Manakula Vinayagar Institute of Technology

Puducherry

GREEN AUDIT REPORT 2021

PSNA Energy Audit and Management Cell

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Executive Summary

A Green campus is one that integrates environmental knowledge into all relevant disciplines and it is a place where environmentally friendly practises and education combine to promote sustainable and eco-friendly practises in the campus. Greening the campus is all about minimising wasteful inefficiencies and utilising conventional sources of energies for its daily power requirements, adopting proper disposal handling methods, procuring environment friendly supplies for day-to-day needs and installing effective recycling programs. Institute has to work out the time bound strategies to implement green campus initiatives. These strategies need to be incorporated into the institutional planning and budgeting processes with the aim of developing a clean and green campus.

Conducting Green - Environment Audit is such an initiative and a part of development strategies in order to find out the environmental performance and to analyse the possible and feasible solutions to move forward in the attainment of eco-friendly institution.

The Green Auditing of Manakula Vinayagar Institute of Technology (MVIT), Pudhucherry entitled to understand and to assess the energy trend, life/work style, activities and its impact on the environment. The conduct of Green Audit in the campus on an annual basis, is to create awareness about the extent of ecological footprints each one creates, among the student community and staff. This audit was mainly focused on greening indicators like consumption of energy in terms of electricity and fossil fuel, quality of soil and water, vegetation, waste management practices and carbon footprint of the campus etc.

A pre-audit questionnaire is prepared and a survey was conducted to know about the existing resources of the campus and resource consumption pattern of the students and staff in the college. In order to assess the quality of water and soil, water and soil samples were collected from different locations of the college campus and analysed for its parameters.

Collected and measured data is assessed and analyzed for better understanding of the energy consumption pattern/trend to fix short term and long term goals. A detailed report pertaining to the environmental management plan with strength, weakness and suggestion on the environmental issues of campus are documented.

Green Auditing of a Higher Education Institution is required as a part of Criterion VII (of the 7 criteria prescribed) under the Guidelines for Submission of the mandatory annual Internal Quality Assurance Report (IQAR) by Accredited Institutions.

This 2021 Green Audit report of Manakula Vinayagar Institute of Technology (MVIT), Pudhucherry, is prepared in such a manner that it can educate every stakeholder of the institution to help improve the energy index and to understand the impacts of energy consumption on the environment and to provide the foundation for the energy management system.

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&
Student Volunteers

Introduction

Manakula Vinayagar Institute of Technology (MVIT), Pudhucherry is one of the well known and reputed institutions, approved by AICTE and affiliated to Pondicherry University. Nestled in the vast expanse of the agricultural lands of Kalitheerthalkuppam on the Puducherry-Villupuram main road, MVIT is the 10th and the most recent edifice that spells modernity and technological advance even as a classically architecture temple of the elephant-faced God welcomes the entrant with deity bestowing intelligence and supernatural powers upon those who worship him with closed palms and an open heart. MVIT with its motto, Educate, Empower and Excel, has risen to meet the ever increasing need for consummate technologists who would usher in a better tomorrow that would free people from the clutches of old world ideas.

MVIT is a self-financing technical institute started in 2008 by Sri Manakula Vinayagar Educational Trust with the aim to make state-of-the-art technology to the rural society and to open up career opportunities for the underprivileged youth in and around the vicinity.

Sri Manakula Vinayagar Educational Trust was established by the Founder Chairman Shri. N Kesavan, a philanthropist and visionary, strongly believed in empowering the society through education. He emphasized upon the good quality education at the grassroots level, which can only transform the dreams of our nation into a real entity and also had a deep concern for extending excellent services to the health care sector to the rural masses and even to the untouched vulnerable section of the society thereby achieving the goal of inclusive growth.

The Sri Manakula Vinayagar Educational trust runs this main campus, which comprises a medical college (MVMC) , an engineering college (MVIT), Nursing College and a polytechnic college.

VISION

"To be a globally reputed Technical Institution creating Competent leaders and Skillful innovators in Science, Technology and Management"

MISSION

Providing a dynamic and creative learning environment for its students to acquire exemplary technical, analytical, professional skills

Imbibing a spirit of innovation and research among its students and faculty for solving critical problems

Promoting Innovation, Employability and entrepreneurship skills through industry academia collaboration

Serving the society through technical intervention and creating socially responsible professionals

Courses offered by the College

<table>
<tr><td rowspan="3">UG</td><td>EEE</td><td>ECE</td><td>CSE</td><td>IT</td><td rowspan="3">9 Programs</td></tr>
<tr><td>Food Technology</td><td>MECH</td><td colspan="2">CSE (IoT, Cyber Security including BlockChain</td></tr>
<tr><td colspan="2">Artificial Intelligence and Machine Learning Technologies</td><td colspan="2">Robotics and Automation</td></tr>
<tr><td>PG</td><td>M.Tech (ECE)</td><td>M.Tech (CSE)</td><td>M.B.A</td><td></td><td>3 Programs</td></tr>
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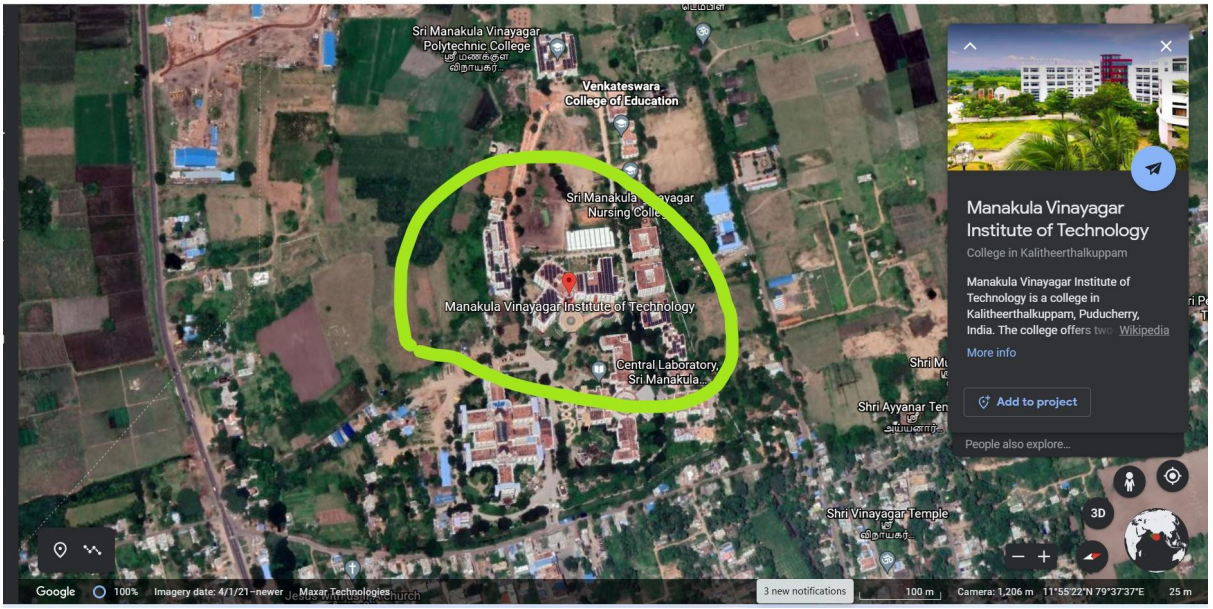


Location of MVIT

Students and Staff Strength

Description	2020-21			Remarks
	Day Scholars	Hostel (GH/LH)	Total	
Number of Students	1466	129	1595	
Number of Faculty (Male/Female)	91/82	2/2	177	
Number of Non- Teaching and Support Staff (Male/Female)	34/19	-	53	
Number of UG/PG Programs	-	-	9/3	
Number of Working Days	-	-	180	

Physical Structure Building Details

Name of the Block/Building	Usage	Built-Up Area (sq.m)	No of Floors	Type of Roof and Available Rooftop Space (sq.m)	Remarks
MIT Building	Office, ClassRooms, Laboratories, Staff Cabins, Power Rooms, Canteen	20184.32	G+4	Flat Roof	Solar PV power plant has been installed for 311 kWp
Gents Hostel	Rooms, Rest Room	925.77	G+3	Flat Roof	Gents Hostel
Ladies Hostel	Rooms, Rest Rooms	4696	G+4	Flat Roof	
Auditorium	Mess	1276	G	Truss	
STP	Treatment-wastewater	1025	G	Flat Roof	

Details of Land	Available Area in sq.m	Remarks
Total Area of the Campus	64749.7	
Playground Area	10000	Volleyball, BasketBall, Running Track
Area under Open air Auditorium	NIL	
Area on Agriculture/Gardening	2800	Gardening
Unused Area	14868	
Area used for other purposes, if any	3000	Pavement/Pathway
Area under Tree Cover	7000	Sides of Pathway

Green/Environmental Auditing and Objectives

Sustainable Development

'The world we have created as a result of our thinking thus far has problems which cannot be solved by thinking the way that we thought when we created them'

Albert Einstein

The industrialised world has already used up many of the Earth"s natural resources, and we are now realising that it will not be possible to carry on in the same way if we want to protect the future of our planet and those who live on it. However, it seems that with increasing technological abilities, we are better able to extract known, or find new, reserves. In addition, reductions in the material intensity of products - the amount of material needed to produce a product - has gradually declined. But, in many cases, the availability of resources should not mean that we do not have a problem with using that resource.

For example, even though we seem to have 'enough' lead, the health and environmental effects of lead use still make a strong case against its persistent or increased use. Equally with fossil fuels: if we compare the carbon emissions that come from using fossil fuels (gas, coal, and oil) - mainly in the combustion engine and power stations - and which contribute to the greenhouse effect and climate change, then we are much more likely to exceed acceptable levels of atmospheric pollution before we run out of fossil fuels. Ultimately, all economic development depends on the Earth"s natural resource base. Concern over the rate at which the Earth"s resources are being used has led to the development of the concept of 'sustainable development', a term that all of us will probably be familiar with.
'Sustainable development' is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

> – The concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and
>
> – The idea of limitations imposed by the state of technology and social organisation on the environment"s ability to meet present and future needs'

> ‘Many essential human needs can be met only through goods and services provided by industry … It has the power to enhance or degrade the environment; it invariably does both.’
>
> *World Commission on Environment and Development*

For business, the concept of sustainable development presents a challenge – to produce higher levels of output while using lower levels of input and generating less waste. Organisations/Institutions are now faced with the challenge of integrating environmental considerations into all aspects of their activities, and ‘Green/Environmental Auditing’ is one of a number of environmental management tools, which enable us to do this.

Objectives

The main objective of this Green Audit is to assess and to promote the environment management and conservation in the campus. The purpose of the audit is to identify, quantify, describe and prioritize the framework of Environment Sustainability in compliance with the applicable regulations, policies and standards. The objectives are:

- To impart and create awareness among the students and staff about the importance and concerns of environment and its sustainability
- To establish the baseline data to assess the utilization of resources and to propose managerial plans in the campus
- To understand and analyze the pattern/trend in the energy consumption
- To assess the carbon footprint of the campus
- To prepare a status report on environmental compliance

Green Audit is a process of systematic identification, quantification, recording, reporting and analysis of components of environmental diversity of the institute. It aims to analyse environmental practices within and outside of the concerned place, which will have an impact on the eco-friendly atmosphere. Eco-friendly campus primarily focuses on the efficient and effective conservation of Energy and Water without compromising the quality of work output and also prioritizes the efficient waste management and Green area management systems and cost effective solutions.

