ANNAI VAILANKANNI COLLEGE OF ENGINEERING

(A Christian Minority Institution)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

Recognized under section 2(f) of UGC Act 1956

Website: www.avce.edu.in

Dr.R.Angeline Prabhavathy,

PRINCIPAL

AUTHENTICATION CERTIFICATE

I certify that the three audit reports, energy, environment and green are prepared by resource persons from St. Xavier's Catholic Engineering College Mr. Marsaline Beno M and Mr.Abragam Siyon Sing M who are Certified Auditors by Bureau of Energy Efficiency, Government of India, Ministry of Power.

ANNAI VAILANKANNI COLLEGE OF ENGINEERING POTTALKULAM AZHAGAPPAPURAM P.O. KANYAKUMARI DISTRICT 629 401

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POTTALKULAM
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KANYAKUMARI DIST.

The audits were conducted by Certified Energy Managers, (working in St. Xavier's catholic engineering college, Nagercoil) who are experts, approved by the Bureau of Energy Efficiency, Government of India,Ministry of Power,New Delhi to ensure compliance with National Standards. The audits were conducted in accordance with Standard Operating Procedures (SOP). Certifications by the Energy Managers are attached.

ANNAI VAILANKANNI COLLEGE OF ENGINEERING POTTALKULAM AZHAGAPPAPURAM KANYAKUMARI DISTRICT 629 401

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KANYAKUMARI DIST.

BUREAU OF ENERGY EFFICIENCY

Examination Registration No. : EM-300296/22 Serial Number 18314/T

Certificate Registration No. : 18314/T

Certificate For Certified Energy Manager

This is to certify that Mr./Mrs./Ms. MARSALINE BENO M Son/Daughter of Mr./Mrs. MARIA LAWRENCE M who has passed the National Examination for certification of energy manager held in the month of July 2022 is qualified as certified energy manager subject to the provisions of Bureau of Energy Efficiency (Certification Procedures for Energy Managers) Regulations, 2010.

This certificate shall be valid for five years with effect from the date of award of this certificate and shall be renewable subject to attending the prescribed refresher training course once in every five years.

His /Her name has been entered in the Register of certified energy manager at Serial Number 18314/T being maintained by the Bureau of Energy Efficiency under the aforesaid regulations.

Mr./Mrs./Ms. MARSALINE BENO M is deemed to have qualified for appointment or designation as energy manager under clause (*l*) of Section 14 of the Energy Conservation Act, 2001 (Act No.52 of 2001).

Given under the seal of the Bureau of Energy Efficiency, this 13th day of January, 2023

Digitally Signed: RAKESH KUMAR RAI
Fri Jan 13 17:08:55 IST 2023
Secretary, BEE New Delhi

Secretary
Bureau of Energy Efficiency
New Delhi

Dates of attending the refresher course	Secretary's Signature	Dates of attending the refresher course	Secretary's Signature

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ऊर्जा दक्षता ब्यूरो

परीक्षा रजिस्ट्रीकरण सं. : EM-300296/22 क्रम सं. 18314/T

प्रमाणपत्र रजिस्ट्रीकरण सं. : 18314/T

प्रमाणित ऊर्जा प्रबंधक के लिए प्रमाणपत्र

यह प्रमाणित किया जाता है कि श्री / श्रीमती / सुश्री मार्सलाइन बेनो एम जो श्री / श्रीमती मारिया लॉरेंस एम के पुत्र / पुत्री हैं जिन्होंने वर्ष 2022 मास जुलाई में आयोजित ऊर्जा प्रबंधक प्रमाणन के लिए राष्ट्रीय परीक्षा उत्तीर्ण की है, ऊर्जा दक्षता ब्यूरो (ऊर्जा प्रबंधकों के लिए प्रमाणन प्रक्रिया) विनियम 2010 के उपबंधों के अध्यधीन रहते हुए प्रमाणित ऊर्जा प्रबंधक के रूप में अर्हक हैं ।

यह प्रमाणपत्र, प्रदान किए जाने की तारीख से पांच वर्ष के लिए विधिमान्य होगा और प्रत्येक पांच वर्ष में एक बार विहित पुनश्चर्या प्रशिक्षण पाठ्यक्रम में उपस्थित रहने के अध्यधीन रहते हुए पुन: नवीकरण किया जाएगा ।

उनके नाम को पूर्वोक्त विनियमों के अधीन ऊर्जा दक्षता ब्यूरो द्वारा अनुरक्षित क्रम संख्या 18314/T पर प्रमाणित ऊर्जा प्रबंधक के रजिस्टर में प्रविष्ट कर दिया गया है ।

श्री / श्रीमती / सुश्री मार्सलाइन बेनो एम ऊर्जा संरक्षण अधिनियम 2001 (2001 का अधिनियम संख्यांक 52) की धारा 14 के खंड (*l*) के अधीन ऊर्जा प्रबंधक के रूप में नियुक्ति या पदनाम के लिए अर्हित समझे गए हैं ।

2023 मास जनवरी दिन 13 को ऊर्जा दक्षता ब्यूरो के अधीन दिया गया है ।

सचिव
ऊर्जा दक्षता ब्यूरो
नई दिल्ली

पुनश्चर्या पाठ्यक्रम में उपस्थित रहने की तारीखें	सचिव के हस्ताक्षर	पुनश्चर्या पाठ्यक्रम में उपस्थित रहने की तारीखें	सचिव के हस्ताक्षर

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BUREAU OF ENERGY EFFICIENCY

Examination Registration No. : EM-300164/21 Serial Number 17630

Certificate Registration No. : 17630/T

Certificate For Certified Energy Manager

This is to certify that Mr./Mrs./Ms. ABRAGAM SIYON SING M Son/Daughter of Mr./Mrs. MANI A who has passed the National Examination for certification of energy manager held in the month of September 2021 is qualified as certified energy manager subject to the provisions of Bureau of Energy Efficiency (Certification Procedures for Energy Managers) Regulations, 2010.

This certificate shall be valid for five years with effect from the date of award of this certificate and shall be renewable subject to attending the prescribed refresher training course once in every five years.

His /Her name has been entered in the Register of certified energy manager at Serial Number 17630 being maintained by the Bureau of Energy Efficiency under the aforesaid regulations.

Mr./Mrs./Ms. ABRAGAM SIYON SING M is deemed to have qualified for appointment or designation as energy manager under clause (*i*) of Section 14 of the Energy Conservation Act, 2001 (Act No.52 of 2001).

Given under the seal of the Bureau of Energy Efficiency, this 28th day of February, 2022

Secretary
Bureau of Energy Efficiency
New Delhi

ANNAI VAILANKANNI COLLEGE OF ENGINEERING
POTTALKULAM, AZHAGAPPAPURAM P.O., KANYAKUMARI DISTRICT, 629 401

Dates of attending the refresher course	Secretary's Signature	Dates of attending the refresher course	Secretary's Signature

ऊर्जा दक्षता ब्यूरो

परीक्षा रजिस्ट्रीकरण सं. : EM-300164/21 क्रम सं. 17630

प्रमाणपत्र रजिस्ट्रीकरण सं. : 17630/T

प्रमाणित ऊर्जा प्रबंधक के लिए प्रमाणपत्र

यह प्रमाणित किया जाता है कि श्री / श्रीमती / सुश्री अब्रागम सियोन सिंग मो जो श्री / श्रीमती मणि ए के पुत्र / पुत्री हैं जिन्होंने वर्ष 2021 मास सितम्बर में आयोजित ऊर्जा प्रबंधक प्रमाणन के लिए राष्ट्रीय परीक्षा उत्तीर्ण की है, ऊर्जा दक्षता ब्यूरो (ऊर्जा प्रबंधकों के लिए प्रमाणन प्रक्रिया) विनियम 2010 के उपबंधों के अध्यधीन रहते हुए प्रमाणित ऊर्जा प्रबंधक के रूप में अर्हक हैं।

यह प्रमाणपत्र, प्रदान किए जाने की तारीख से पांच वर्ष के लिए विधिमान्य होगा और प्रत्येक पांच वर्ष में एक बार विहित पुनश्चर्या प्रशिक्षण पाठ्यक्रम में उपस्थित रहने के अध्यधीन रहते हुए पुन: नवीकरण किया जाएगा।

उनके नाम को पूर्वोक्त विनियमों के अधीन ऊर्जा दक्षता ब्यूरो द्वारा अनुरक्षित क्रम संख्या 17630 पर प्रमाणित ऊर्जा प्रबंधक के रजिस्टर में प्रविष्ट कर दिया गया है।

श्री / श्रीमती / सुश्री अब्रागम सियोन सिंग मो ऊर्जा संरक्षण अधिनियम 2001 (2001 का अधिनियम संख्यांक 52) की धारा 14 के खंड (*i*) के अधीन ऊर्जा प्रबंधक के रूप में नियुक्ति या पदनाम के लिए अर्हित समझे गए हैं।

2022 मास फरवरी दिन 28 को ऊर्जा दक्षता ब्यूरो के अधीन दिया गया है।

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सचिव
ऊर्जा दक्षता ब्यूरो
नई दिल्ली

पुनश्चर्या पाठ्यक्रम में उपस्थित रहने की तारीखें	सचिव के हस्ताक्षर	पुनश्चर्या पाठ्यक्रम में उपस्थित रहने की तारीखें	सचिव के हस्ताक्षर

ENERGY AUDIT REPORT

(May 2023 – April 2024)

at

ANNAI VAILANKANNI
COLLEGE OF ENGINEERING
(Approved by AICTE,New Delhi & Affiliated to Anna University)

Submitted by,

Energy Management Cell,

St.Xavier's Catholic College of Engineering

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ACKNOWLEDGEMENT

Annai Vailankanni College of Engineering (AVCE) evinced interest to do an energy audit to find out the possibility of energy savings in their campus. It is an excellent move by the management to find the possible areas of energy wastage and come out with the solutions.

We thank the Founder and Chairman of AVCE **Dr. D. Peter Jesudhas** for his commitment and focus given to the energy conservation towards improving economy. We thank him for giving the permission to visit various places inside the campus to conduct the audit.

We would like to place our sincere thanks to Principal **Dr. R. Angeline Prabhavathy** and the IQAC Co-ordinator **Dr. N. Abilash** for entrusting the Energy Audit work with us and for the continuous encouragement given by them throughout the audit.

We express our thanks and appreciation for all the executives and staff members of AVCE for rendering their support in smooth conduct of the audit.

We are pleased to submit this Energy Audit Report to the Principal of AVCE and wish all the best for implementation of identified Energy Conservation Opportunity as well as recommendations after sincere study & observations.

