.4		
	AMOUNT	95200	11600	249883.2	93441.6	84034.8	419880.8	569771
Mar-17	UNIT	297	117	43750	9718	16700		
	RATE	400	200	7.2	10.8	5.4		
	AMOUNT	118800	23400	315000	104954.4	90180	502482.4	695874

Table 4.5 Bill Invoice

VJCET Vazhakulam



CHAPTER 5

RECOMMENDATIONS FOR BETTER ENERGY EFFICIENCY

Based on the analysis of the power consumption data, certain steps have been recommended for improving energy efficiency of the campus. Complete cost analysis of implementation of recommended measures has been performed wherever necessary. Also, a number of general measures for energy efficiency have been listed. Described below are some important recommendations for better energy efficiency:

5.1 REPLACING CONVENTIONAL BALLAST [CHOKE] FTLs WITH LED TSLs

Dominant light source at most places in the campus is traditional 40W FTLs with conventional Ballast[Choke] which consumes 14-16W in addition to the 40W. As per our data collection, the campus has in total 1432 conventional Ballast[Choke] FTLs and 104 LED TSLs. If these Electronic Ballast[Choke]s are replaced by LED TSLs, 28-30W power can be saved per FTL.

COST ANALYSIS OF REPLACING ELECTRICAL BALLAST [CHOKE] FTL WITH LED TSLs

*Total No. of conventional Ballast [Choke] FTLs in Campus = 1432

*Average Power of conventional Ballast [Choke] FTL = 56W

*Average Power of LED TSLs = 16W

*Power saved per TL = (56-16) W=40W

*Total Power saving = 1432*40W= 57280W = 57.280kW

* Average use of LED TSLs per year = 270*10 = 2700hrs

* Total Energy saved per year = 57.280*2700=**154656kWh**

*Saving in Rs. per year = 154656*3.75 = **Rs. 5, 79,960**

VJCET Vazhakulam



*Cost of one LED TL = Rs. 549

*Total Cost of Replacing all Conventional Ballast [Choke] FTLs =
 $1229 \times 549 = \text{Rs } 6,74,721$

* Capital Cost Recovery = $(674721)/579960 = 1.16$ years

5.2 REPLACING ELECTRONIC REGULATOR CEILING FANS BY BLDC

Most of the buildings in VJCET campus are of Electronic Regulator Type. According to the data collected, there are a total of 1229 fans which are of electronic regulator type. For those kinds of fans the power wattage is 75W. If we replace those fans with BLDC we can save lot of energy as the average power wattage of BLDC fan is 28 W.

COST ANALYSIS OF REPLACING RESISTANCE REGULATORS WITH BLDC FANS

*Total No. of resistance regulated fans in Campus = 1229

*Average Power saved per fan = $(75-28) \text{ W} = 47\text{W}$

*Total Power saving = $1229 \times 47\text{W} = 57763\text{W} = 57.763\text{kW}$

*Average Use of fans per year = $270 \times 11\text{h} = 2970\text{h}$

*Total Energy saved per year = $57.763 \times 2970 = 171556.11 \text{ Kw}$

*Saving in Rs. per year = $\text{Rs. } 171556.11 \times 3.75 = \text{Rs. } 6,43,335.4125$

*Cost of one BLDC fan = Rs 3500

*Total cost of replacing all the fans = $3500 \times 1229 = \text{Rs } 43,01,500$

*Capital Cost Recovery time = $(4301500) / (643336) = 6.68\text{yr}$

Hence, the capital cost recovery time for replacing all resistance regulated fans of the campus is around 6.68 years.

5.3 MINIMIZING REPAIR WORKS IN FANS

During data collection, the repaired fans have been found to be consuming very high power as compared to the rated power. Fans repaired once and twice were consuming 16W and 43W more than the average consumption of new



fans respectively. Thus, effort should be made to minimize the repairing of fans and also repair work should be supervised properly.

5.4 REDUCE THE UPS LOAD

VJCET has installed UPS's of varying capacities ranging from 5 kVA to 40 kVA. These UPS's are provided for the safe operation of various loads in the campus. These UPS'S are analysed for different parameters like loading, power factor, voltage, etc. A chart is given below to show the installed capacity and present loading of each UPS installed in the campus.

LOCATION	CAPACITY (kVA)
A BLOCK	40 kVA
B BLOCK	30 kVA
C BLOCK	40 kVA
D BLOCK	60 kVA
R&D BLOCK	30 kVA
MBA BLOCK	30 kVA
TOTAL	230 kVA

Table 5.4 UPS load in college

College has an installed capacity of 320 kw generator backup. Whenever the supply fails generator picks up in less than a minute. In such a condition ups load can be reduced to back up the sensitive loads only that is server, computer etc.. In some labs, even AC are connected to the ups load. Large amount of energy is consumed during the charging and discharge of batteries. Even after a small power off of less than 30 sec batteries start to charge. Hence by reducing this load large amount of energy can be saved.

VJCET Vazhakulam



5.5 BETTER PRACTICES FOR THE USE OF COMPUTERS.

- Use of smart plug save up to 30w
- Switch off power switch after every use.
- Only switch on needy accessories
- Switch on only needy computers
- Reduce unnecessary use of computer

5.6 CHANGE TEXTURE OF COLLEGE UNIFORM

Heat get trapped inside our cloth during hot times. Smooth textured clothing such as cotton or merino wool can keep skin from getting warm. Wearing loose, smooth and light clothing helps to control rise of body temperature.