All these performance indicators are identified, assessed and analysed for the better understanding of utilization of resources and systems in this process of Green Audit in Manakula Vinayagar Institute of Technology.

The key focus areas that are considered in this Audit:

Water Management
Energy Management
Waste/e-waste Management
Green Area Management
Transportation
Carbon Footprint

Methodology

The Audit team visited and stayed in the campus for three days to obtain and observe the required data in order to develop baseline analysis to fulfil the purpose of Green Audit. The energy consumption, waste management practises and green cover top in the institution are assessed. The water samples at different locations are collected. The sample collection, preservation, and analysis were done in the scientific manner as per standards.

The different aspects of Green Audit were discussed with the student community, staff members and management. Environmental issues and the need for sustainability were also disseminated among them.

Pre-Audit was conducted in the MVIT campus with the help of staff and students to assess the desired and required performance indicators. A detailed questionnaire survey method was adopted to collect the data in order to identify the opportunities. After the pre-audit data and baseline data collection, the detailed audit was conducted in the campus and Based on the assessment and analysis the following observations and recommendations were presented.

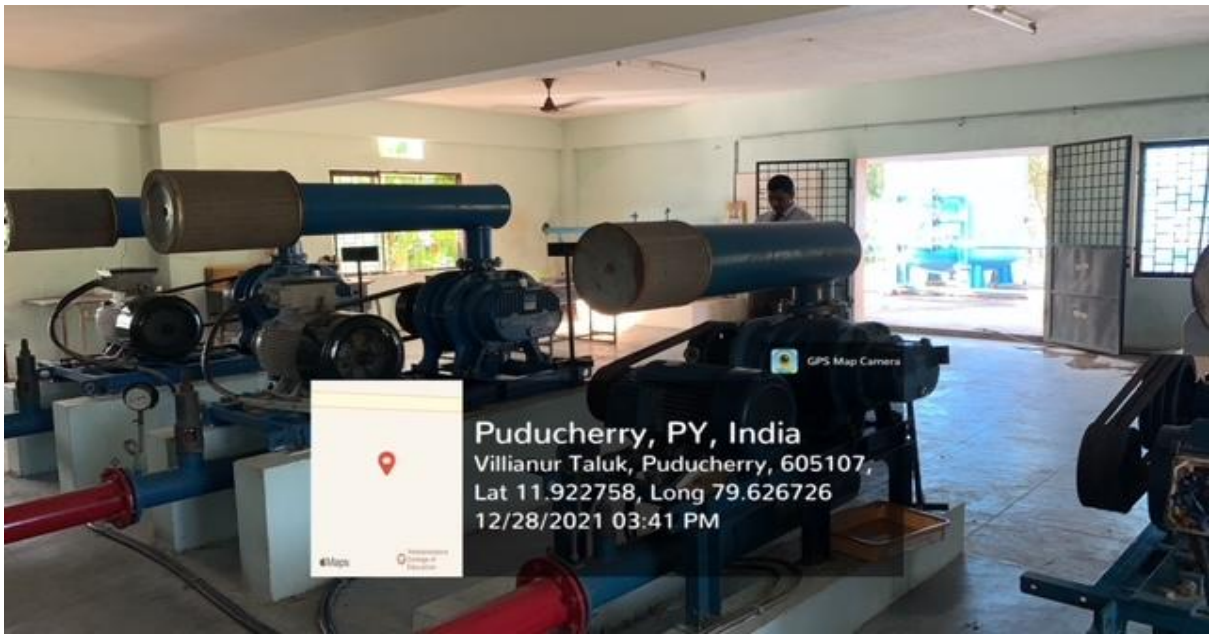
Water Management

The College maintains separate data on water yield from the sources and usage for different applications such as RO Plant, STP, Gardening, new construction and other purposes. However the audit team collected the detailed data on water use in the campus. The College can maintain a database on various aspects as given in the table below and the efforts to conserve water can rigorously be adopted.

The Audit Team noted that the Campus on the whole, consumes 33,75,000 Litres of water every month is used for day-to-day activities of regular use and one Sewage Treatment Plant of 1,75,000 litres of capacity operates 24x7 to treat the used water of 90000 litres/day from MVIT and yields 51,500 litres/day of treated water which is used for greening the campus purpose. College does not depend upon private water supply from outside the campus for any kind of water requirements in the campus.

The water consumption per day of 1,12,500 Litre is pumped out from the subsurface Main Borewell situated at the west wing south side of MV medical college, by electric pumps and sent to regular use and to RO plants. A separate Sewage Treatment Plant of 1,75,000 litres/day of input and 1.00,000 litres/day of output capacity is installed to treat the used water in the campus. Of 1,75,000 litres of input 90.000 litres/day of used water is from MVIT campus and of 1,00,000 litres of treated water 51428 litres/day (51%) of treated output is pumped back to gardening and other purposes.

There is a dedicated RO plant for MVIT produces 400 litres per hour with water rejection of 800 litres per hour. This reject is filtered before being used for the purpose of gardening. Of the campus electric energy consumption, 17% can be attributed to pumps including STP and RO plants.



Sewage Treatment Plant

Water Audit

Conservation of water through effective rainwater harvesting and recycling of greywater are to be considered as essential activities by the College community and to be practiced vigorously. The average annual rainfall in Dindigul, Tamilnadu is 1355 mm. For a 10-sq.ft. roof area getting 1 mm rainfall, rain harvest will be1 litre. Taking this as an empirical guide, 5100.63 x 1355 = 69,11,354 litres is the rainwater availability from the rooftops.

This much amount of (6.9 million litres/year) available rainwater can be collected and stored in constructing infiltration or percolation ponds or proper rainwater harvesting tanks or recharge tanks at 4or 5 different locations. Installation of rainwater harvesting reduces flooding and erosion, water bills, demand on groundwater and recharges the nearby borewells effectively.

Sl.No	Particulars	Response	Remarks
1	Source of Water	Subsurface- Bore well	West wing South side- MVMC Medical College
2	No of Wells/Bore Wells	Bore Well – 01 Nos	
3	No of Motors used	20 Nos	Bore well- 1 Nos. MIT Building Sump – 1 No Boys Hostel – 1 Nos. Ladies Hostel Sump STP – 21 Nos.
4	Motor Specifications/Rating	Borewell 12.5 hp MVIT Sump 5 hp Boys/LH sump 5 hp Boys Hostel 2 hp STP Air agitation system 40 hp 2 nos Air agitation system 20 hp 2 nos Sewage Pump 10 hp/3 nos Sewage Pump 7.5 hp/5 nos Filter Feed Pump 10 hp/2 nos Sludge Pump 5 hp/2 nos Garden Pump 10 hp/2nos Chemical Dosing Pump 7.5 hp Sludge Agitator 1.5 hp Submersible Pump 2 hp	
5	Depth of Well	110 ftt	
6	Water Level/Yield	70 ft	
7	No of Water Tanks/Sumps	Water Tank – 06	Water Tank

		Sump – 05	MIT Building – 4 Nos. Ladies Hostel – 1 Nos. Boys Hostel – 1 Nos. Sump MIT Building - 1 Nos. Ladies Hostel – 1 Nos. STP – 3 Nos.
8	Capacity of Tanks/Sumps	**MVIT Building** 3 Nos. of Concrete Water Tank – each 15000 Lit. Capacity Sump- 50000 Lit. Capacity **Ladies Hostel** Concrete Tank – 20000 Lit. Sump- 50000 Lit. **Boys Hostel** Concrete Tank – 15000 Lit. R.O Sintex Tank – 1000 Lit. **STP** Collection Tank – 1000000 Lit. Filter Tank – 400000 Lit. Disposable Tank - 400000 Lit	
9	Quantity of water pumped/day	112500 Lit./day	
10	Water Treatment Plants RO/STP	MVIT RO plant 1 no STP 1 no	
11	Input/output flow from Plants	RO Plant Input – 1200 Lit./hr Output – 400 Lit./hr STP Input – 175000 Lit./day Output – 100000 lit./day	RO Reject – 800 Lit./hr STP- Sludge - 42 % 90000 lit/day (MVIT) 51428 lit/day (MVIT)
12	Usage of Treated Water	100 Percent **Reuse**	
13	Sources of Wastewater	STP	
14	Use of Waste Water	Gardening	
15	Wastewater from Labs	Yes	
16	Treatment for lab wastewater	STP	
17	Whether any Green Chemistry method Practiced in Labs	No	
18	Availability of Rain Water Harvesting	Yes	**MIT Building** North East – 1 Nos. North West – 1 Nos. South West – 1 Nos. Ladies Hostel North West – 1 Nos. Boys Hostel South East – 1 Nos.

19	No of Tanks/Volume of Rainwater	05/ 2040 m^3	
20	Any Leaky Taps/appliances	Yes	
21	Volume of water wasted/year	158.4 KL/year	
22	Any Water Management plan adopted	Yes	Move towards Sustainable Development
23	Any other water conservation techniques followed	Yes	
24	Availability of Water Conservation Posters/Slogans	Yes	Slogan - Save Water
25	Any Water Pollution	No	

Results of Water Quality

Sl.No	Parameters	Borewell	Acceptable Limits	STP Treated Water	Limits for STP
1	pH at 25 deg.C	6.97 mg/L	6.5-8.5	7.58	5.5-9.0
2	BOD	-	-	3 mg/l	10 mg/l
3	Total Suspended Solids	-L	-	5 mg/L	20 mg/l
4	Total Dissolved Solids	620 mg/l	500 mg/l	-	-
5	COD	167.94 mg/L		24 mg/l	50 mg/l
6	Total Nitrogen	-	-	4.48 mg/l	10 mg/l
7	Total Hardness	330 mg/l	200 mg/l	-	-

Energy Management

"The strategy of adjusting and optimizing energy, using systems and procedures so as to reduce energy requirements per unit of output while holding constant or reducing the total costs of producing the outputs from these systems"

The objectives of Energy Management include:

To achieve and maintain the optimum energy procurement and utilization throughout the institution.

To minimize energy costs/waste without affecting the comfort level and quality.

To minimize environmental effects.

Successful energy management must combine an effective strategy with the right practical action. It begins with the head of the institution and then involves all the staff members, students on a day-to-day basis. Priority should be given to energy management and make it an integral part of institution management strategy.