Energy Management Cell, SXCCE

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ENERGY AUDIT TEAM

The energy audit team comprises of the following members.

Sl.No	Name of the Person	Designation
1	Dr. M. Marsaline Beno	BEE Certified Energy Manager, Head – Energy Management Cell, Professor & Dean – Research, SXCCE
2	Dr. Jain B. Marshel	Assistant Professor / EEE, SXCCE
3	Dr. V. Jesus Bobin	Assistant Professor / EEE, SXCCE
4	Mr. M. Abragam Siyon Sing	BEE Certified Energy Manager, Assistant Professor / EEE, SXCCE
5	Mr. S. Benziher	Skilled Assistant, SXCCE

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EXECUTIVE SUMMARY

The energy management cell of St.Xavier's Catholic College of Engineering (SXCCE) conducted a Detailed Energy Audit at Annai Vailankanni College of Engineering from 03rd May 2024 to 06th May 2024.

The methodology adopted for conducting the detailed energy audit are basic data collection, measurement at major electrical energy consuming equipment and analysis of data collected and identification of specific energy saving proposals.

The energy audit team from SXCCE have identified an annual energy saving potential of **Rs. 11,87,077.88** based on present energy cost.

The summary of annual savings identified is as below:

a)	Annual savings with investment (3 proposals)	:	**Rs. 11.87 Lakhs**
b)	Investment Required	:	**Rs. 32.73 Lakhs**
c)	Average payback period for capital proposals	:	**2.75 Years**

SPECIFIC ACTION PLAN

a) Annai Vailankanni College of Engineering should identify specific person or department to implement the above proposals.

b) Specific target date for implementation of proposals should be made after the submission of this report.

c) The institution should prioritize the above proposals and implement them in a phased manner.

d) In our opinion all the proposals can be implemented within one year, straightaway and should be on top priority.

e) The institution should form an energy committee. The Secretary should head the committee. The committee should meet once in Three months and review the progress of implementation activity and identify new areas for energy conservation.

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CHAPTER 1

INTRODUCTION

Annai Vailankanni College of Engineering (AVCE) is a private, self-financing, co-educational Engineering College established in the year 2008 by Dr. D. Peter Jesudhas. It is located near Pothaiyadi Salai, Kanyakumari, the southernmost town in India. AVCE is about 8 Kms from the Kanyakumari Railway Station and 15 Kms from Nagercoil junction. AVCE is approved by All India Council for Technical Education (AICTE), New Delhi & has been affiliated to ANNA University, Chennai since 2008. The college is surrounded by an array of green-clad, sky scraping mountains of the Western Ghats. The weather is cool and breezy with clouds drifting high over the mountains giving frequent drizzles. The main feature of the college comprises world class infrastructure with experienced and talented faculties, excellent pass percentage, good placement records and society-oriented products/projects developed by the students. Technical Education is the most important thing for the growth and progress of any society. It not only imparts knowledge and skill, but also is responsible for building human capital that is necessary for innovations and ultimately, the economic growth of the country.

AVCE is an institution where students are trained not only to equip themselves with knowledge but also to cope with the tasks that are in store for them. We also develop other aspects of personality to sustain themselves in their life. Our aim is to provide education to one and all, especially in the rural community. AVCE has always aimed at providing quality education: social moral value based and need-based education to the students and at empowering the local community. Our students are encouraged to participate in inter-college and open State level, National level and International level technical, cultural and sports activities. Development of human potential is crucial to the upliftment of any society and we at AVCE are proud of contributing to it. Our students are provided a variety of training, industrial exposure and overall personality development apart from regular academic activities so that they are capable of adding value at any organization after their graduation.

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CHAPTER 2

SUMMARY OF ENERGY SAVING PROPOSALS

Sl.No	Energy Saving Proposals	Annual Savings (Rs,)	Investment (Rs.)	Payback (Period In Years)
1	Replace the conventional ceiling fan with BLDC Fan	1,97,180.28	8,82,500	4.47
2	Replace low star rated AC to high star rated AC	16,077.6	1,40,000	8.7
3	Install PV power system in the campus	9,73,820	22,50,000	2.3
	Total	**11,87,077.88**	**32,72,500**	**2.75**

The summary of annual savings identified is as below:

a) Annual savings with investment (3 proposals) : **Rs. 11.87 Lakhs**

b) Investment Required : **Rs. 32.73 Lakhs**

c) Average payback period for capital proposals : **2.75 Years**

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CHAPTER 3

ENERGY AUDIT METHODOLOGY

The methodology adopted for conducting the Energy Audit at Annai Vailankanni College of Engineering is as follows:

1. Observation of various areas inside the campus with the guide.
2. Discussion with the energy audit team to execute the data collection plan.
3. Basic data collection on list of power consuming equipment and operating parameters.
4. Analysis of data collected and measurements to develop specific energy saving proposals.
5. Discussion with the Energy audit team on the identified proposals.
6. Preparation of the Energy Audit report with recommendations to reduce the energy wastage.
7. Presentation on the findings of the energy audit to the management

SCOPE OF ENERGY AUDIT

The task of energy audit undertaken has the objective of identifying the energy saving opportunity through the visit, equipment study with measurements & to recommend the action plan with energy saving & financial calculation for implementation of proposed energy saving measures. This audit will help the management to save the energy and electricity bill.

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CHAPTER 4

ENERGY CONSUMPTION PATTERN

Annai Vailankanni College of Engineering has availed one LT Power Supply from Tamil Nadu Electricity Board for their Energy requirements. The Energy Consumption for the last 12 Months is highlighted in the following table.

Name of the consumer: D.PETER JESUDHAS

Type of connection: LT Tariff – LT IIB(2)

<u>Detail Analysis of month wise Energy consumption.</u>

Month	Units consumed in kWh	Consumption charge in Rs.	Other Charges in Rs.	Bill Amount in Rupees
May-23	5324.7	47496.32	29041.07	76537
Jun-23	5019.9	44777.51	28937.63	73715
July-23	3874.5	35338.03	28853.17	64191
Aug-23	5192.1	47429.83	29628.7	77059
Sep-23	6201.9	56654.36	30106.5	86761
Oct-23	6291.3	57471.03	30147.4	87618
Nov-23	6417.3	58622.04	30254.7	88877
Dec-23	5425.5	49561.94	29751.9	79314
Jan-24	4780.2	43667.13	29357.6	73025
Feb-24	5223	47712.11	29676	77388
Mar-24	7716.6	70491.14	30848.2	101339
Apr-24	6325.5	57783.44	30212.8	87996
	67,792.5	**6,17,004.9**	**3,56,815.7**	**9,73,820**

From the electricity bill, the contracted demand, actual demand, power factor, energy consumed and bill amount was observed for the period from May 2023 to April 2024. The observations are as follows

1. The sanctioned load for the last 12 months was 81 kW.

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2. The fixed charge per kW is Rs.325 upto June 2023(in Old regulation) and is increased to Rs.332 from July 2023(in New Regulation).

3. The electricity cost for LT connection is Rs.8.50 per unit upto June 2023(in Old regulation) and is increased to Rs.8.70 from July 2023(in New Regulation).

4. The electricity consumption charge during normal time from May 2023 to April 2024 is **Rs. 6,17,004.90.**

5. The power factor is found to be good. It ranges from 0.92 to 0.98 (0.95 on average).

6. The miscellaneous charge from Jan 2023 to Dec 2023 is **Rs. 3,56,815.70**

7. The total electricity bill was found to be **Rs. 9,73,820.00**

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CHAPTER 5

AUDIT OBSERVATIONS

The audit team has visited all the blocks such as hostels, canteen, outdoors, security offices inside the campus. The team has collected the no of equipment in each room of the block, operating hours, wattages, etc. The electrical distributed system, lighting system, air conditioning system, implemented energy saving measures are observed.

Details of important Equipment in the campus

NAME OF EQUIPMENTS	NOS	Power Rating	OPERATING HOURS
LED LIGHT	148	40 Watts	-
LEB TUBELIGHT	356	20 Watts	-
LED Bulb	88	9 Watts	-
CEILING FAN	353	65 Watts	14 hrs, 7 hrs
COMPUTER	329	35 Watts	-
PRINTER	14	36 Watts	-
PROJECTOR	8	15 Watts	-
AIR CONDITIONER (3 star)	4	1000 Watts	7 hrs
AIR CONDITIONER (No star)	14	1500 Watts	Not working
UPS	4	5 kVA, 7.5 kVA	24 hrs

AUDIT TEAM OBSERVATIONS

1. Energy efficient LED lights are installed at most places.
2. No efficient energy savers in lighting system.
3. All the installed ceiling fans are conventional Induction motor ceiling fans.
4. No regular cleaning of filters in air conditioners.
5. All the air conditioners are 3 star and no rated.

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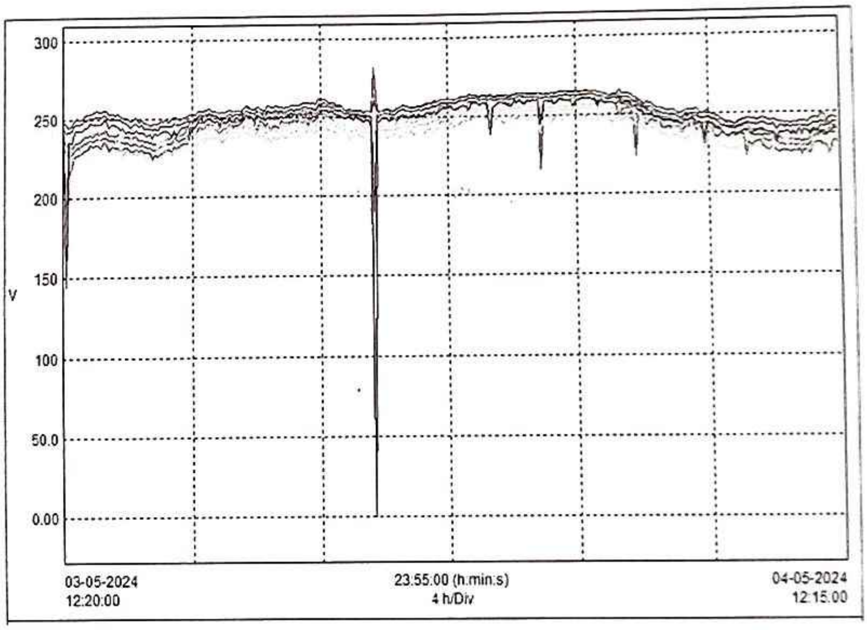
6. Almost all the UPS are operated for 24 hours.
7. No proper metering at the input panels.
8. No marking of switches.
9. No awareness posters displayed near the electrical switch boards.
10. No renewable energy generation.