5.7 NEW SOURCE OF ENERGY-UPGRADE 50 KW SOLAR POWER PLANT ON THE ROOF TOP OF COLLEGE TO 200 KW

Design of Viswajyothi College is best for placing solar panels on the roof top. Since the college is situated on a hill top there is no possibility of shade and sunlight will be available for the whole day. Solar panels provide electricity as well as protection to the roof top. Campuses are catering to green-savvy prospective students by getting more of their electricity from solar energy. At this condition **ANERT** - the Government of Kerala organization for renewable energy projects is providing subsidized rates for solar panels. We can also utilize this and energy can be saved up to 30%.

Here is a sample layout for the solar power plant. By upgrading to 200 KW an average of 150-160 KW of solar energy will be available which is enough to run the 50% of total usage. Thus, the electricity bill can be reduced.



Figure 5.7.1 elevation at terrace 1

VJCET Vazhakulam

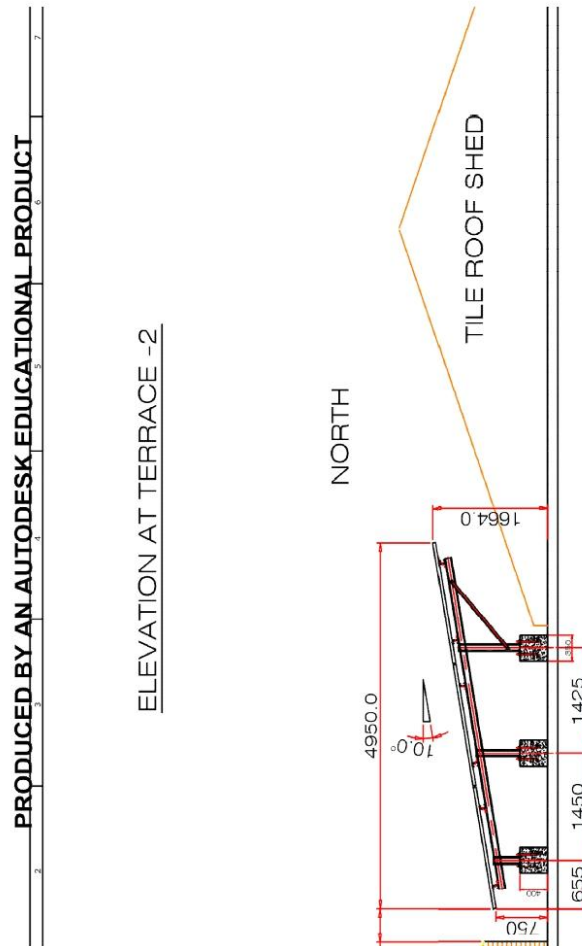


Figure 5.7.2 elevation at terrace 2



Photographs of 50 kW solar power plant installed on roof top

5.8 MAXIMUM DEMAND MANAGEMENT

The contract demand allowed by KSEB for college is 180 KVA. As per the collected data our average maximum demand is 250 KVA so there is a need for contract demand improvement to avoid payment of excess demand charge. By uplifting the fixed demand value to 280 KVA penalty can be avoided. Currently we pay 600 rupees for each unit above the fixed value

VJCET Vazhakulam



5.9 BETTER PRACTICES FOR AC

The institute has in total 7 window type ACs and 20 split type ACs which make a very large part of total energy consumption of the campus. But, at many places it was found that AC is not used with best recommended practices. Even simple things, such as insulation, are not taken care of. Window panes were found broken at many places. Also, at certain places ACs were found to be used without keeping curtains. These poor practices account for increase in AC load and thus consumption.

Summarized below are some guidelines for most efficient use of ACs:

▮ PROPER INSULATION

Good quality insulation must be maintained in the air-conditioned rooms by keeping all doors and windows closed properly so as to prevent cool air go out and hot air come in.

▮ CURTAINS

Always keep curtains on window stop prevent direct sunlight inside the room to avoid heating of cooled air. This reduces AC load significantly.

▮ MAINTENANCE

Proper maintenance and cleaning of ACs is required at regular intervals to make it work at highest efficiency. Any dirt in filter may reduce efficiency of ACs very significantly.

▮ OPERATING

The ACs should be switched on 15 minutes before actual use and should be switched off before leaving the room.



CHAPTER 6

CONCLUSION

Fuel and electricity are major expenses in any business today. Ever increasing fuel prices and stricter regulations pertaining to commercial energy consumption has made it imperative for modern business to ensure optimum utilization of energy resources and convert to cheaper and more sustainable energy resources. Efficient energy consumption is crucial for the economic success of all companies.

The objective of Energy Audit is to promote the idea of Energy Conservation in the Campus of VJCET. The purpose of the energy audit is to identify, quantify, describe and prioritize cost saving measures relating to energy use in the Hostels, Departments and Institute Central Facilities.

Through this project we were able to suggest certain ideas to make the energy bill smaller and the globe greener. Well it is not a matter only to this college but it depends on the global energy circumstances. We hope that through the implementation of our project a 30% of energy can be saved.


ANESH KURIAN ME, MIE
Chartered Engineer (Electrical)
BEE Certified Energy Auditor
Reg. No: EA-17246

VJCET Vazhakulam