Energy Audit

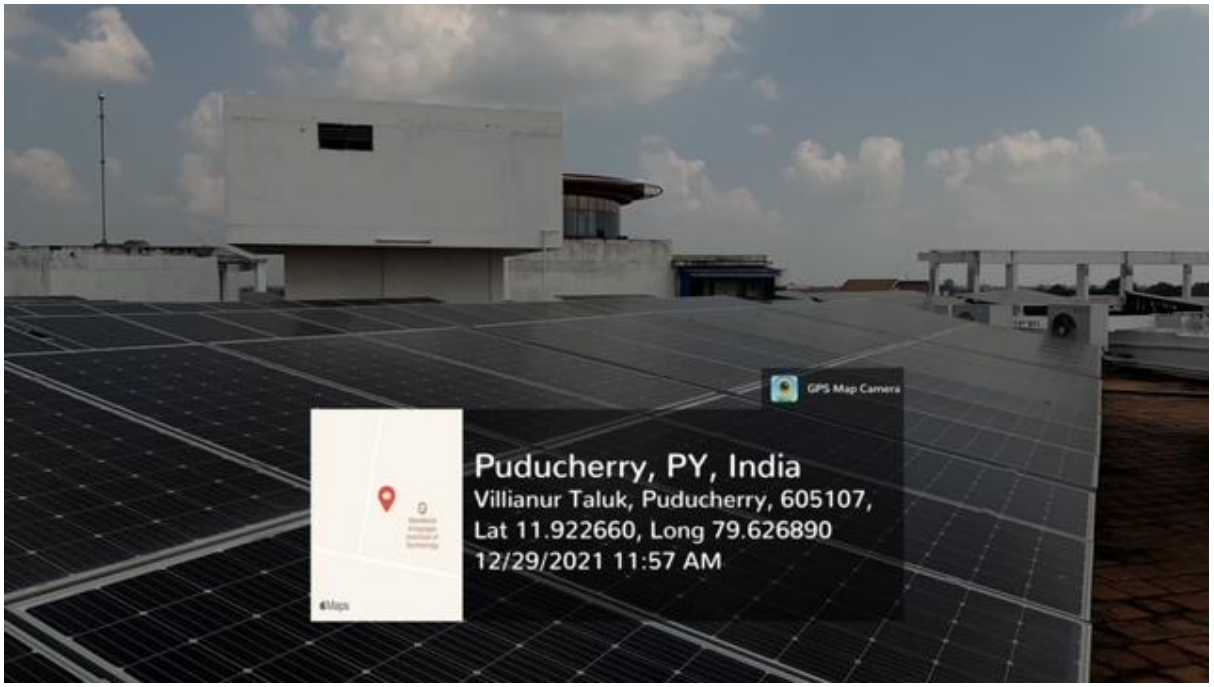
This part of the audit covers the electrical energy consumption in MVIT Campus, which is defined by all of the supply points (EB point and SSBs), Labs and equipment for the academic year 2020-21.

Introduction

Sri Manakula Vinayagar Educational Trust has one HT service - customer code - 467- at the main campus to cater to the needs of all the institutions situated in the campus and Hostels. This HT service has two OLTC transformers of rating 990 kVA, 22kV/433 V prolac make and 800 kVA, 22 kV/433 V Universal make transformers with two standby generators of capacity of 725 kVA caterpillar make and 500 kVA Kirloskar make to cater to the needs of MVMC, MVIT, Nursing and Polytechnic college.

A separate feeder of 2x400 sqmm of 300 m length from MV panel supplies power to the MVIT campus for a connected load of 660 kW with a dedicated demand of 300 kVA without considering solar generation and with a standby generator of 725 kVA with automatic changeover.

To promote Renewable Energy Consumption a Solar Rooftop PV (on grid) has been installed for 311.71 kWp at MVIT rooftop and this solar generation is completely used by MVIT campus.



MVIT Solar PV PP for 311.71 kWp

Distribution of circuits

At MVIT main SMSB Panel, 6 feeders of different ratings are exclusively installed to take care of electricity distribution at MVIT Building and 3 feeders are available to feed power for common facilities such as:

1. Ground Floor
2. I Floor
3. II Floor
4. III Floor
5. IV Floor
6. Machines Lab
7. Auditorium
8. Boys Hostel
9. Nursing

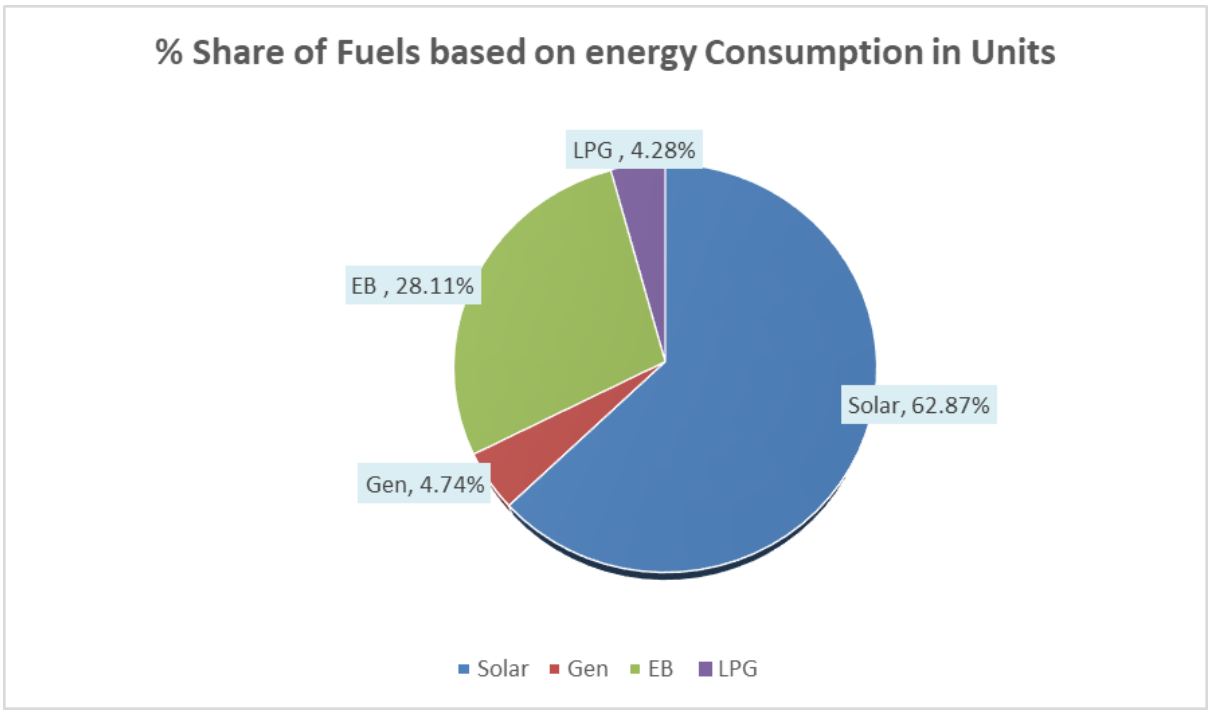
Electrical Appliances (MVIT)

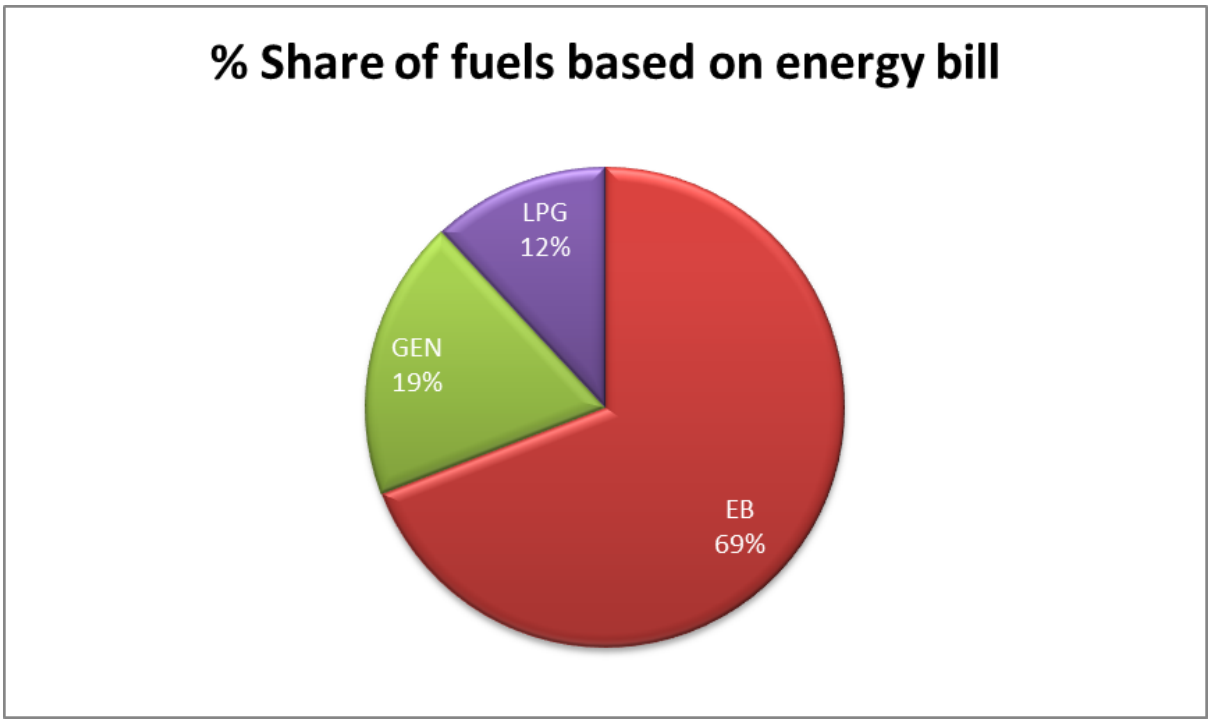
Name of Appliance/Equipment	Quantity	Rating in Watts/unit	Total kW (3ph)	Hours /Day	Annual kWh Consumption (300 days)
Tube Light	1059	36+7	15.18	4-5	22770
LED (Round)	155	10-12	0.62	4-5	930
LED (Round)	33	60	0.66	4-5	990
Tube Light LED	22	20	0.15	4-5	225
LED compact	95	18	0.57	4-5	855
LED 2x2	98	40	0.13	4-5	450
LED	145	9	0.435	4-5	652
CFL compact 2x36	32	72	0.77	4-5	1152