POWER QUALITY OBSERVATIONS

The power consumed by the institution is measured for 24 hours to analyse the power quality issues using Atandra ALM 31 power quality analyser. The various electrical parameters such as Grid Frequency, Supply Voltage, Line Current, Neutral Current, Power demand, Power Factor are recorded for 24 hours in a day. All the electrical parameters are within the permissible variation in limit. The variation of the electrical parameters with respect to the time is plotted and shown in diagrams below.

1. **Power quality analyser – Measured Phase to Neutral Voltage**



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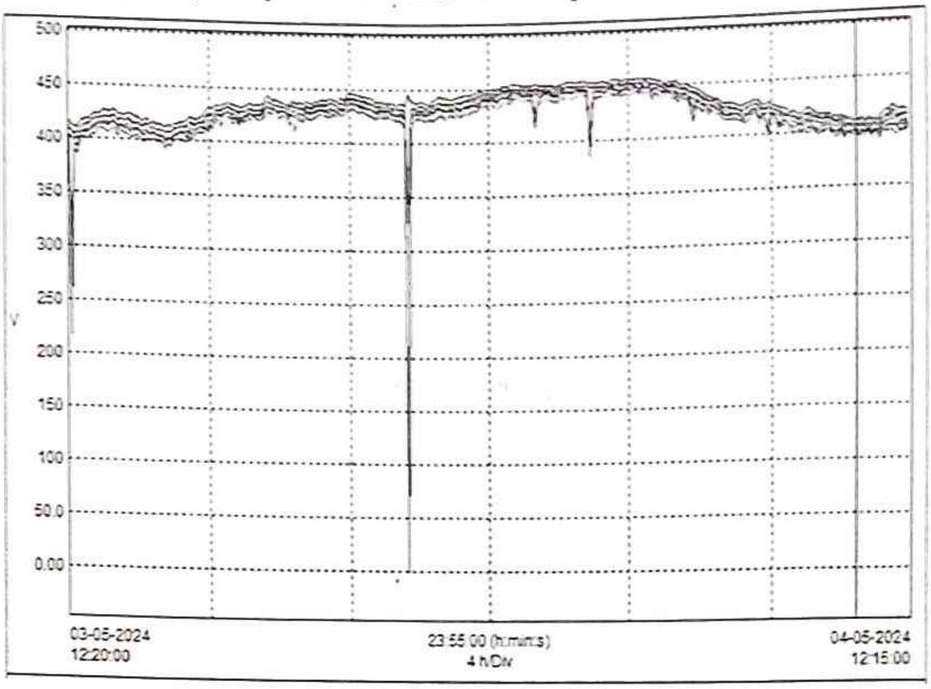
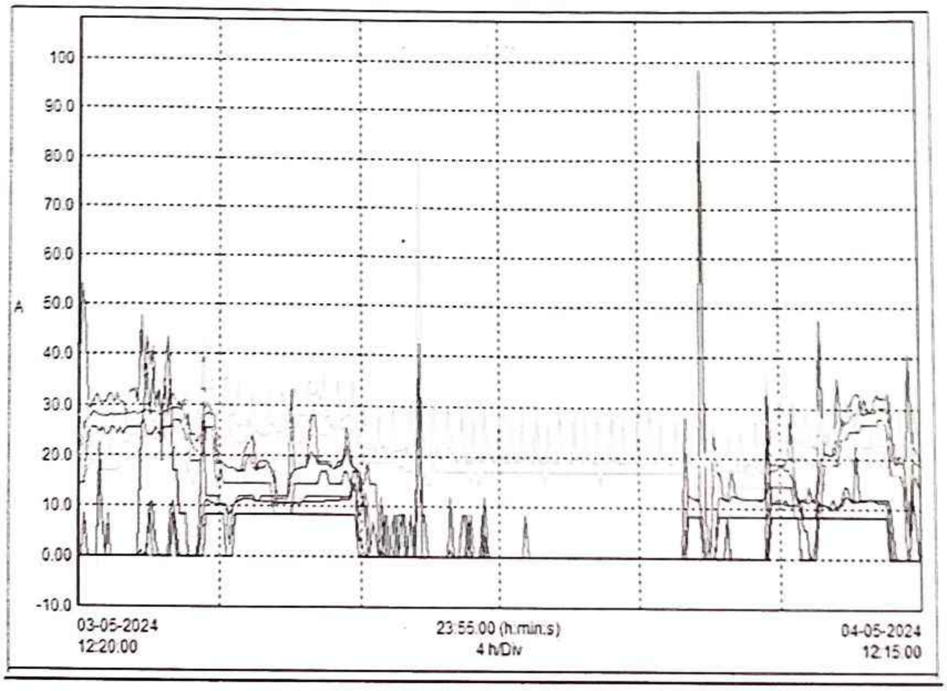
2. Power quality analyser – Measured Phase to phase voltage



3. Power quality analyser – Measured current



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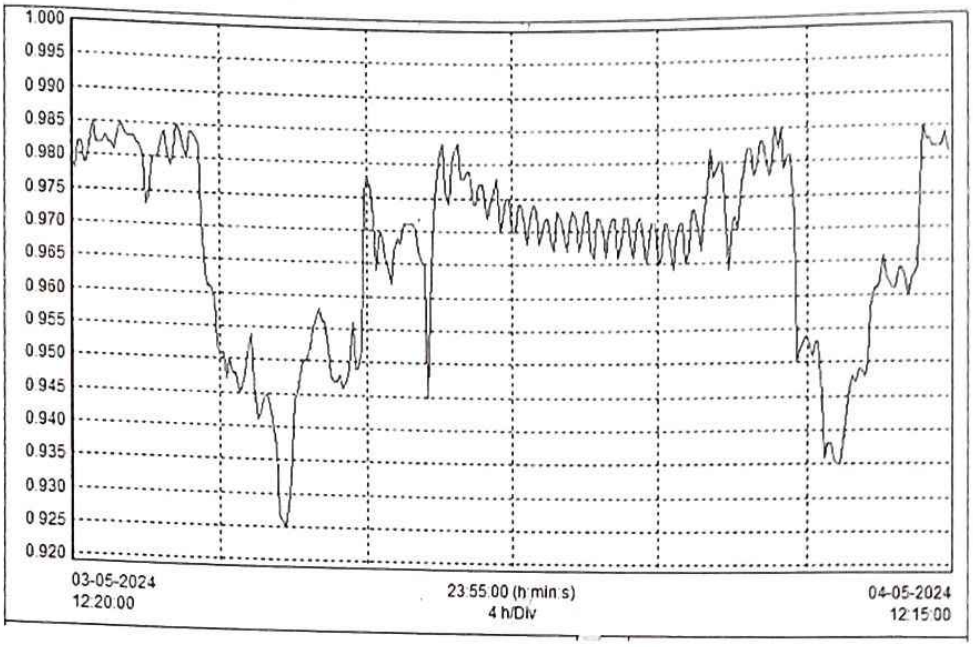
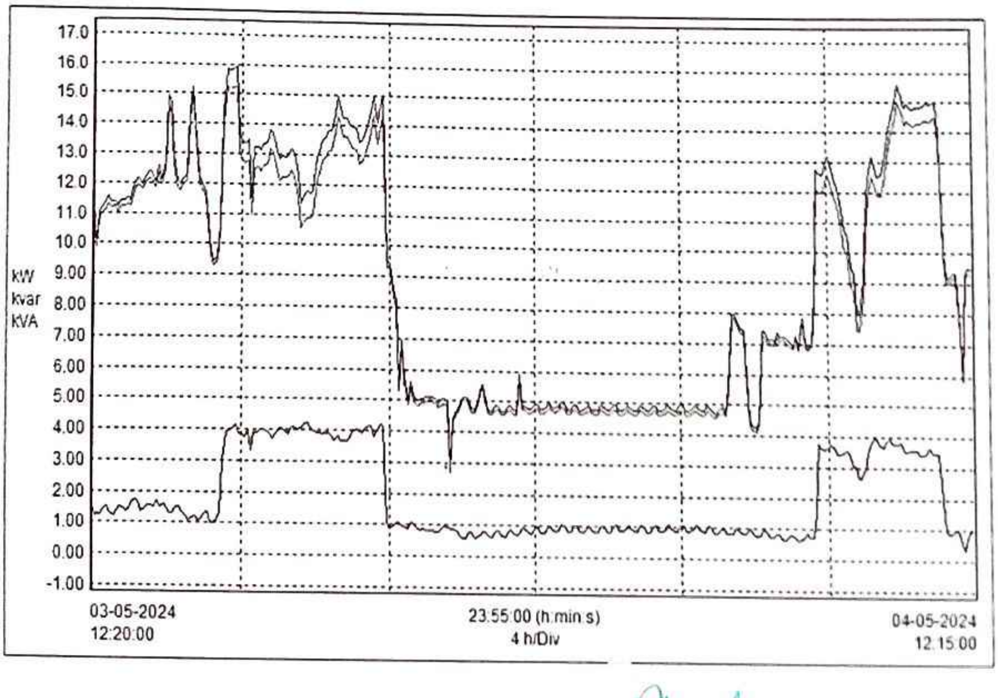
4. **Power quality analyser – Measured Power factor**