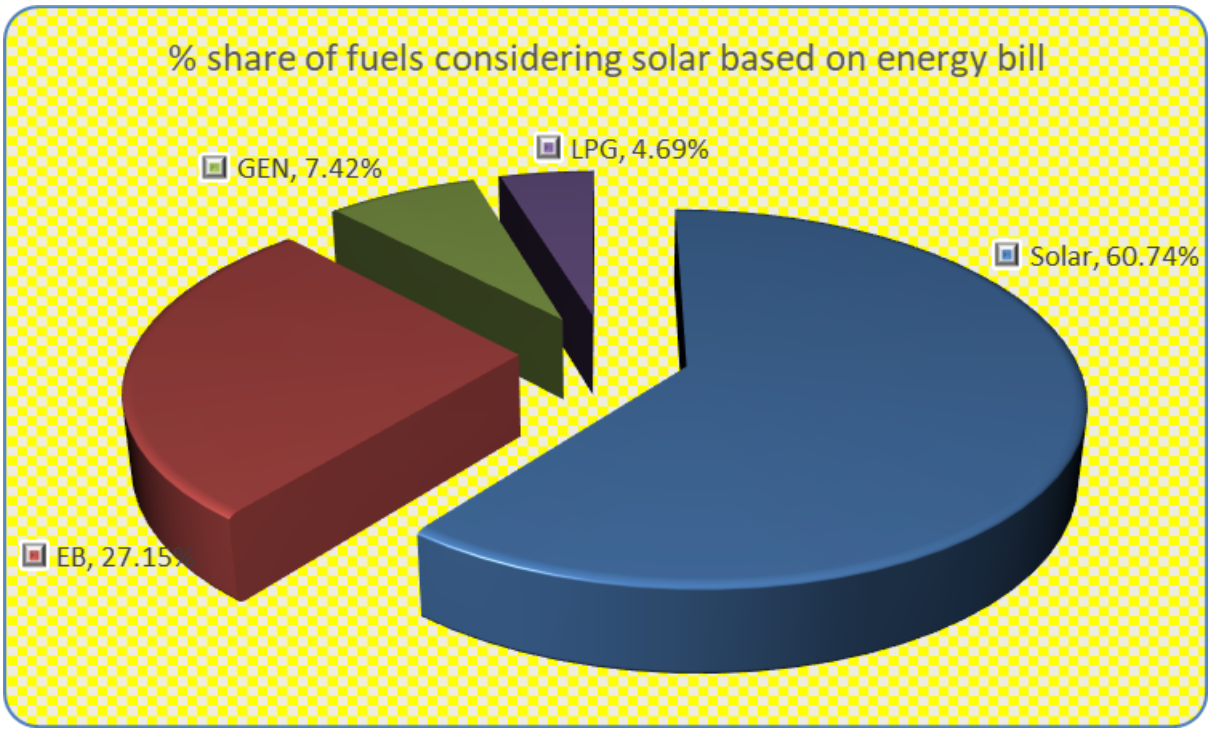
Street/Garden lights	105	10-50	0.875	10	2625
CFL	45	18	0.27	4-5	405
TV	3	120	0.12	6	216
Daylight (Tempo)	2	500	0.33	6	600
Amplifier	1	80	0.03	2	18
Chimney	1	150	0.05	3	45
UPS/Computers	8/680	8 -16 kW/300	68	4	81600
Lifts	2	7.5 hp	5.6	3	5040
Water Cooler	7	500	1.12	6	2016
Printers & scanners	16&2	250&80	1.39	1	416
Projectors	38	280	3.55	2	2130
AC units	5	219 T	262.8	3-4	236520
Oven	5	500-3000	1.75	1	437.5
Refrigerator	3	150	0.15	4	180
Grinder	2	745-1500	0.75	1	225
Boiler	3	1500-2000	1.67	1	500
Lab Equipment	42	0.5 hp - 5 hp	26.11	0.5	3916
Welding/Cutting machine	3	2000	2	1	600
Copier	5	1500	2.5	1	750
Fan	762	60	15.24	6	27432
Borewell	1	12.5 hp	9.33	3	8397
MVIT Sump- pump	1	5 hp	3.73	4	4476
STP pumps (51% for MVIT)	21	1.5-40 hp	178 kW	4	106800
Other pumps	2	0.5 - 1.5 hp	1.5	5	2250

Auditorium (Shared common facility and MVIT is assumed to have 2 functions per month or 6 hrs/month)					
AC Units	1	88 T	105.6	6	6336
LED	96	21	0.672	6	40.32
3F TL	140	43	2	6	3600
Spot Light	9	70	0.21	6	12.6
Projector	1	350	0.12	6	7.2
UPS	2	8&16	24	6	1440
Tempo	8	400	1.1	6	66
Hostels					
Tube Light	126	43	1.8	6	3240
Fan	67	60	1.34	10	4020
Exhaust Fan	1	3730	1.24	3	1116
Freezer	1	2000	0.67	4	804
Grinder	3	3730	3.73	3	3357
Pump/Sump	2	2&5 hp	5.23	2	3138

Major Energy Use and Areas







1. Based on the thermal (Diesel and LPG) and electrical energy units (EB and Solar) wise consumption for the year 2020-21 (Dec20 - Nov21), a major percentage (**62.87%**) of Energy was consumed from Solar generation and **28.11%** of energy from Puducherry Electricity Department at an average cost of **Rs. 7.82** per unit, the **4.74%** of energy (thermal) was supplied by the DG sets at the cost of **Rs.12.67** per unit and the other **4.69%** of energy (thermal) was consumed in the form of LPG at the cost of **Rs.8.87** per unit.

2. The %share of fuels money wise, **61%** of energy (bill) consumed from solar generation **at free of cost** which is an excellent green energy contribution for the MVIT campus. The remaining 39% of the total energy (bill) spent towards EB consumption, Diesel for Gensets and LPG in such a way that 27.15%, 7.42% and 4.69% respectively during the year.

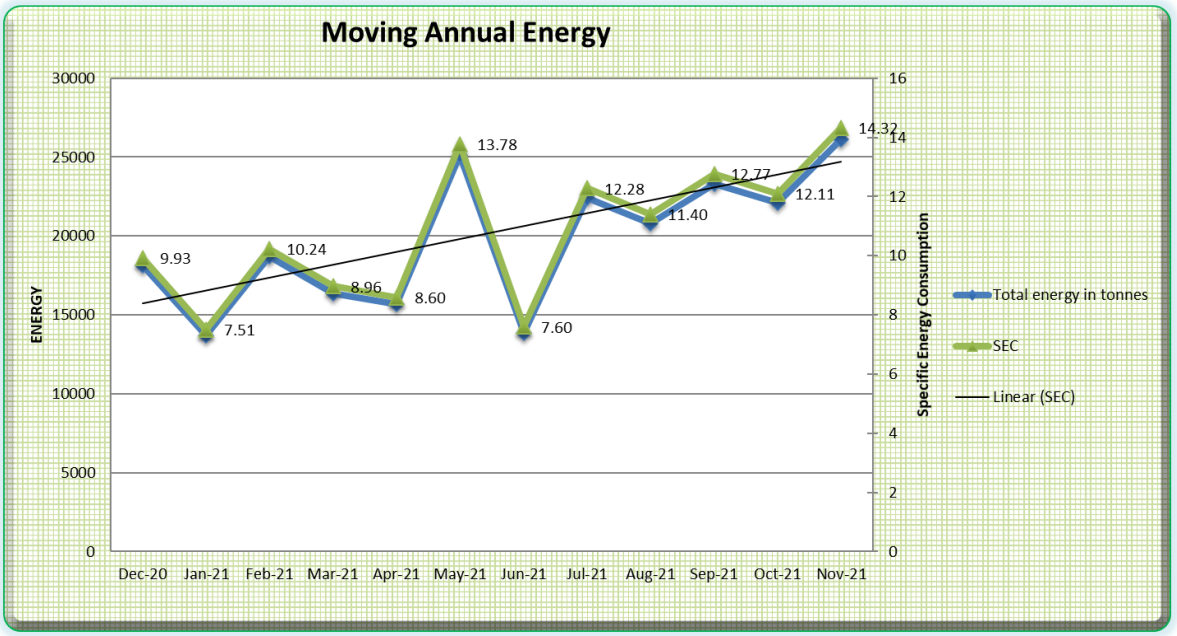
3. Hence, the average cost of energy consumption at MVIT is Rs. **8.56** per unit for the period of Dec 2020 to Nov 2021.

Energy Efficiency and Conservation

Energy Efficiency and Conservation are separate, but related concepts. Energy conservation is achieved when growth of energy consumption is reduced in physical terms. Energy Conservation can therefore be the result of several processes or developments, such as innovative practices or technological progress. On the other hand Energy Efficiency is achieved when energy intensity in a specified product, process or area of production or consumption is reduced without affecting the quality of output, consumption or comfort levels. Promotion of Energy Efficiency will contribute to energy conservation and is therefore an integral part of energy conservation promotional policies.

Specific Energy Consumption (SEC)

a. Moving Annual Energy

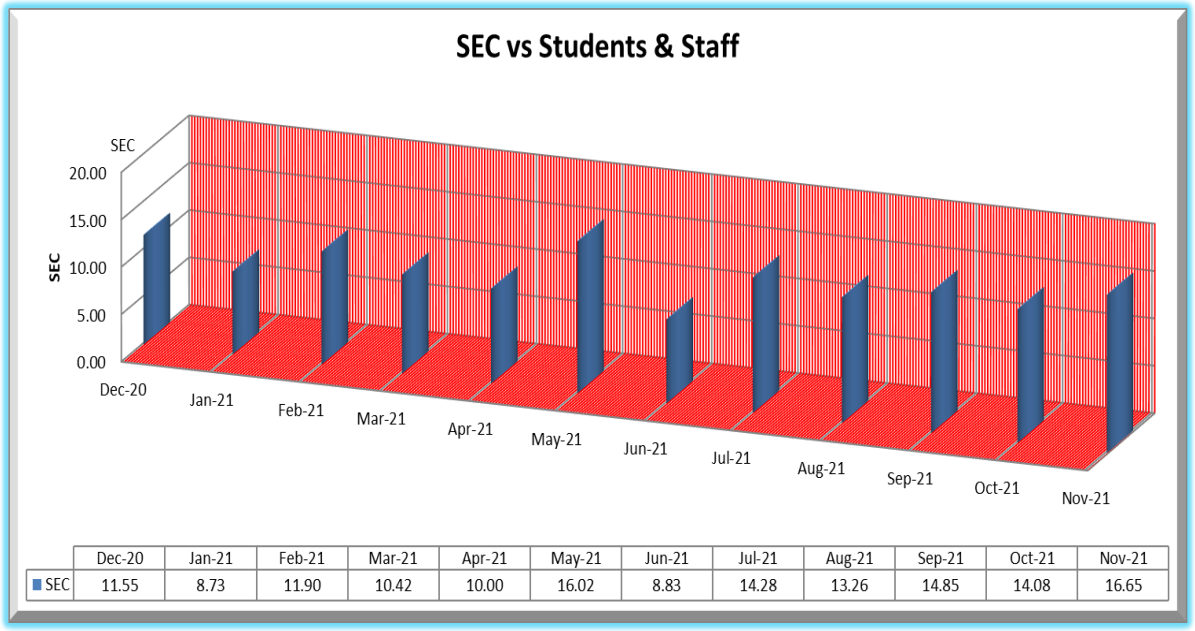


Moving Annual Energy curve has been plotted as above for the specified period of Dec 2020 to Nov 2021. From the plotted curve, we could observe and understand that the trend is not uniform during the middle and fluctuating in other parts of the curve. This is mainly because of covid lock-down uncertainty. Normally the trend used to be fluctuating which is obvious and it is mainly because of the working style and semester pattern of educational institutions.