5. **Power quality analyser – Measured Power**



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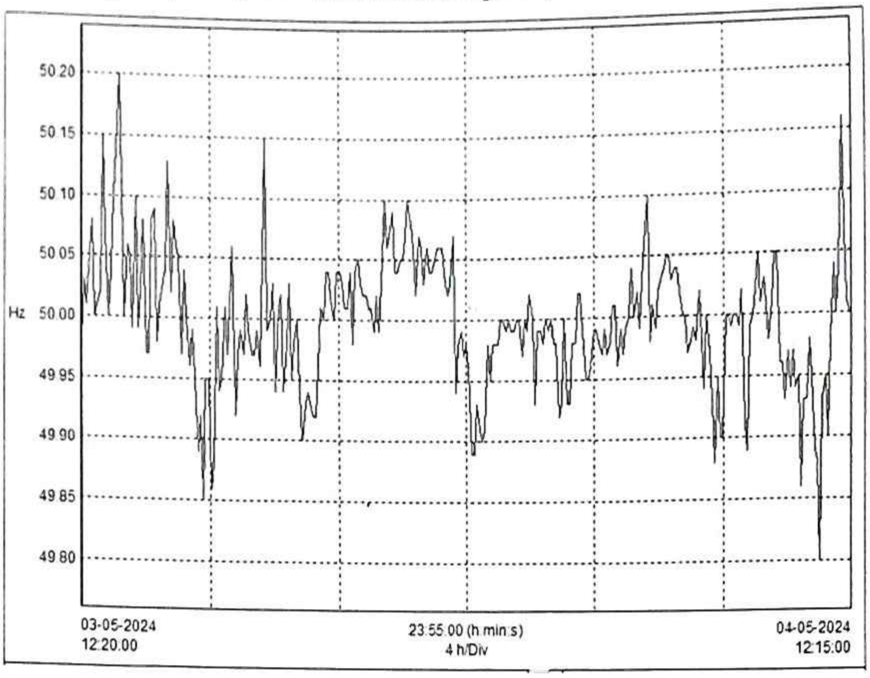
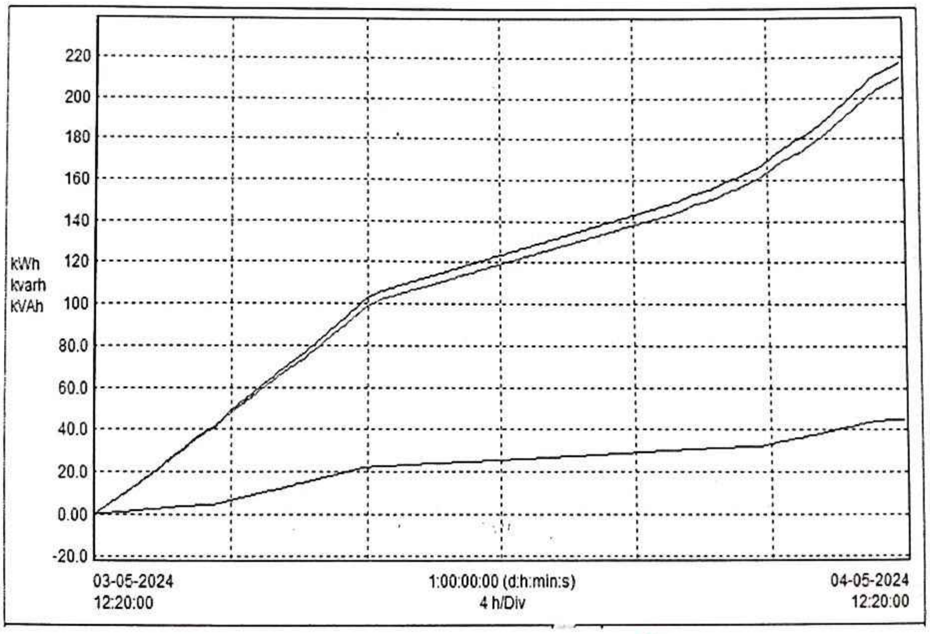
6. **Power quality analyser – Measured Frequency**



7. **Power quality analyser – Measured Energy**



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CHAPTER 6

ENERGY SAVING RECOMMENDATIONS

From the findings and observations, the energy audit team suggests the following recommendations at Annai Vailankanni College of Engineering.

RECOMMENDATION 01

Replace the conventional ceiling fan with BLDC Fan

Presently conventional single phase induction motor based Ceiling fans are commonly used for ventilation in Classrooms, Laboratory and Staff rooms. The conventional ceiling fan consumes 65Watts, whereas the BLDC type Ceiling fan consumes 35Watts for the same sweep area. There is a potential to save 30 Watts power per ceiling fan, if the conventional ceiling fan is replaced with BLDC type ceiling fan.

Benefits

There are around 353 fans are found inside the campus. The estimated annual savings is **Rs. 1,97,180.28/-** with an investment of Rs.8,82,500/- which will be paid back in **4.47 Years**.

The Breakup for Energy Saving opportunities with BLDC fan

Locations	No. Of Fan	Operating Hours	No. Of Days	Energy Cost Saving Potential in Rupees	Investment in Rupees	Payback Period in Years
Main Building, Mech. & First Year Block	246 Nos	7 Hours	220 Days	98877.24	615000	6.21
Hostel	107 Nos	16 Hours	220 Days	98303.04	267500	2.72
Total No. Of Fan in College	**353 Nos**			**1,97,180.28**	**8,82,500**	**4.47**

Whenever, the management have a plan to buy ceiling fans for new building or expansion or modernization activities, it is recommended to buy BLDC fan.

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Calculations to work out the Annual Cost Saving and Payback period :

If a Conventional Fan operates for 7 Hours daily for 220 days,

Annual Energy for Conventional fan= 65Watts X 7Hours X 220days

= 100.1 kWh

Annual Energy Cost for Conventional fan= 100.1 kWh X Rs.8.7/kWh

= Rs.870.87/-

Annual Energy for BLDC fan= 35Watts X 7Hours X 220 days

= 53.9kWh

Annual Energy Cost for BLDC fan= 53.9kWh X Rs.8.7/kWh

= Rs.468.93

Saving in Annual Energy Cost with BLDC fan= Rs. 870.87– Rs.468.93= Rs.401.94 /-

Investment required for New BLDC fan= Rs. 2500/-

Payback period in month for the BLDC fan= (Investment/Energy Saving) X 12

= (Rs.2500 / Rs. 401.94) X 12

= 74.63 ≅ 6.2 Years

If a Conventional Fan operates for 16 Hours daily for 220 days,

Annual Energy for Conventional fan= 65Watts X 16Hours X 220days

= 228.8kWh

Annual Energy Cost for Conventional fan= 228.8 kWh X Rs.8.7/kWh

= Rs.1990.56/-

Annual Energy for BLDC fan= 35Watts X 16Hours X 220 days

= 123.2kWh

Annual Energy Cost for BLDC fan= 123.2kWh X Rs.8.7/kWh = Rs.1071.84/-

Saving in Annual Energy Cost with BLDC fan= Rs.1990.56– Rs.1071.84= Rs.918.72 /-

Investment required for New BLDC fan= Rs. 2500/-

Payback period in month for the BLDC fan= (Investment/Energy Saving) X 12

= (Rs.2500 / Rs. 918.72) X 12

= 32.65 ≅ 2.72 Years

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RECOMMENDATION 02

Replace low star rated AC to high star rated AC

Presently air conditioners used in the institutions are three star rated. Low star rated ACs consume more power. But five star rated ACs consume less power and need less maintenance.

3 star rated ACs consume around 1000 watts whereas 5 star rated consume only 700 watts.

Benefits

Currently there only 4 Nos of air conditioners installed inside the campus are in working condition. If all those are replaced with 5 star rated ACs, then the estimated annual savings is **Rs.16,077.6/-** with an investment of **Rs.1,40,000/-,** which will be paid back in **8.7 years.** The replacement priority can be given to the locations where the AC is utilized more.

No. Of ACs	Operating Hours	No. Of Days	Energy Cost Saving Potential in Rupees	Investment in Rupees	Payback Period in Years
4 Nos – 3 star	7 Hours	220 Days	16077.6	140000	8.7
14 Nos – No star	Not in working condition				

Calculations to work out the Annual Cost Saving and Payback period :

For 3 star rated ACs

Annual Energy for 3 star AC = 1000 Watts X 7Hours X 220 days
= 1540 kWh

Annual Energy Cost for 3 star AC = 1540 kWh X Rs.8.7/kWh = Rs.13,398/-

Annual Energy for 5 star AC = 700Watts X 7Hours X 220 days
= 1078 kWh

Annual Energy Cost for 5 star AC = 1078 kWh X Rs.8.7/kWh= Rs.9378.6/-

Saving in Annual Energy Cost with 5 star AC = Rs.13398 – Rs.9378.6 = Rs.4019.4 /-

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Investment required for New 5 star AC = Rs. 35000/-

Payback period in month for the 5 star AC = (Investment/Energy Saving) X 12

= (Rs.35000 / Rs.4019.4) X 12

= 104.49 ≅ 8.7 years

RECOMMENDATION 03

Install PV power system in the campus

It is recommended to install on grid rooftop solar PV systems of 38 kW to self-generate the required Energy for the institution. Switching to a photovoltaic (PV) system is indeed an effective energy-saving recommendation to reduce CO_2 emissions and promote sustainability. PV systems, also known as solar power systems, convert sunlight directly into electricity using solar panels comprised of photovoltaic cells. By embracing solar energy and investing in PV systems, the institution can contribute to a sustainable energy future while mitigating the impacts of climate change and reducing reliance on fossil fuels.

The energy consumption of the institution is 67,792.5 kWh per year. In general, 1 kW solar panel will produce 5 kWh per day. Thus, **38 kW solar panel** is required to produce around 68,000 kWh per year.

The approximate PV system installation cost is **Rs.22,50,000** (as per online price). The life time is **25 years.** Based on the considered period, the annual saving in energy costs will be **Rs.9,73,820**. The invested amount will be **paid back in 2.3 years**.

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CHAPTER 7

SCOPE FOR IMPROVEMENT

During the Detailed Energy Audit at the institution, the teams have identified some of the areas possible to improve further, which also gives energy saving but it won't payback within three years of time and also difficult to quantify in some cases. But, it increases the reliability of the equipment in a great extent.

IMPROVEMENT OPPORTUNITIES

1. **Marking of Switch Control for Lights, Fans & Air-Conditioners**

Presently the students find difficulties to identify the switch for a tube light / fan in Classrooms & laboratories. Hence, they switch ON all the switches and do the work even one or two student sitting in the classroom/Laboratories.

Number the Light, Fan & Air conditioner and Marking should be done on Switch point as well as near the Tube light, Fan & Air conditioners. This will helpful to the students to switch ON the required Tube light, Fan & Air conditioner alone.

2. **Placing the display boards on saving electricity**

Even though awareness on saving electricity is given to the students and staff members, there is still tremendous scope to create awareness among them about efficient & optimum use of electricity to save. Instruction cum awareness board shall be displayed near each switch-board, toilet block & bathrooms to influence & guide all the users to arrest misuse & wastage of power.

3. **Use of Master Switch outside each class room**

In many cases, the students forget to switch off the lights and fan when they are leaving to laboratories or staffrooms. So all the equipment are in turn on condition when no one is there in the classroom. Installation of master switch outside of each classroom can make it easy for anyone to switch off all the appliances of the rooms. This can help in saving the energy wastage.

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4. Regular cleaning of air filters and cooling pins at regular intervals

Improper cleaning of air filters in air conditioners may leads to deposition of dust in the cooling pins of the air conditioners and the filters are choked. The performance of the air conditioners should be reviewed only after cleaning the filters and removing the dirt's in the cooling pins.

The cleaning of Air filters plays a major role on power consumption on the blower of the Air conditioners. This needs to be done once in a month. Non-maintenance of air filter leads to excess power consumption in the air conditioners blowers. The cleaning frequency should be reviewed with respect to the dust settled on the air filters. Hence it is recommended to regularly clean the filters and cooling pins of air conditioners.

5. Install Sleep Mode Facility for all the Computer System

The computer system running in idle mode consumes 90 – 200Watts of power. There is a provision available in the system to set the computer to sleep mode. In the sleep mode of operation the monitor power consumption is nil & system will consume a little bit of power to restore the earlier status.

The recommended time for going to sleep mode should be set to 3 Minutes. Whenever the system is idle for more than 3 minutes, the system automatically goes to sleep mode.

6. Best practices to be followed for UPS

There are 4 Nos. of UPS with different ratings are installed at the laboratories. It is advisable to turn on the UPS only when using the computer systems for laboratories. It should be turned off after the computer usage.

Normally, A 3KVA UPS will consumes 150Watts power at no-load. There is a good scope to minimize no-load power consumption by switching OFF the UPS running idle. Switch OFF UPS as per the requirements. Students are advised to sit adjacent computer to avoid switch ON of all the UPS.

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To operate security cameras for 24 hours, it is advisable to use less rated UPS. Also make sure that all the cameras are in working conditions. Since supplying the power to non-working cameras with the UPS will result in more energy wastage.

7. Avoid use of pedestal & wall mounted fans

The Pedestal fan & Wall mounted fans runs at 1500 to 3000RPM. The power consumption varies from 85 to 240Watts depending upon the size of blades and speed. The airflow is forceful and makes the person feel tired soon. The energy spent by a person using pedestal fan for comfort will be more.

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CHAPTER 8

MANAGEMENT ASPECTS & CONCLUSIONS

The Objectives of AVCE should be

1. To make energy conservation a permanent activity inside the campus.
2. To achieve lowest energy cost without compromising quality of Educational services.
3. To make one of the Best institutions on the aspect of energy utilization and sustainable power generation in India.
4. To achieve this objective, a firm top management commitment is required at the highest level that the institution wants to conserve energy on a time bound basis.
5. To give top priority to implement the recommended proposals and reap benefits.

APPROACH TO AN ENERGY CONSERVATION IDEA

Each energy conservation idea should be seen as an opportunity for improvement. The approach must be on how to implement each proposal and overcome the problems, if any.

It is easier to say a proposal is not possible or not implementable but the benefit comes from the actual implementation, which needs lot of courage, conviction, will power and perseverance to implement.

IMMEDIATE ACTIONS

From the identified proposals, following are the few actions that can be implemented in a short period of time without much effort and reduced investment.

- Replace the faulty conventional ceiling fan with BLDC Fan.
- Replace the low star rated air conditioner that is operated for most of the day, particularly in offices and frequently operated laboratories.

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CONCLUSIONS

1. The energy audit team has jointly identified proposals for implementation
2. An annual savings potential of **Rs. 2,13,257.88** can be realized by implementing the recommended proposals
3. The annual savings can be achieved with an investment of **Rs. 10,22,500** which will be paid back in **4.79 Years**
4. Installing renewable energy system alone will save **Rs. 9,73,820** annually with an investment of **Rs.22,50,000**, can be paid back in 2.3 years.
5. Implementation of identified proposals should be given top priority and should be done step-by-step

05/04/2021

Dr. M. MARSALINE BENO
Professor, EEE Department,
Dean Research,
St. Xavier's Catholic College of Engg.
Nagercoil - 3.

GREEN AUDIT REPORT

2023 - 2024

ANNAI VAILANKANNI COLLEGE OF ENGINEERING

(Approved by AICTE,New Delhi & Affiliated to Anna University)

Pottalkulam, Malangarai road Post,

Kanyakumari District-629401, Tamil Nadu, India.

Submitted by

Energy Management Cell

St. Xavier's Catholic College of Engineering

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CHAPTER 1

INTRODUCTION

The Energy management cell of St. Xavier's Catholic College of Engineering is delighted to submit the Green Audit report for Annai Vailankanni College of Engineering for the period 2023 – 2024. This report focuses on the Carbon Foot Print reduction measures being implemented by the College Management in close coordination and assistance by the staff and students of the institution. The Green audit was conducted in the campus on 03/05/2024.

The concept, structure of the audit, its objectives, methodology, tools of analysis, time frame of the Audit, the themes and cross cutting themes are detailed below.

THE CONCEPT

Environmental Auditing is defined as: "A management tool comprising a systematic, documented, periodic and objective evaluation of how well organization, management and equipment are performing with the aim of safeguarding the environment and natural resources in its operations/projects".

The European Commission in its proposed regulation on environmental auditing also adopts the ICC definition of environmental audit. However, the outcome of Green Audit should establish with concrete evidence that the measures undertaken and facilities in the institution under green auditing reduces carbon foot print in the atmosphere.

Carbon Foot print is historically defined as the total set of greenhouse gas emissions caused by an individual, event or organization, and expressed as carbon dioxide equivalent.

ANNAI VAILANKANNI COLLEGE OF ENGINEERING – A BRIEF PROFILE

Annai Vailankanni College of Engineering (AVCE) is a private, self-financing, co-educational Engineering College established in the year 2008 by Dr. D. Peter Jesudhas. It is located near Pothaiyadi Salai, Kanyakumari, the southernmost town in India. AVCE is about 8 Kms from the Kanyakumari Railway Station and 15 Kms from Nagercoil junction. AVCE is approved by All India Council for Technical Education (AICTE), New Delhi & has been

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affiliated to Anna University, Chennai since 2008. The college is surrounded by an array of green-clad, sky-scraping mountains of the Western Ghats. The weather is cool and breezy with clouds drifting high over the mountains giving frequent drizzles. The total campus area is 54632.56 m^2 and the built-up area is 23518.66 m^2. The projected area is 31,113.9 m^2.

The following courses are offered through various departments. The courses are;

UG Courses

- B.E. - Civil Engineering
- B.E. - Mechanical Engineering
- B.E. - Electronics & Communication Engineering
- B.E. - Computer Science & Engineering
- B.Tech. - Artificial Intelligence and Data Science
- B.E.- Biomedical Engineering

PG Courses

- M.E. – Communication systems
- M.E. - Computer Science and Engineering
- M.E. – Thermal Engineering
- M.B.A.

OBJECTIVES OF GREEN AUDITING

Objectives are needed to define quantitative and qualitative level of achievement of Annai Vailankanni College of Engineering – herein after referred to as institution - in terms of Carbon Foot Print reduction.

The objectives of green audit at AVCE

- To assess whether the measures implemented by Annai Vailankanni College of Engineering have helped to reduce the carbon foot print in the atmosphere.
- To assess whether the investments made in electricity power management, biodiversity and environment consciousness among the students have helped the

institution to achieve the required carbon dioxide absorption and emission in the campus of the institution

- To assess whether the non-academic activities of the institution support the collection, recovery, reuse, recycling of the solid waste that harms the environment.
- To identify the gaps and suggest recommendations to improve the green campus status of the institution.

METHODOLOGY ADOPTED

The methodology adopted to conduct Green Audit of the Institution has the following components;

On site visit

The auditing team visited the institution on 03-05-2024 to assess the greenhouse gas emissions from the institution, carbon foot print reduction measures and energy efficient devises. The key focus was to assess the green cover and the flora status of the institution.

Focused Group Discussion

The focused group includes selected staff and students of AVCE. The discussion focused on identifying the attitudes and awareness towards environmental issues at the institution level was done. The discussion revolved around three key questions; Do they consider themselves eco-conscious? Do they consider the organization to be eco-friendly? What do they think are the top priorities that should be tackled?

The Office/ Building Survey

Collecting information on the office-based environmental impacts, like square footage, utility bills, energy saving devises, and IT equipment. This information is added to the carbon footprint data, giving an accurate picture of the organization's annual greenhouse gas emissions and reduction measures.

The Carbon Footprint

- The data collected from the following sources are taken into consideration to calculate Carbon Foot Print emissions and reductions; the flora status of the campus like total

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number of plants, trees, shrubs – alternate green energy production and consumption to reduce fossil fuel-based energy. The number of fluorescent lamps, CFL and LED tube lights to improve energy efficiency in the campus/ building through our carbon footprint calculator is also taken in to account.

- The carbon foot print calculator will enable the institution to measure annual tons of carbon emissions by the institution. Besides, it will enable the institution to break it down by key "carbon drivers" so that the institution knows how much of carbon footprint comes from which type of behaviour (e.g. high power consuming incandescent bulbs vs. LED lights, LPG cylinder vs. Bio Gas etc.).

Green Audit Assessment Team

Sl.No	Name	Designation
1	Dr. M Marsaline Beno	BEE Certified Energy Manager, Professor & Dean for Research, Head - Energy Management Cell /SXCCE
2	Dr. Jain B Marshel	Assistant Professor/ EEE/ SXCCE
3	Mr. Abragam Siyon Sing M	BEE Certified Energy Manager, Assistant Professor/ EEE/ SXCCE
4	Dr. Jesus Bobin V	Assistant Professor/ EEE/ SXCCE
5	Mr. S. Benziher	Skilled Assistant/ EEE/ SXCCE
6	Dr. Angeline Prabhabathy R	Principal/ AVCE
7	Dr. Abilash N	IQAC Co-ordinator/ AVCE
8	Dr. Johnny Varghese A	Associate Professor/Mech./AVCE

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CHAPTER 2

CARBON AUDIT TOOLS AND ANALYSIS

A **carbon footprint** is historically defined as "the total set of greenhouse gas emissions caused by an individual, event, organization or product expressed as **carbon** dioxide equivalent."

FLORA STATUS OF THE INSTITUTION

The projected area of the institution is given below,

Total area of the campus = 54,632.56 m^2 (13.499 acres)

Built – up area = 23,518.66 m^2 (5.812 acres)

Projected area = 31,114 m^2 (7.688 acres)

The area taken into consideration for data collection of flora is only the projected area.

Calculation calendar of Trees

560 to 700 fully grown trees shall be raised in one acre of land. This depends on the type of soil, the species/ family type of the tree and spacing. However, with the normal spacing of 6x10 feet, the total number of trees shall be taken up as 600/acre.