Energy consumption usually starts picking up at the commencement of every semester (July or Feb) and reaches maximum during the middle of each semester (September or April). From the above

consumption curve the maximum energy consumption occurred in the month of November 21 and the minimum consumption was in the month of January 21.

b. SEC vs Students & Staff



	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21
SEC	11.55	8.73	11.90	10.42	10.00	16.02	8.83	14.28	13.26	14.85	14.08	16.65

Total Number of Students and Staff is approximately considered as 1825

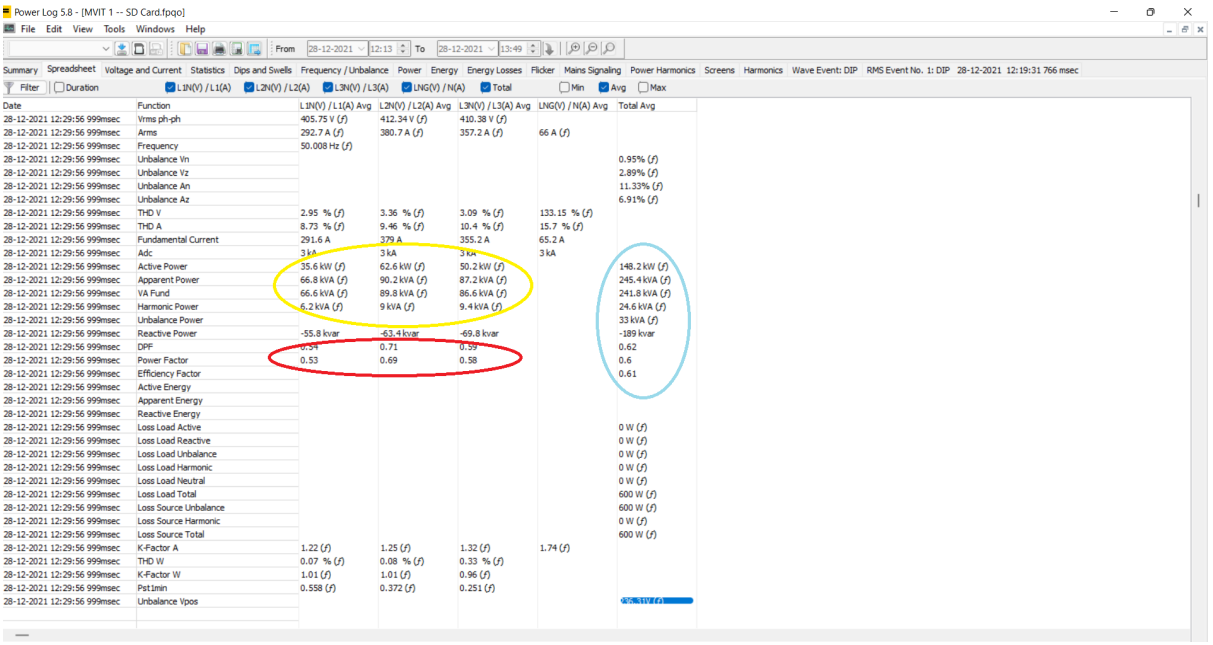
Specific Energy consumption (energy consumption per student) is ranging from 8.73 kWh (units) per month (January 21) to 16.65 kWh (units) per month (November 21). Both these SEC values are on a higher side when compared to other similar types of educational institutions. Suitable energy conservation measures should be adopted to minimize the SEC values.

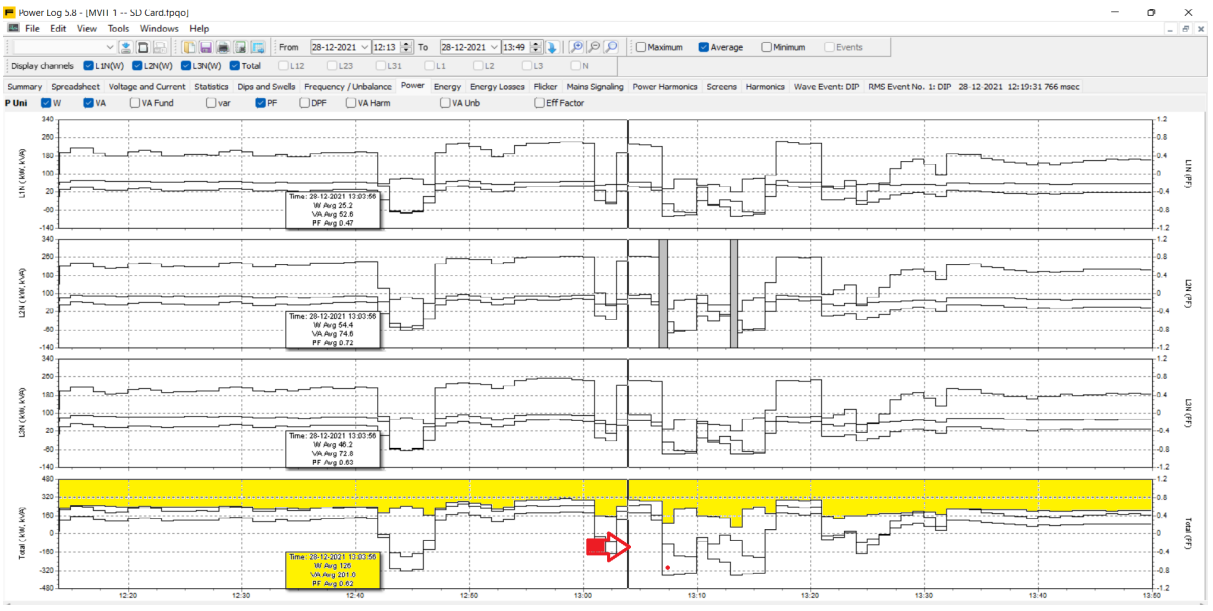
Observations and Recommendations

ESO 1

Present Status: At present the MVIT campus is being fed by the utility PED and Solar PV plant of 311.71 kWp for the connected load of 660 kW. The power factor at this MVIT SMSB is very low ranging from 0.53 to 0.68 and on an average it is observed as 0.62 lag. Because of this poor power factor the demand is high for the low active power consumption which leads to the loss of power in various ways.

The installed APFC of 150 kVAr is currently not working properly.





Modification Proposed: Replace the faulted switches, contactors and capacitors in the available APFC panel and provide capacitors of different ratings for 200 kVAr of 12 stages. Make sure that the installed PLC is working properly and injecting required kVAr into the system. This will help improve the power factor near unity which considerably reduces the cable stress and power loss.

Investment and payback period

Annual energy consumption in the campus from PED (Dec20-Nov21) @7.82/unit = 189251 units

Annual energy consumption from Gen set @12.67/unit - 31914 units

Total energy consumption at MVIT (EB+GEN) - 221165 units

-

Annual energy cost for the year @8.52/unit = Rs. 1884293

Investment and Payback period

Investment cost for retrofitting APFC panel - 1,00,000.00 (max)

Annual Savings in energy consumption
(at a very moderate savings of 3%) - 6635 units

Annual Savings @Rs.8.52 - Rs. 56530

Payback period - (100000/56530)*12

Payback period = 21 **months**

= 1 years 9 months

ESO2

Present Status In the MVIT Building 1059 numbers of 36 W Tube light fittings are installed.

Modification Proposed All these 1059 tube light fittings can be replaced by 20 W LED tube fittings in a phased manner (retrofitting). Tube light retrofit requires less investment or no investment.

Investment and Payback period

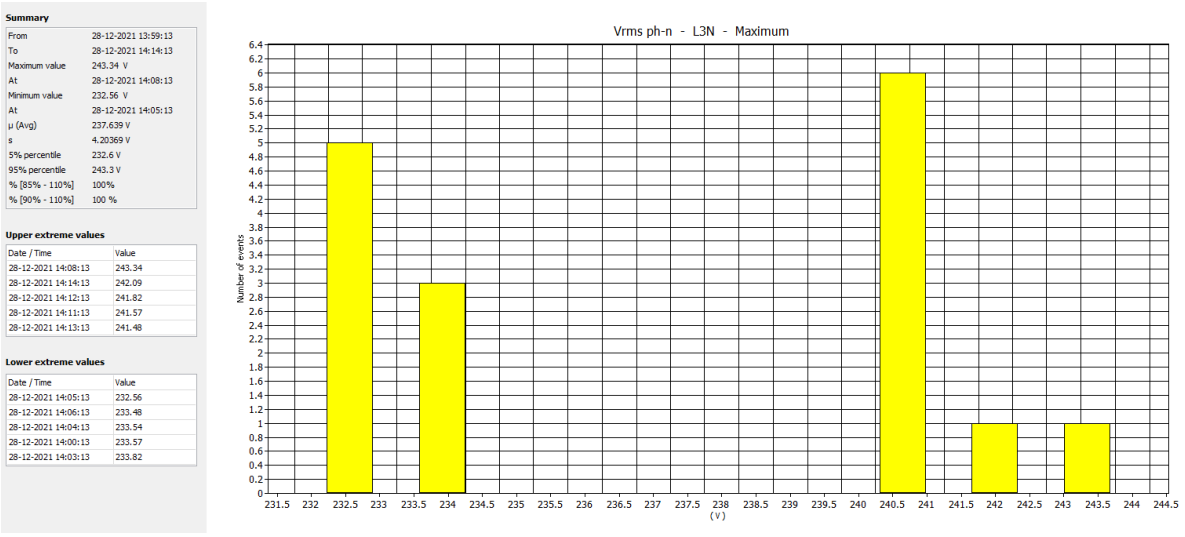
Annual energy consumption for the existing 36 W TL fittings	- 22770 units
Annual energy cost @Rs. 8.52/unit	- Rs. 1,94,000
Annual Energy consumption for the proposed fittings	- 11385 units
Annual Energy cost for the proposed LED fittings	- Rs. 97000
Annual Energy savings after the retrofit	- Rs. 194000 - 97000 = 97000
Investment cost for 1059 nos.of 20W LED fittings	- Rs.4,23,600
Payback period	- 423600/97000 = 52 months
	- **4 years 4 months**

ESO 3

Install a separate servo voltage stabilizer for the lighting circuit of 20 kW

Present Status

MVIT campus has a lighting load of 20 kW in the entire building and gets power from relevant SSB panels. This total lighting load operates at working voltage, ranging from 220V to 245V.



Summary

From	28-12-2021 13:59:13
To	28-12-2021 14:14:13
Maximum value	243.34 V
At	28-12-2021 14:08:13
Minimum value	232.56 V
At	28-12-2021 14:05:13
μ (Avg)	237.639 V
s	4.20369 V
5% percentile	232.6 V
95% percentile	243.3 V
% [85% - 110%]	100%
% [90% - 110%]	100 %

Upper extreme values

Date / Time	Value
28-12-2021 14:08:13	243.34
28-12-2021 14:14:13	242.09
28-12-2021 14:12:13	241.82
28-12-2021 14:11:13	241.57
28-12-2021 14:13:13	241.48

Lower extreme values

Date / Time	Value
28-12-2021 14:05:13	232.56
28-12-2021 14:06:13	233.48
28-12-2021 14:04:13	233.54
28-12-2021 14:00:13	233.57
28-12-2021 14:03:13	233.82

Modification Proposed

The existing lighting loads should be provided with a separate lighting control circuit as we do it in HT service consumers. Provide a 3 phase, 30 kVA rated voltage servo stabilizer of good quality and set the output voltage, 200 V as the working voltage for the lighting circuit. (Reduced working voltage will not affect the quality of illumination)

Investment and payback period

Energy consumption/year at rated voltage, say **240 V** = 20 kW *5*300

= 30000 units

Energy consumption/year at the set voltage, **200 V** = 0.694*30000

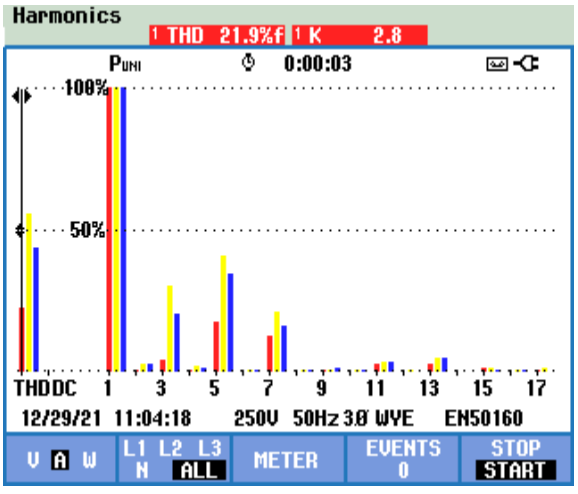
= 20820 units

Annual energy savings	= 30000-20820
	= 9180 units
Annual cost savings	= 9180*8.52
	= Rs. 78214/-
Total investment	= Rs. 60000 (max)
Payback period	= (60000/78214)*12
	= 9.2 months

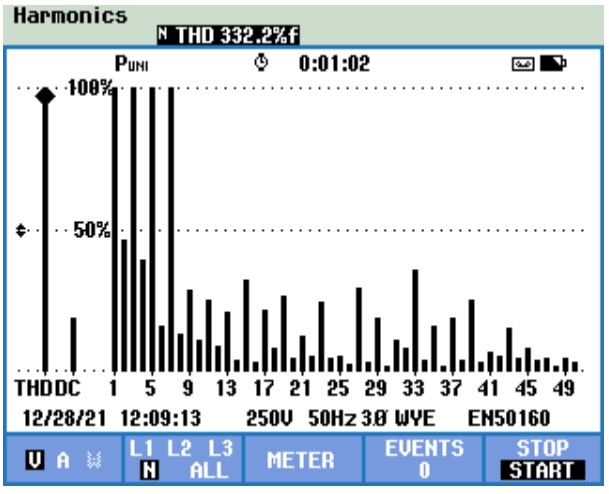
ESO 4

Present Status The Total Harmonic Distortion (THD) is higher at the MVIT SMSB service point because of 3rd order, 5th order harmonics and neutral harmonics presence at the load points.

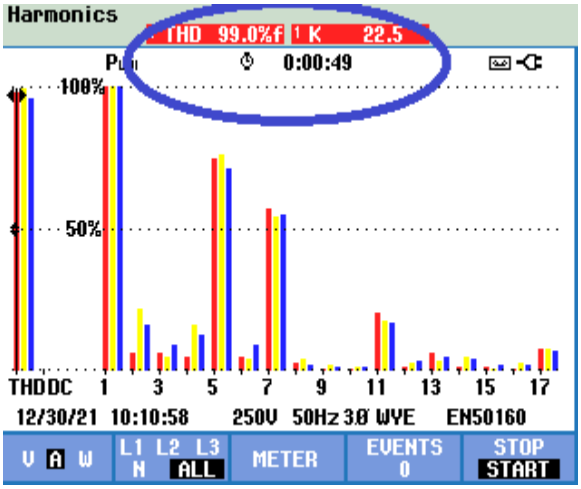
As per the regulations THD(V) and THD(I) limits at point of common coupling should be 5% and 8% respectively.



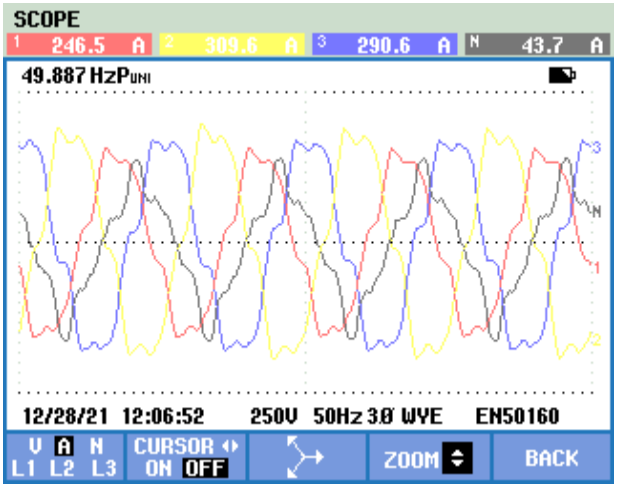
Higher THD(I) at II Floor



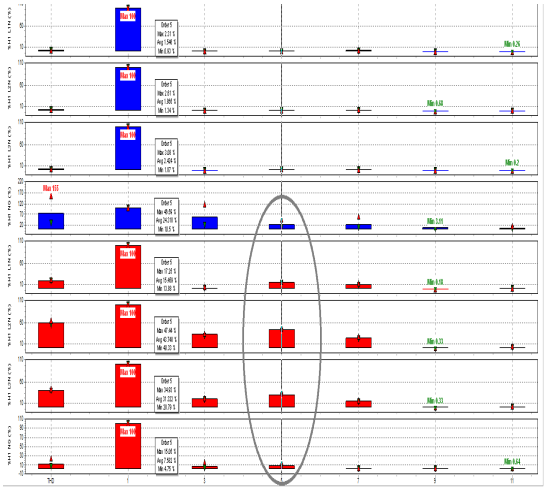
Neutral Harmonics at SMSB GF



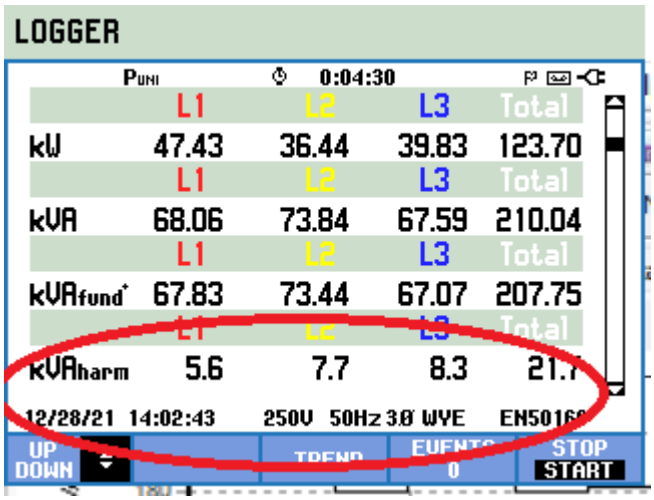
Higher THD(I) at I Floor



Distorted Waveform at Main SMSB and neutral current



Domination of 3rd and 5th order Harmonics at II Floor



Harmonic kVA loss

Modification Proposed The presence of 3rd order harmonics, 5th order harmonics and neutral harmonics will induce unwanted problems and unwarranted short circuits in the supply system and will adversely affect the quality of power supply in the campus and also cause energy loss in the system. This harmonic presence can be mitigated by providing proper earthing or grounding (earth pits) at all SSBs and at all the load points and at solar injection terminals. Filters may also be installed if necessary.

Investment and Payback period

Annual energy consumption in the campus including solar (20-21) = 644472 units

Annual Energy loss due to the presence of Harmonics 3% - 19334 units

Annual Energy Savings after reducing the Harmonics - 19334*8.52 = Rs.164727

Investment and Payback

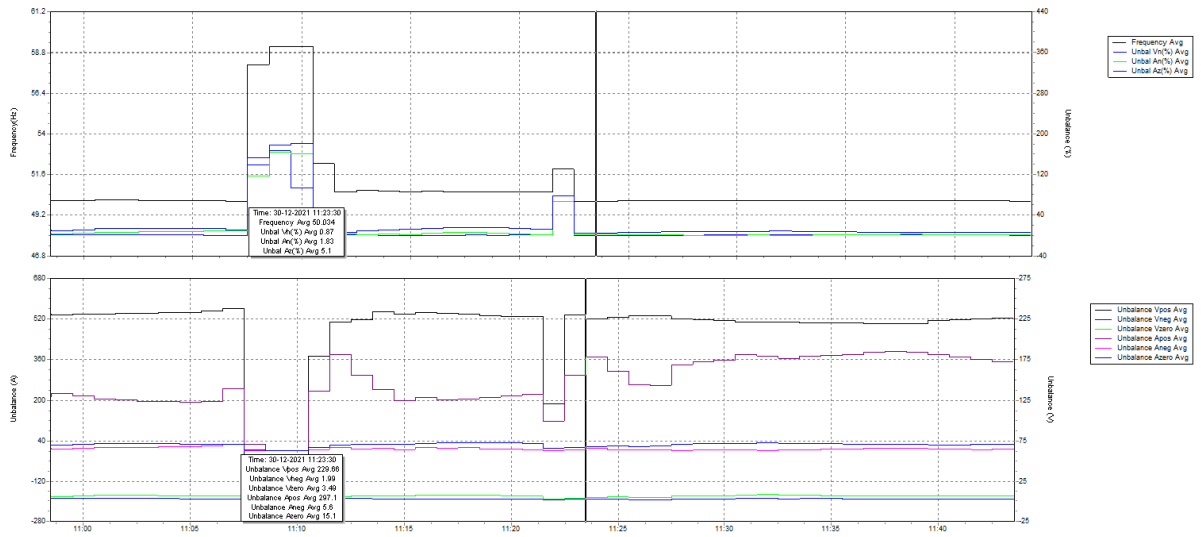
Cost for one earth pit provision - Rs. 3000/qty
Provision of 12 Earth Pits at 6 locations (2 each) - Rs. 3000*12 = Rs.36000

Payback period - (36000/164727)*12 = **2.6 months**

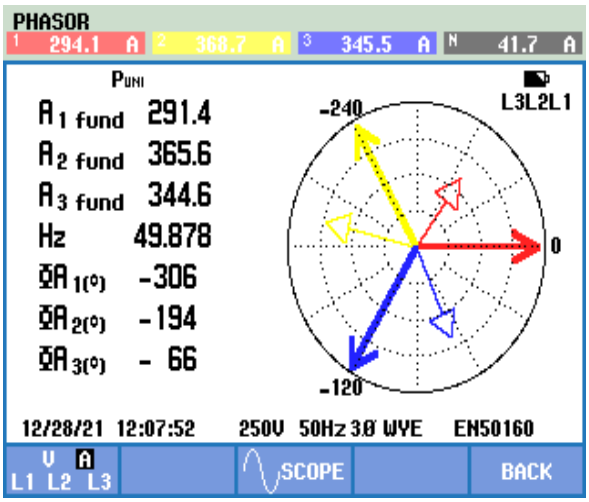
ESO 5

Present Status Most of the loads are single phase and these are not equally distributed in all the floors.