Nature raises trees, bushes and shrubs without manmade spacing and hence they are thickly populated and defies head count. However, the staff members and students made an approximate survey of the number of flora in the area.

Table 2.1: Flora status of the campus

Sl.no	Status of trees/plants/ bush trees	Number/area
1	Total number of fully grown trees	948
2	Total number of semi grown trees	672
3	Total number of shrubs	156
4	Total number of bushes and potted plants	205
5	Total area of grass lawn (sq. feet)	5,325

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CARBON ABSORPTION BY FLORA IN THE INSTITUTION

Assumptions to measure carbon absorption

1. Number of mature trees in one acre = 700 trees
2. Carbon absorption capacity of 700 trees is equivalent to carbon emitted by a speeding car for 26,000 miles
3. Conversion of 26,000 miles into Kilometre is = 41,843 KM
4. Average Kilometre covered by a car per litre of petrol is 20 KM
5. Total quantity of petrol consumed by the car (41,843/20) = 2092 litres

The carbon emission by one litre of petrol is 2.3 Kg of CO_2. At this rate the total quantity of carbon emitted by 2092 litres of petrol is (2092 x 2.3 kg) = 4812 kg CO_2 or 4.8 tons of CO_2. Therefore, the carbon absorption of one fully grown tree is 4812/700 = 6.8 Kg of CO_2

The foot print calculation is based on the standard unit of one litre petrol = 2.3 Kg. CO_2.

Calculation of Carbon Absorption by flora

Carbon absorption of one fully grown tree = 6.8 Kg of CO_2.

1. Therefore, the carbon absorption of 948 fully grown trees in the plain lands of the institution is (948×6.8 Kg. CO_2) = **6,446.4 Kg. CO_2 or 6.446 tons of CO_2**
2. At this rate the carbon absorption of 672 semi grown trees is half or 50% of the carbon absorption capacity of fully grown trees. Hence the carbon absorption is **(672 × 3.4 Kg. CO_2) = 2,284.8 Kg. CO_2 or 2.285 tons**
3. There are 361 plants raised in the gardens of the institution. Carbon absorption of plants, bushes and shrubs vary widely according to the species, Genus and Family. Certain bush plants absorb as high as 49,000 grams CO_2 per plant where as some other bush plants absorb as low as 150-gram CO_2 per plant. In the absence of a detailed scientific study and botanical survey of the species of bush and thorny plants, it is fixed that per plant carbon absorption at 200 gram per plant in consultation with environment scientists.

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Based on this the total carbon absorption of 361 (156 + 205) plants is calculated at 361 x 200 grams = 72,200 grams or 72.2 Kilograms. If it is converted into tons, it is **0.0722 tons of CO_2.**

4. The institution maintains grass fields besides the buildings. The total area of grass fields is 5,325 sq.ft. The carbon absorption capacity of 10 sq.ft area of grass is 1 gram. CO_2. At this rate 5,325 sq.ft area of grass absorbs **532.5 gram or 0.533 Kg CO_2 per day.**

   At this rate, total carbon absorption per year is 0.533 Kg x 365 = 194.545 Kg or **0.195 tons per year**

   The grant total of carbon absorption of the flora in the campus of Annai Vailankanni College of Engineering is (1+2+3+4) = **8.998 tons**

This is the sink effect of the Flora in the campus and the proactive Carbon Foot Print reduction measures.

Table 2.2: CO_2 absorption by flora

Sl.no	Type of trees/ bushes	Number of trees/ bushes	CO_2 absorption by flora
1	Fully grown trees	948	6.446 tons
2.	Semi grown trees	672	2.285 tons
3	Bushes & Shrubs	361	0.072 tons
4	Grass lawn	5,325 sq.ft	0.195 tons
		Total	**8.9982 tons**

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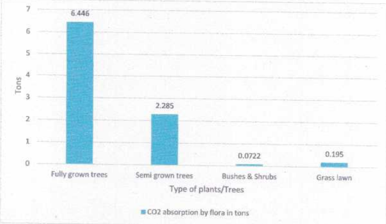

Figure 2.1: CO_2 absorption by flora

OXYGEN EMISSION BY FLORA AT AVCE

According to the Arbor Day Foundation, "A mature leafy tree produces as much oxygen in a season as 10 people inhale in a year." A person breathes 7 or 8 litres of air per minute. Air consists of about 20% oxygen. But when you exhale, your breath is about 15% oxygen, so you consumed about 5%. Therefore, a person uses about 550 litres of pure oxygen each day.

Calculation of oxygen emission by flora

The number of litres in 1 kilogram depends on the density of the substance being measured. The litre is a unit of volume, and the kilogram a unit of mass. Litre and kilogram are approximately equivalent when the substance measured has a density close to 1 kilogram per litre.

"On an average, one fully grown tree produces nearly 260 pounds or 117.6 kg of oxygen each year. Two mature trees can provide enough oxygen for a family of four persons."

Kilogram is considered for calculation.

1. Total Kg. of oxygen emitted by 948 fully grown trees per year is (117.6 x 948) = 111,484.8 Kg. of Oxygen or **111.485 tons of Oxygen**

2. Total oxygen emitted by semi grown trees (672× 58.8) = 39,513.6 kg oxygen or **39.514 tons** (oxygen emission is half or 50% of the fully grown-up tree)

3. Total oxygen emitted by 361 (156 + 205) plants is calculated based on the following oxygen inhaling requirement per person/day. One normal human being requires 550 litres of oxygen per day to avoid airlock. 400 bush plants produce enough oxygen per day to enable a person to breathe adequate quantity of oxygen of 550 litres. Total quantum of oxygen produced by 400 plants per day is 550 litres of oxygen.

If we take 400 plants as one unit, then the number of units of bush plants in the campus is (361/400) = 0.9025

Total quantity of oxygen produced by 0.9025 units is (0.9025 x 550 litres) = 496.375 litres of oxygen per day.

The annual production of oxygen at this rate is (496.375 x 365) = 181,176.875 litres or Kg. of oxygen. If this is converted into tons, it is approximately **181.177 tons**

4. Grass lawns are incredible oxygen making machines. A 25 square foot area will supply enough oxygen to support one person for a day. In other words, quantitatively speaking, 25 square foot area of grass produces 550 liters of oxygen per day.

Hence, we take 25 square foot area as one unit which is equivalent to 550 litres of oxygen.

Total area of grass land is 5,325 sq.ft. If we calculate units, it is 5,325/25 = 213 units which produces (213 x 550 litres of oxygen) = 117,150 litres of oxygen per day

Total quantity of oxygen produced by the 5,325 sq.ft. Grass is (117,150 litres/day x 365 days) = 42,759,750 litres of oxygen or approximately **42,759.75 tons** of oxygen.

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Table 2.3: Oxygen produced by flora

Sl.no	Type of trees/plants	Number of trees/plants	Oxygen produced by flora in tons
1	Fully grown trees	948	111.485
2	Semi grown trees	672	39.514
3	Bushes & Shrubs	361	181.177
4	Grass lawns	5,325 sq.ft	42,759.75
		Total	**43,091.926**

It is found that the grass lawns are the highest producer of oxygen in the campus. The total oxygen produced in the campus is calculated as 43,091.926 tons.

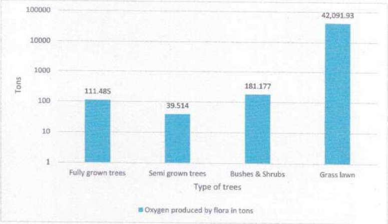

Figure 2.2: Oxygen produced by flora

CHAPTER 3

ENERGY SAVING MEASURES AND CARBON FOOT PRINT REDUCTION

The Energy Audit Report of the College during the period 2023 – 2024 reveals that the total consumption of electricity is **67,792.5 units**.

CO_2 EMISSIONS BY COAL EQUIVALENT OF ENERGY CONSUMED

One unit of electricity equals to 1000 watts hour (1KWhr.) It requires 0.538 Kg. or approximately ½ kg of coal to produce one unit of electricity. Total quantity of coal required to produce 67,792.5 units of electricity is (67,792.5 x 0.538 Kg coal) = **36,472.365 Kg. coal or 36.472 tons of coal.**

One Kg. of coal emits 2.86 Kg. of CO_2 into the atmosphere and thereby increasing the carbon foot print which in turn results in proportionate global warming. Therefore, 36.472 tons of coal consumed indirectly by the institution emit (36,472.365 kg of coal x 2.86 Kg. CO_2) = 104,311 Kg or **104.311 tons of CO_2** into the atmosphere

ENERGY CONSUMPTION WITH INCANDECENT BULBS FOR LIGHTING

Energy consumption of incandescent bulbs is taken as reference source to calculate the reduction of CO_2 emission through the installation of LED bulbs or tubes. Also, bulbs and tubes with power rating below 60 watts has been taken to calculate carbon emission reduction. The following table illustrates the total Incandescent lamps used (as reference only for calculation) and the energy consumed by them.

Table 3.1: Energy consumed by incandescent lamp as reference

Sl. No.	Contents	Value
1	Total no. of incandescent lamps used as reference	592
2	Average energy consumption by an incandescent lamp.	60 W
3	Energy consumed by 592 lamps for 5 hrs/day.	117.6 units
4	Energy consumption of 592 lamps for 200 days/ year. (592 x 60 watts x 5 hrs x 200 days)	35,520 units

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CO_2 REDUCTION THROUGH ENERGY EFFICIENT MEASURES

Annai Vailankanni College of Engineering is conscious of the damages to the atmosphere due to carbon emission and has been implementing various programs/ activities to reduce energy consumption on one hand and increasing green energy sources on the other hand. They are;

1. Replacing high energy consuming lighting system with energy efficient lighting systems
2. Replacing low star rated Air Conditioners in Computer labs with energy efficient Fans/ 5 star rated AC's.
3. Using fuel from bio gas plant and Gobar gas plant for cooking purpose.

CARBON FOOT PRINT REDUCTION ANALYSIS

First, it is appropriate to analyse the carbon emission of 35,520 units of electricity consumed by 592 incandescent lamps per year. The standard tool of analysis employed in this green Audit is coal equivalent of electricity.

0.538 Kg. of coal is required to produce one unit of electricity.

Total units of electricity consumed by 592 incandescent lamps = 35,520 units

Coal equivalent of 35,520 units (35,520 x 0.538 Kg. coal) = **19,109.76 kg or 19.109 tons of coal.**

One Kg of coal emits 2.86 Kg of CO_2 into the atmosphere.