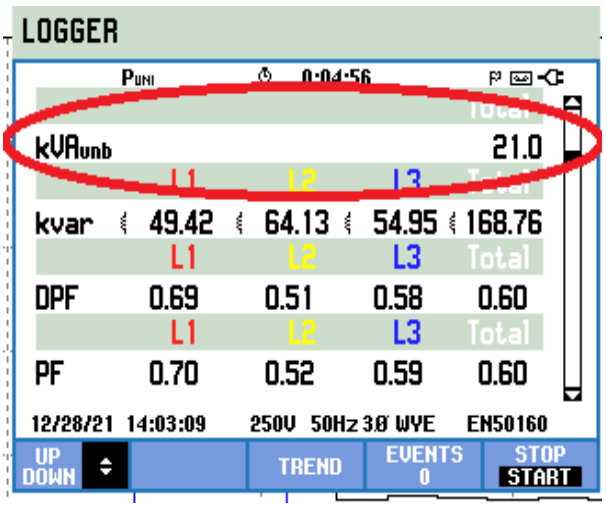
Modification Proposed Verify and check all the single phase connected loads and redistribute them among the phases equally. That is a balanced distribution of single phase loads in all 3 phases.



Unequal distribution of electrical loads



Unbalanced load distribution



Loss due to unbalanced load

Investment Nil

Benefits **2 to 3 % of energy loss in total energy consumption will be reduced at free of cost.**

Waste Management/Audit

Waste management in the institution refers to the activities that are required to manage waste from the point of collecting the waste to recycling and disposal. Waste in waste management refers to unwanted or unusable materials that are produced through human activities and can have many forms. Proper waste management in the campus will help improve and enhance the green environment in the institution. The audit focused on the volume and type of wastes and current practices adopted in the institution.

The institution disposes of the produced solid wastes in the campus at regular intervals. The solid waste generation in the campus varies between individuals, day-to-day activities and working days. An average value per individual is estimated from the audit survey results and tabulated in the following table. This data is used for the understanding of carbon footprint in the campus.

Sl No	Type of Waste	Site/Location	Qty/Day in kg	DIsposal	Remarks
1	Food Waste	Mess & Canteen	10 & 8	Private agencies	For animal feed
2	Food Waste	Ladies Hostel	5	Private agencies	For animal feed
3	Paper waste	Student, staff & Hostel	2.1	Private vendors	recycling
4	Paper waste	Canteens	2.1	Private vendors	recycling
5	Plastic waste	Office, Classrooms, Hostels & Canteens	1.2	Private vendors	recycling
6	Glass, Utensils	Laboratories,Hostel	0.1	Private Vendors	recycling
7	Napkins	Toilets & Hostels	7.2	Burning	Use Incinerators
8	Electronic Waste	MVIT Building, Hostels & Canteens	0.06	Private Vendors	recycling

The wastes generated in the campus are collected and disposed of as best as possible. Wet wastes are separated at source itself. For disposal, only competent agencies are approached and materials handed over. As given in the table, most items are intended to be recycled, reused or processed.

Observations & Recommendations

1. Well publicized, easily accessible and sufficient collection points can be provided at appropriate locations for recyclable waste materials and individual responsibility shall also be disseminated.

2. The best way to dispose of the used sanitary pads is to dispose of it into the Incinerator. The Incinerator will burn the used sanitary pad without causing any harm to the environment. Hence it is recommended to install incinerators in the ladies toilets both in campus and in the ladies hostel for the disposal of napkins.

3. Vegetable waste and other leaf litter can be used to feed in the vermi-compost pit and the resulting vermin-cast can be used as manure in the garden.

4. More than 60% of pumped water is used for flushing, utensil cleaning, floor wash, hand wash etc., in the campus and the grey water from these activities is drained out properly. A STP of 175000 litres/day is installed in the campus to treat the used water and the output from the plant is used for gardening and plantation which is a very good practice followed in the campus.

Green Area Management

The Manakula Vinayagar Institute of Technology campus is spread over 16 acres of land of which 19% (3 acres) of area is covered with gardening and plantations. This entire campus is evergreen with a variety of trees, bushes and grass. The fauna and flora are very rich and the buildings in the campus are constructed with minimum disturbance to this lingering greenery.

Many tree plantation programs are organized in the campus and in the nearby villages to create awareness among the students and local people. The plantation includes different types of indigineous species of wild and ornamental plants.

The number of Tree varieties identified in the campus is 19 and the number of Trees (above 15 cm of girth alone considered) is 283 counted in the campus for the calculation of carbon footprint analysis and the number of plant species identified is 18 and the number of plants is 1117 (above 0.5 m height).

Tree Data

Sl No	Common/Botanical name of the trees	Girth at Breast Height (cms)	Quantity
1	FoxTail Palm	15 - 30	121
2	Mango Tree	15 - 90	18
3	Aswatha Tree	100	1
4	Almond Tree	15-50	8
5	Jack Fruit Tree	15-100	16
6	Coconut Tree	50-80	36
7	Neem Tree	60-80	6
8	Palmyra Tree	75	1
9	Cardboard Palm	20	2
10	Araucaria columnaris	50	1
11	Caesalpinia sappan Tree	70-90	14
12	Pecans Tree	80	2
13	Emerald ash Tree	120	1

14	Bamboo	20	15
15	Senna persicifolia	100	1
16	Syzygium cunini	15-100	21
17	Lemon Tree	15	1
18	Guava Tree	35-60	2
19	Manilkara Zapota Sapodilla	15-60	16
Total			283

Bushes/Plants Data

Sl.No	Name of the Plants	Height in m	Quantity
1	Acalypha Wilkesiana	1	102
2	Viburnum Suspensum	1	11
3	Melaleucae	2	56
4	Mediterranean Cypress	3-5.5	33
5	Pandanus pygmaeus	0.5-0.75	144
6	Alpinia mutica	1.8	22
7	Carissa Maerocarp	1.5	45
8	Ocimum Gratissimum	1.5	1
9	Ficus Altissima	2.5	9
10	Golden Lucifer	0.75	95
11	Indian shot	0.75	110
12	Portulaca Oleracea	1	23
13	Duranta repens gold	0.25	50
14	Plumeria Alba plant	1.5-3	7
15	Cyathula Prostrata	1-1.5	124
16	Cotoneaster congestus	1	155

17	Ixora coccinea	2.5	70
18	Rhapis Excersa	1	60
Total			1117

Lawn Data

Sl No	Location	Size of the Lawn in sq.m.	Remarks
1	MVIT Building	2274.6	
2	Ladies Hostel	125.4	
Total		2400	

Transportation

Transportation emits more than half of nitrogen oxides in open air, and is a major source of global warming emissions in the world. Studies have linked pollutants from vehicle exhaust to adverse impacts on nearly every organ system in the body. Air pollution from cars, trucks and buses is split into primary and secondary pollution. Primary pollution is emitted directly into the atmosphere and secondary pollution results from chemical reactions between pollutants in the atmosphere.

These modes of transportation mostly run on fossil fuels such as diesel, petrol and gas and these are having heavy carbon footprints (the amount of carbon dioxide released into the atmosphere as a result of the activities of a particular individual, event, organization, or community) which directly affects Global Warming.

The Audit team conducted a survey to find out the transportation carbon footprint of the MVIT and the results are summarized in the following table.

Sl. No	Mode of Transport	No of Vehicles	Travellers	To & Fro km/day
1	Two Wheelers (single/shared)	70	100	55
2	Share Auto	3	15	8
3	Own Car (single/shared)	6	8	48
4	Mini Bus/Private Van	-	-	-
5	College Bus	26	1450	60
6	Public Transportation	-	100	70
7	By Walk	-	20	6

1. The hostel students and staff travel to their hometowns once or twice in a month normally, and at the beginning and end of every Semester. The mode of transport is mainly by bus or by auto.

2. The mode of transportation for parents and visitors is public bus or own car.

3. Inside the campus, all the academic blocks and other buildings are close to each other in the greenery environment and hence students and staff prefer to walk regularly.

Carbon Footprint

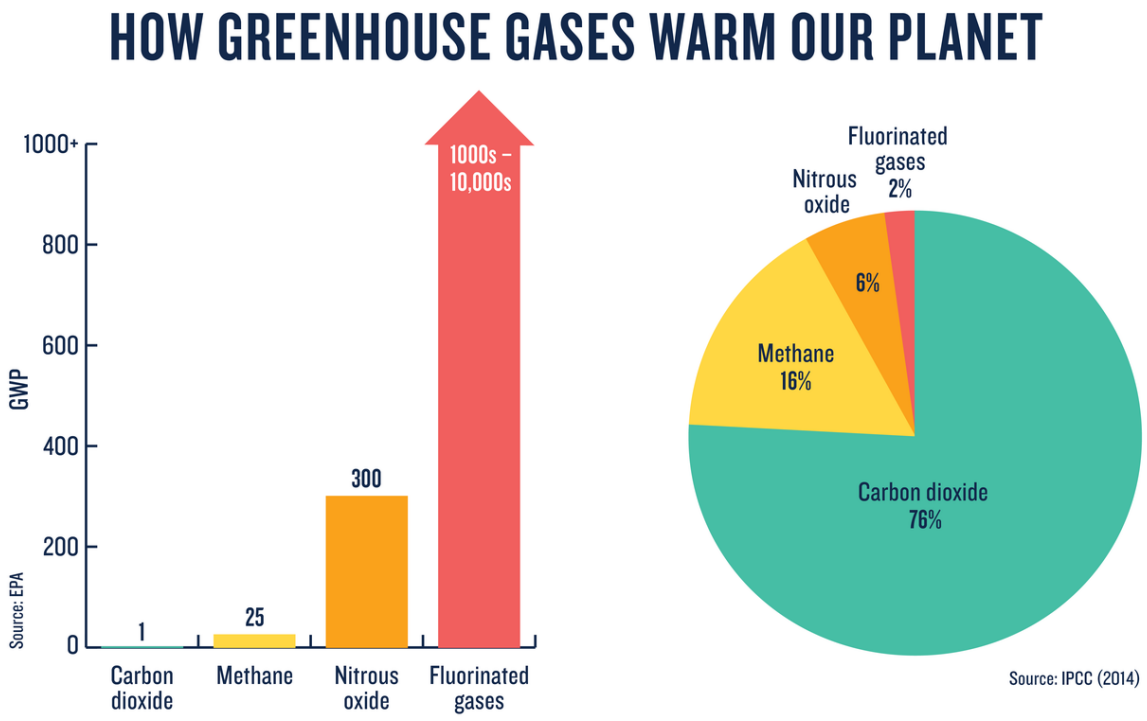
A carbon footprint is defined as the total amount of greenhouse gases produced to directly and indirectly support human activities, usually expressed in equivalent tonnes of carbon dioxide (CO2). Greenhouse gases, including the carbon-containing gases carbon dioxide and methane, can be emitted through the burning of fossil fuels, land clearance and the production and consumption of food, manufactured goods, materials, wood, roads, buildings, transportation and other services.