At this rate, **19,109.76** Kg of coal emits **(19,109.76 x 2.86) = 54,653.91 Kg CO_2 into the atmosphere or 54.653 tons of CO_2**

The following are the CO_2 reduction measures adopted in the institution.

The institution has installed so far 3 varieties of LED lamps of different power capacity numbering 592 to reduce the carbon di oxide emission. There are 148 number of 40-watt lamps, 356 numbers of 20-watt lamps and 88 number of 9-watt lamps.

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Table 3.2: Energy Efficient lights

Name of Equipment	Quantity	Power Rating
LED lamp	148	40 Watts
LED lamp	356	20 Watts
LED lamp	88	9 Watts

40 watts LED lamps

One 40 watts lamp consumes (40 watts x 5 hours) 200-watt hours of electricity per day. At this rate one lamp consumes (200 x 200 watts) 40,000-watt hours per year. If it is converted into units, it is 40,000/1,000 = 40 units. 148 lamps consume (40 units x 148) = 5,920 units. 5,920 units require (5,920 x 0.538) = 3,184.96 Kg of coal. This quantity of coal emits (3,184.96 x 2.86) = **9,108.986 Kg of CO_2**

What is the quantity of carbon emission reduction through this measure? The formula for the calculation of carbon emission from electric lamps is as follows; Power rating in watts x number of lamps x number of hours x number of days / 1,000 x 0.538 x 2.86

The carbon emission of 148 incandescent lamps with 60 watts capacity is (60 watts x 148 x 5 hours x 200/ 1,000 x 0.538 x 2.86) = **13,663.48 Kg of CO_2.**

The carbon reduction as by replacing incandescent lamps by LED lamps is (13,663.48 – 9,108.986) = 4,554.5 Kg of CO_2 or **4.55 tons of CO_2**

20 watts LED lamps

The institution has installed 356 LED lamps with 20 watts capacity. The carbon emission during the reporting period is 20 watts x 356 lamps x 5 hours x 200 days / 1,000 x 0.538 x 2.86 = 10,955.4 Kg. CO_2 or **10.96 tons of CO_2**

The carbon emission of 356 incandescent lamps with 60 watts capacity is (60 watts x 356 lamps x five hours x 200 days / 1,000 x 0.538 x 2.86) = 32,866.2 Kg CO_2 or **32.87 tons of CO_2**

The carbon emission reduction is (32.87 tons – 10.96 tons) = **21.91 tons of CO_2**

9 watts LED lamps

The institution has installed 88 LED lamps with 9 watts capacity. The carbon emission during the reporting period is 9 watts x 88 lamps x 5 hours x 200 days / 1,000 x 0.538 x 2.86 = 1,218 Kg. CO_2 or **1.22 tons of CO_2**

The carbon emission of 88 incandescent lamps with 60 watts capacity is (60 watts x 88 lamps x five hours x 200 days / 1,000 x 0.538 x 2.86) = 8,124.23 Kg CO_2 or **8.12 tons of CO_2**

The carbon emission reduction is (8.12 tons – 1.22 tons) = **6.9 tons of CO_2**

The following table illustrate the total carbon emission reduction through installation of energy efficient lamps in the institution

Table 3.3: CO_2 reduction in tons

Sl.no	Particulars of lamp	Watts	Quantity	CO_2 emission by present lighting in tons	CO_2 emission by incandescent lamps in tons	CO_2 reduction in tons
1	LED lamps	40	148	9.11	13.66	4.55
2	LED lamps	20	356	10.96	32.87	21.91
3	LED lamps	9	88	1.22	8.12	6.9
		Total	**592**	**21.29**	**54.65**	**33.36**

The net carbon reduction by installing energy efficient LED lamps is 33.36 tons of CO_2.

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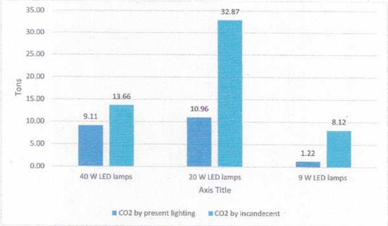

Figure 3.1: CO_2 emission: Present lightings Vs Incandescent lamps

The usage of energy efficient lighting system in substitution to incandescent lamps has reduced the CO_2 emission by 33.36 tons. It is evident from the following chart.

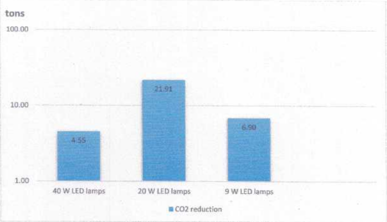

Figure 3.2: CO_2 reduction through LED lamps

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CHAPTER 4

BIO GAS PLANT, GOBAR GAS PLANT AND OTHER INITIATIVES

The institution has installed Bio-gas plant and Gobar gas plant to reduce further carbon emission.

BIO GAS PLANT

A bio gas plants have been installed in the college premises with the capacity of 1 cubic meter. The feeders for the bio gas plant consist of food waste and other degradable waste from the girls hostels.

Figure 4.1: Bio gas plant

GOBAR GAS PLANT

A Gobar gas plant also have been installed in the college premises with the capacity of 3 cubic meters. The feeders for the bio gas plant consist of waste from the cattle.

The Bio gas plant and Gobar gas plant are capable of producing 50 kg of cooking gas which can replace 3 LPG cylinders in a year.

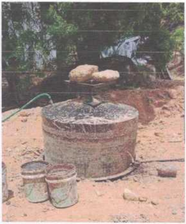

Figure 4.2: Gobar gas plant

CALCULATION OF CARBON EMISSION IN COMPARISON WITH LPG

LPG: Input Value (In Kg/ Yr.) X 2.983 (Emission Factor) = Output value in Kg of CO_2. Based on this formula, the carbon emission from LPG cylinder equivalent of the bio gas plant is calculated below;

Total reduction of Carbon Foot Print per year through bio gas and gobar gas unit is (50 Kg) x (2.983 Emission Factor) = **149.15 Kg of CO_2.**

SOLAR ENERGY INITIATIVE

Solar Energy is the most feasible and viable green energy available around the globe. The viability and feasibility are very high in the tropical countries like India. Annai Vailankanni College of Engineering is located in an ideal place to trap solar energy to the maximum.

10 number of 90 W solar PV based street light illumination system is to be installed as a trial run in the college campus as a part of student project. It is expected to produce 1.642 units of energy per year which is sufficient to operate a 9 W LED lamp for 0.5 hours every day. Compared to the vast potential, this power generation is extremely low.

Furthermore, the institution is encouraging students to do renewable energy-based projects understanding the importance of green energy.

VERMI COMPOST TANK

It has been planned and initiated to collect compostable fallen leaves from trees and plants in a Vermi compost tank. These wastes shall be converted into compost manure and used in the gardens to reduce the usage of chemical-based fertilizers and pesticides.

Figure 4.3: Vermi Compost tank

NUCLEAR RADIATION MONITORING SYSTEM

A nuclear radiation monitoring system has been installed and maintained in the campus by Nuclear Power Corporation of India to detect the amount of nuclear radiation if any, emitted by Koodangulam Nuclear power plant.

Figure 4.4: Nuclear radiation motoring system

CHAPTER 5

TRANSPORT SYSTEM AND CARBON EMISSION

India ranks third in the world – after China and United States - in terms of CO_2 emissions from transport system. It is estimated that 9% of the total carbon emissions from India emanates from the transport system. Hence it is appropriate, in this context, to analyse the carbon dioxide emissions from the fleet of four wheelers owned by the institution. The calculation does not take into account the number of two wheelers and four wheelers owned by the faculty and students.

The following data gives us the quantity of diesel consumed by the vehicles during the last year. There are 10 number of 48 seated buses that are in use to provide transport service to the students hailing from distant places.

CONSUMPTION OF DIESEL BY BUSES

The fuel consumption by vehicles is determined by the type of vehicle, year of manufacturing, maintenance status, traffic system of the particular area etc. Considering these factors in view it is estimated that the average distance covered by one bus per litre of diesel is taken as 5 km as standard unit for calculation. Based on this, the total litres of diesel consumed by the 10 buses and a van is **63,714 litres of diesel.**

Table 5.1: Fuel consumption by vehicles

Vehicle	Quantity	Fuel type	Distance covered/year	Mileage	Diesel consumption/ year (litres)	CO_2 emission (tons)
Bus (SML)	4	Diesel	96,000	6	16,000	42.88
Bus (Ashok Leyland)	6	Diesel	1,44,000	4	36,000	96.48
Van (TATA)	1	Diesel	12,000	7	1,714	4.6
				Total	**53,714**	**143.96**

As per the calculation calendar, per litre of diesel emits 2.68 kg. of CO_2. At this rate, the total quantity of CO_2 emitted by 53,714 litres of diesel is **143.96 tons CO_2.**

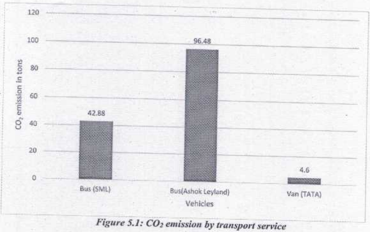

Figure 5.1: CO_2 emission by transport service

All the above said vehicles are equipped with speed governor mechanism to avoid rash driving and also to improve fuel efficiency. The filters are also replaced once in every 3 months.

CHAPTER 6

WATER AUDIT

The institution is located in an area close to the slopes of western ghats and hence the runoff water from rain is the source of fresh water that shall be harvested and this maintains the underground water table alive. At present the rain water is channelized through drainage system to a reservoir well with a storage capacity of 400 cubic meter. This well maintains the underground water table sufficient to sustain the summer seasons. This water enables the bore wells in the campus to get enough feed even during drought summer.

Figure. 6.1: Rain water harvesting well

Furthermore the rain water falling on the roof top of the buildings are pipelined in to rain water harvesting system. This also maintains the underground water table alive throughout the year.

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Figure 6.2: Rain water collection system

It is seen that most of the taps used in AVCE are of press and release type. This prevents wastage of water.

Figure 6.3: Press and release type taps

CHAPTER 7

SUGGESTIONS AND RECOMMENDATIONS

IMPRESSIONS

The overall impression one gets while green auditing the campus is that it qualifies to be labelled as Green Campus. The geographical location and the vast area of the institution is a contributing factor to green the campus.

Conversion of the solid waste, particularly food waste in hostel into bio gas is an impressive achievement and commitment to reduce carbon foot print.

The college management and the faculty of Electrical and Electronics deserve appreciation to reduce carbon foot print through installing various energy efficient measures. One example is replacing incandescent and fluorescent lamps with less energy consuming LED bulbs.