The term was popularized by a $250 million advertising campaign by the oil and gas company BP in an attempt to move public attention away from restricting the activities of fossil fuel companies and onto individual responsibility for solving climate change. In most cases, the total carbon footprint cannot be calculated exactly because of inadequate knowledge of data about the complex interactions between contributing processes, including the influence of natural processes that store or release carbon dioxide. For this reason, Wright, Kemp, and Williams in the journal of carbon management, proposed the following definition of a carbon footprint.

A measure of the total amount of carbon dioxide (CO_2) and methane (CH_4) emissions of a defined population, system or activity, considering all relevant sources, sinks and storage within the spatial and temporal boundary of the population, system or activity of interest. Calculated as carbon dioxide equivalent using the relevant 100-year Global Warming Potential (GWP100). GWP is a measure of the total energy that a gas absorbs over a given period of time (usually 100 years) relative to the emissions of 1 tonne of carbon dioxide.

Since the start of the Industrial Revolution, more than 2,000 billion tonnes of carbon dioxide have been released into the atmosphere by human activities, according to the Global Carbon Project. North America and Europe are responsible for approximately half of that total, while the emerging economies of China and India have contributed another 14 percent. For the remainder, 150-plus countries share responsibility.

An analysis of carbon dioxide emissions by country today shows that China now leads the pack, responsible for 27 percent of all emissions. Next comes the United States (15 percent), the European Union's 28 member states including the United Kingdom (10 percent), and India (7 percent) next. Together, these global powers account for almost 60 percent of all emissions.



The global warming potential (GWP) of human-generated greenhouse gases is a measure of how much heat each gas traps in the atmosphere, relative to carbon dioxide.

How much each human-caused greenhouse gas contributes to total emissions around the globe.

Today's human-caused greenhouse gas emissions are higher than ever, the concentration of greenhouse gases in the atmosphere is rising rapidly, and according to the IPCC, the planet is heating up. Between preindustrial times and now, the earth's average temperature has increased 1.8 degrees Fahrenheit (1.0 degrees Celsius), with approximately two-thirds of that warming occurring in the last handful of decades alone. According to the Intergovernmental Panel on Climate Change (IPCC), 1983 to 2012 was likely the warmest 30-year period of the last 1,400 years (in the Northern Hemisphere, where assessment is possible). And all five of the years from 2014 to 2018 were the hottest on record globally. If warming trends continue at the current rate, it's estimated global warming will reach 2.7 degrees Fahrenheit (1.5 degrees Celsius) above pre industrial levels between 2030 and 2052.

The Carbon Footprint calculation of MVIT, Puducherry for instance, is only to understand whether or not the campus activities are making excess demands on the ecology of the campus and its surroundings, and to resort to remediation through possible 'reductions on consumption', and enlargement of 'carbon sinks' such as greenery.

The college community can explore all means of reducing the 'consumption' that pollutes/emits high, increase the use of emission free energy forms, employ the 'reduce-reuse-recycle-refuse' or (the 4R) strategy for wastes, and expand GHG absorbing/sequestering technologies and greenery – to achieve a bit more than what is required as per the calculation. That will help improve the campus to flourish as a 'Greener Campus'.

Carbon Footprint Analysis

Different types of audits are conducted in the campus and the outcomes are given in the previous sections. Having these findings and outcomes, we can summarize the following data in order to estimate the carbon footprint of MVIT campus.

1. The total area available and used for various activities in the institution
2. The total number of persons (students, staff and others) involved in the day-to-day functions of the institution
3. The mode of transportation and its usage
4. The types and details of energy consumption in the campus and their pattern
5. The amount of water, food materials, stationeries etc. consumed and energy used for providing them
6. The details of wastes including food waste and e-waste
7. The biodiversity in the campus and their potential to mitigate GHG emissions
8. The availability of carbon positive (renewable) energy generation within the campus

Assumptions made for the calculation of Carbon Footprint

The following assumptions based on well researched and globally accepted empirical procedures are used for assessing the carbon footprint as well as for determining the mitigation measures.

1. The coefficients taken are as per IPCC, International Energy Agency, India's BEE or FAO (in case of food related ones) as well as from India specific studies by Research Institutions
2. For each litre of petrol fuel consumed by a car, 2.38 kg carbon dioxide (CO_2) is emitted and for each litre of diesel fuel 2.653 kg carbon dioxide (CO_2) is emitted
3. Average mileage given by a car runs on diesel is assumed as 20 km per litre and on petrol as 18 km per litre
4. Fuel consumption of a bus is considered as 5 km per litre and it is assumed to have 50 passengers

5. Mileage of a share auto is considered as 30 km per litre of petrol in the region
6. Two wheelers are assumed to give a mileage of 50 km/litre of Petrol
7. A mature tree (full-grown) tree absorbs 21 kg of CO_2 per year
8. Carbon absorption of bush plants varies widely according to species. Some types of bushes have a potential of 49,000g of CO_2 absorption per plant, whereas some others absorb as low as 150 grams of CO_2 per plant. As a general guide, the per-plant carbon absorption is assumed as 200g CO_2
9. CO_2 absorption potential of 1-sq.m. area of lawn is approximately 127 g per year
10. A human being uses about 378 litres of pure oxygen per day
11. Paper is assumed to be of density of 70 GSM
12. No of events and participants will decide the contribution of carbon footprint

Carbon Footprint Assessment

Having done the detailed audit and with the outcomes, the following activity based carbon footprint is to be assessed.

1. Carbon footprint because of
    a. Electrical energy consumption in the campus
    b. Thermal energy Consumption - fuels like diesel, petrol, LPG etc
2. Carbon footprint because of wastes
    a. Food Waste
    b. Paper waste
    c. Waste water
    d. E-waste and other wastes
3. Carbon footprint because of Transportation
    a. Mode of transportation
4. Carbon footprint because of events and general activities in the campus

Mitigation available or to be created

1. Use of Renewable Energy
    a. Solar PV
    b. Solar thermal energy
    c. Bio gas etc.
2. Use of Energy Efficient Equipment of Techniques
    a. Replacement of Tube lights with LED fittings
    b. Use of energy efficient devices or appliances
    c. Mitigation of Harmonics in the system
    d. Equal Load Sharing etc.
3. Use of Waste Water, Recycling and Waste management
    a. Waste Reduction
    b. Sewage Treatment Plant
    c. Adoption of Drip Irrigation
    d. Conversion of waste to energy
    e. Vermicompost pond
    f. Rain water harvesting
4. Conservation of Biodiversity
    a. Management of biodiversity
    b. New plantations
    c. Uplift in Gardening etc.

Considering the above, the Carbon Footprint is estimated for **MVIT** and the remediation is also tabulated as compensation provided. The difference between these two will give the requirement of remediation to be planned and implemented in the campus in near future.

Estimation of Carbon Footprint - MVIT

Sl.No	Description	Emission Rate	Annual consumption/Quantity	Eqt. CO_2 Tonnes/year
I	Electrical Energy consumption	0.80 kg/kWh	189251 kWh	151.4
	Diesel consumption	2.653 kg of CO_2 /litre	4648 litres	12.33
	LPG	2.983 kg of CO_2/kg	2072 kg	6.18
II	Food Waste	1.9 kg of CO_2/kg	6.9 T	13.11
	Paper Waste	1.725 kg of CO_2/kg	1.26 T	2.17
	Water Waste	0.298 kg of CO_2/kL	158.4 kL	0.5
	Plastic Waste	6 kg of CO_2/kg	360 kg	2.16
	Glass/Other	0.77 kg of CO_2/kg	48	0.037
	Sanitary Napkin	0.5 kg of CO_2/kg	2160 kg	1.08
III	Two Wheelers	2.38 kg of CO_2/L	3850*300/50=23100	54.978
	Share Auto	2.653 kg of CO_2/L	24*300/30=240	0.636
	Own Car	2.653 kg of CO_2/L	288*300/20=4320	11.46
	Bus	2.653 kg of CO_2/L	1560*300/5=93600	248.32
	Public Transportation	2.653 kg of CO_2/L	100*70*300/(5*50)=8400	22.285
IV	Events	Approx	500*8*1.5=6000kg	15.92
Total				542.566

Remediation Carbon Footprint - MVIT

Sl.No	Description	Emission Rate	Capacity/Quantity	Eqt. CO_2 Tonnes/year
1	Solar PV Generation	0.80 kg/kWh	311.17 kWp/423307 kWh generation	338.646
	Replacing TL with LED fittings	0.80 kg/kWh	11385 kWh	9.11
	Harmonics Mitigation	0.80 kg/kWh	19334 kWh	15.467
II	Recycling	0.298 kg/kL	15428.4 kL	4.6
III	Lawn	127g/sq.m/yr	2400 sq.m	0.345
	Trees	21 kg of CO_2/year	283	5.943
	Bushes/Plantation	200 g of CO_2/year	1117	0.223
	Outreach activities	21 kg of CO_2/year	50% of 400	4.2
Total				378.534

Carbon Footprint Result

Estimated carbon footprint of MVIT campus for the year 20-21 - 542.566 Tonnes of CO_2/year

Available Remediation in the campus - 378.534 Tonnes of CO_2/year

Remediation Gap -542.56 - 378.534 = 164.032 tCO_2/yr

Total number of persons in the campus - 1825

The per capita carbon footprint - 542.566/1825 = 0.297 tCO_2/year

- 297 kg of CO_2/year

Hence, The per capita carbon footprint for the Manakula Vinayagar Institute of Technology, is 297 kg or 0.297 tonnes of CO_2 equivalent and the remediation gap between the assessed carbon footprint and available remediation is found to be 164.032 tCO_2/year which is very minimal and excellent as the institution has taken initiatives in promoting green energy.

According to the latest survey of Govt. of India 2016, the per capita emission for an Indian was 1.91 tonnes of CO_2 equivalent per year and it was projected as 2 - 2.5 by the year 2020. As per our carbon footprint analysis, the carbon footprint per capita of MVIT, for the year 20-21, is calculated to be 0.297 tCO_2/year which is very less than the national average of 1.91 tCO_2/year. Thus, Manakula Vinayagar Institute of Technology (MVIT) is a **GREEN** Campus.

Green Audit Certificate

This Green Audit has been conducted for Manakula Vinayagar Institute of Technology (MVIT) in accordance with the International Standards for ISO 14000 family of standards set by ISO TC 207 and its sub-committees, Bureau of Energy Efficiency standards, and stipulations under the Energy Conservation Act 2003 of Government of India and other relevant mandates for promotion of sustainable living and education in a healthy environment.

In our opinion, the Institution has presented true and up-to-date data on the various activities of this higher education institution before the audit team, and appropriate audit procedures have been completed by the audit team for preparing this report. The assessments and recommendations are based on verified data presented before the team on the situation as they existed at the time of audit.

MVIT Green Audit has found that the institution's per capita carbon footprint is only 0.297 tCO_2 of equivalent, a level far below the national average of 1.91 tCO_2 of equivalent, with status as Green and a commitment to continue its green practices with approved remediation practices also in place.

Dr V Rajasekaran
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