SUGGESTIONS AND RECOMMENDATIONS

There exists vast scope to improve the green campus status of the College through biodiversity promotion measures and tapping green energy sources.

1. More than 4 acres of land area is available to raise horticulture gardens, fruit bearing trees and shade giving trees. About 2,000 such trees and 4,000 plants shall be raised in the campus in the next three years. Through transplantation 500 tree plants shall be raised in one year. Within six-month period, the campus will get 2.5-year-old tree plants numbering 4,500.
2. Another 5,000 sq.ft area of grass lawns shall be raised through the involvement of student members to enhance the oxygen emission further.
3. Solar panels shall be installed on the concrete top of the buildings to produce 68,000 units of electricity annually, so that the campus becomes self-reliant energy campus. To enhance the solar power productivity, aluminium foil-based reflectors shall be installed on the eastern and western side of the solar panel. 38 kW solar plant has to be installed in the rooftop for being self-reliant in power production.
4. Energy efficient measures such as replacement of all bulbs with LED lamps, replacing all old electrical regulators of the fans with energy efficient electronic regulators, replacement of all air conditioning units with all higher star rated system are also suggested.

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5. Electronic body temperature sensors may be fixed in the rooms that have air conditioners so that power is shut down for air conditioners automatically when nobody is in the room. This shall reduce wastage of electricity caused by human error.
6. Students from the ECE and EEE departments shall be trained as e - waste managers to manage the e- waste system. These e-managers shall be in constant touch with schools, orphanages and other institutions through social media and inform them of the outdated computer systems that shall be used by these less intense research institutions. They also shall dispose of the less efficient, damaged and non-functioning e- wastes to the venders.
7. Banana stems shall be used as supplementary feeder to increase the productivity of the bio gas plants.
8. Water quality testing lab shall be installed in one part of the laboratory to test the potability of the drinking water to ensure the students are free from water borne diseases.
9. All the water taps shall be fitted with high efficiency aerator to reduce water consumption.
10. All the toilets shall be fitted with dual flush water closets to reduce water consumption by 40%. Few 10 litres per flush tank shall be converted into dual flush water closets which uses only 2 litres of water for liquid waste and 6 litres of water for solid waste.
11. A water pump may be installed in the rain water harvesting well to feed the grass and plants in the campus.
12. Roof top of the building shall be covered with a weathering course layer, which is a mixture of broken bricks in lime mortar, followed by earthen tiles covering. This insulation reduces the cooling loads of the air conditioning system.
13. Environment education shall be disseminated to all the college students through one hour Life skill study class once in a week. This will create wider level environment consciousness among the student community. They will be sensitized to encourage pillion riding with their peers or using public transport system instead of using two wheelers. Moreover, they will also motivate their parents to replace all the incandescent or fluorescent bulbs/tubes with energy efficient LED bulbs.

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Annexure 1

Flora in AVCE

Common name: Mango tree
Botanical Name: Mangifera indica

Common name: Drum stick
Botanical Name: Moringa oleifra

Common name: Lemon tree
Botanical Name: Citrus Limon

Common name: Custard apple tree
Botanical Name: Annona squamosa

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Common name: Tamarind tree
Botanical Name: Tamarindus indica

Common name: Palmyra
Botanical Name: Borassus Flabellifer

Common name: Coconut tree
Botanical Name: Cocos nucifera

Common name: Oleander
Botanical Name: Nerium Oleander

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Environmental Audit Report

ANNAI VAILANKANNI
COLLEGE OF ENGINEERING
(Approved by AICTE,New Delhi & Affiliated to Anna University)

Prepared by: The Energy Management Cell,

St. Xavier's Catholic College of Engineering

Date: 03/05/2024

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Table of Contents

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1. Executive Summary

This Environmental Audit Report for Annai Vailankanni College of Engineering (AVCE) evaluates the institution's environmental performance for the period 2023-2024.The environmental audit of Annai Vailankanni College of Engineering (AVCE) was conducted to evaluate compliance with environmental regulations and to identify opportunities for improving environmental performance. . The audit was conducted by the Energy Management Cell of St. Xavier's Catholic College of Engineering on 03/05/2024. The audit aims to assess the carbon footprint, energy consumption, and environmental practices of AVCE, and provide recommendations for improvement. The audit covered key areas including air emissions, water usage, waste management, and energy consumption. The findings indicate that Annai Vailankanni College of Engineering (AVCE) has generally adhered to regulatory requirements but identified several areas for improvement.

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2. Introduction

Concept of Environmental Auditing

Environmental auditing is a systematic, documented, periodic, and objective process for evaluating the performance of an organization, management, and equipment in safeguarding the environment. It aims to reduce the carbon footprint and enhance sustainability practices within the institution.

Objectives

- Assess the effectiveness of carbon footprint reduction measures at AVCE.
- Evaluate investments in energy management, biodiversity, and environmental consciousness.
- Identify gaps and provide recommendations for improving the institution's green campus status.
- The objective of this audit was to Annai Vailankanni College of Engineering (AVCE)'s compliance with relevant environmental regulations and standards, and to identify areas for potential improvement in environmental management practices.

College Profile

Annai Vailankanni College of Engineering, established in 2008, is a private, self-financing, co-educational engineering college located in Kanyakumari. The campus spans 54,632.56 m^2 with a built-up area of 23,518.66 m^2. AVCE is affiliated with Anna University, Chennai, and offers various undergraduate and postgraduate courses.

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3. Methodology

1. On-site Visit

The audit team visited AVCE on 03/05/2024 to evaluate greenhouse gas emissions, energy-efficient devices, and the green cover of the campus.

2. Focused Group Discussion

Discussions were held with selected staff and students to understand their environmental awareness and identify key priorities for improvement.

3. Office/Building Survey

Information on environmental impacts such as utility bills and energy-saving devices was collected to provide a comprehensive overview of AVCE's annual greenhouse gas emissions and reduction measures.

4. Carbon Footprint Calculation

Data on flora status and energy consumption were used to calculate carbon emissions and reductions. A carbon footprint calculator helped measure annual tons of carbon emissions and identify key "carbon drivers."

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4. Findings

4.1 Flora Status and Carbon Absorption

Flora Status

Fully grown trees: 948

Semi-grown trees: 672

Shrubs: 156

Bushes and potted plants: 205

Grass lawn: 5,325 sq. ft.

Carbon Absorption Calculation

1. Fully grown trees: 6,446.4 kg CO_2 (6.446 tons)
2. Semi-grown trees: 2,284.8 kg CO_2 (2.285 tons)
3. Shrubs and bushes: 72.2 kg CO_2 (0.0722 tons)
4. Grass lawns: 194.545 kg CO_2 (0.195 tons)

Total Carbon Absorption: 8.9982 tons of CO_2 annually.

Oxygen Emission by Flora

1. Fully grown trees: 111,484.8 kg (111.485 tons) of O_2 annually
2. Semi-grown trees: 39,513.6 kg (39.514 tons) of O_2 annually
3. Shrubs and bushes: 181,176.875 liters (181.177 tons) of O_2 annually
4. Grass lawns: 42,759,750 liters (42,759.75 tons) of O_2 annually

Total Oxygen Emission: 43,091.926 tons of O_2 annually.

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4.2. Energy Consumption and Carbon Footprint Reduction

Monthly Energy Consumption Analysis

Month	Units Consumed (kWh)	Consumption Charge (₹)	Other Charges (₹)	Total Bill Amount (₹)
May-23	5324.7	47,496.32	29,041.07	76,537
Jun-23	5019.9	44,777.51	28,937.63	73,715
Jul-23	3874.5	35,338.03	28,853.17	64,191
Aug-23	5192.1	47,429.83	29,628.7	77,059
Sep-23	6201.9	56,654.36	30,106.5	86,761
Oct-23	6291.3	57,471.03	30,147.4	87,618
Nov-23	6417.3	58,622.04	30,254.7	88,877
Dec-23	5425.5	49,561.94	29,751.9	79,314
Jan-24	4780.2	43,667.13	29,357.6	73,025
Feb-24	5223	47,712.11	29,676	77,388
Mar-24	7716.6	70,491.14	30,848.2	101,339
Apr-24	6325.5	57,783.44	30,212.8	87,996

Total (2023-2024): 67,792.5 kWh, ₹617,004.9 consumption charge, ₹356,815.7 other charges, ₹973,820 total bill amount.

The total electricity consumption for 2023-2024 was 67,792.5 units.

Carbon Emission from Coal-Based Energy

Coal required: 36,472.365 kg (36.472 tons)

CO_2 emission from coal: 104.311 kg (104.311 tons)

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4.3 Energy-Efficient Measures

AVCE has installed various energy-efficient LED lamps to reduce carbon emissions.

LED Lamp Impact

1. 148 LED lamps (40W):
   - Energy consumed: 5,920 units
   - CO_2 emission: 9,108.986 kg
   - Reduction from incandescent lamps: 4,554.5 kg (4.55 tons)

2. 356 LED lamps (20W):
   - Energy consumed: 10,955.4 kg CO_2
   - Reduction from incandescent lamps: 21.91 tons of CO_2

3. 88 LED lamps (9W):
   - Energy consumed: 1,218 kg CO_2
   - Reduction from incandescent lamps: 6.9 tons of CO_2

Total Carbon Emission Reduction: Approximately 33.36 tons of CO_2.

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4.4 Overall Findings:

4.4.1. Air Emissions

Observations:

- Regular monitoring and reporting of emissions are in place.

Recommendations:

- Implement a continuous monitoring system for real-time data.

4.4.2. Water Usage and Discharge

Observations:

- Water usage is monitored.

Recommendations:

- Explore opportunities for water recycling and reuse within the facility.
- Conduct regular training for staff on water conservation techniques.

4.4.3. Waste Management

Observations:

- Segregation of hazardous and non-hazardous waste is practiced.

Recommendations:

- Increase the frequency of waste audits and training sessions.

4.4.4. Energy Consumption

Observations:

- Energy consumption data is recorded and analyzed.
- Energy-saving measures, such as LED lighting, are in place.

Recommendations:

- Consider implementing more renewable energy sources, such as solar panels or Micro wind mills.

4.4.5. Chemical Storage and Handling

Not Applicable

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5. Conclusion

This report highlights the significant steps taken by Annai Vailankanni College of Engineering towards energy conservation and sustainability. Implementing the recommended measures can further enhance their environmental performance and contribute to a greener campus. Continued efforts in environmental education and awareness, coupled with the adoption of energy-efficient technologies, will help AVCE maintain and improve its green campus status.

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