Marian College Kuttikkanam
Autonomous

Green Audit Report 2018

Nature's Green Guardians Foundation

MARIAN COLLEGE
KUTTIKKANAM
(AUTONOMOUS)

MAKING COMPLETE

Green Audit Report 2018

NGFn

Nature's Green Guardians Foundation

**“The best time to plant a tree was 20 years ago;
The next best time is Today”** - *Chinese proverb*

Preface

The future of humankind depends very much on our ability to change our lifestyles and agree to follow a low consumption pattern of living in terms of resources taken from the globe and return to a sustainable development path at the earliest. Climate around the world – in developed as well as developing regions – has started showing violent changes, destroying life and property and annihilating peaceful living conditions.

The opportunity window for restoring nature to its prolonged state of hosting life forms to flourish under its caring environs is according to scientists, very short and lasting only up to 2030. Within this time, with the willing actions of every citizen wherever they are, coordinated and directed actions should start and continue thereafter till a balancing stage is reached where moderate use of resources and mitigation actions for healing the hurts already inflicted, balance positively to a sustainable nature. If we do not start action now, the situation may go out of control and when our grandchildren reach adulthood, their chances of survival will be very bleak.

Life expectancy of those few who survive will be much shorter than what we have now. This is something we all agree to avoid. The students who are in schools and colleges now are to be the enlightened leaders of immediate tomorrow. Our national educational authorities, as in most developed countries, therefore insist that every student in our country should learn how damages to the environment occur and how to avoid such situations, emphasizing more on possible remedial measures. This green education should start from schools and colleges, and the insistence on Green Audit of higher education institutions on an annual basis, is to make students and staff well informed of the extent of ecological footprints each one creates, as well as on which areas one should concentrate to make his or her environs greener than before.

The 2018 Green Audit report of Marian College Kuttikkanam (Autonomous), is prepared in such a manner that it can educate every stakeholder of the institution, on the major contributors tending to destroy and on every step helpful to restoration leading to further flourishing of its green status. A brief presentation of the contents of this report by the teachers to the other stakeholders would help in getting every one of them to start taking further steps to achieve a 'brighter shade of green' for his or her campus and the region.

- Audit Team

Contents

Marian College Autonomous, Kuttikkanam

Vision & Mission

Marian Vision:

Marian aspires to be a transformational leader in education, facilitating and celebrating the full flowering of 'Life in Abundance'

Marian Motto:

Making Complete

Marian Mission:

We commit ourselves to achieve our Vision through:
Relentless pursuit of knowledge,
Fostering spiritual and human values,
Networking and collaborating for synergy,
Establishing campus-community network,
Promoting sustainable living,
Ensuring a learning environment of creativity,
Adventure of ideas,
Constant innovation,
Enabling academic ambiance, and
State-of-the-art Information Communication Technology

Marian College, Kuttikkanam (Autonomous)
Idukki District, Kerala
Green Audit Report 2018

Executive Summary

This Report presents the results of Green Auditing conducted at Marian College, Kuttikkanam (Autonomous) an educational institution in Peermade, Idukki district, Kerala, which offers graduate and postgraduate courses. Established by the Catholic Diocese of Kanjirapally in 1995, Marian is to provide the student community with education in information technology, commerce, social work and management and is accredited with 'A' Grade by National Assessment and Accreditation Council (NAAC) (CGPA 3.52) of India. Affiliated to Mahatma Gandhi University, Kottayam, the institution is declared as a College with Potential for Excellence (CPE) by the University Grants Commission (UGC).

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. While Financial Auditing, Environmental Auditing and Energy Auditing, as well as Performance Auditing are familiar to all employees and administrators, Green Auditing is far less familiar to all stakeholders including students and general public. It is most of the time capable of evoking several doubts and misunderstandings on its need as well as on the methodology. Yet, Green Auditing is not to be understood as another name for ecological or environmental auditing. It is much broader and encompasses audit of the following aspects of an institution's normal functioning: Use of Water, Energy, Renewables, etc. and the state of Health (of all), Environmental Quality, Transportation & Communication as well as assessment on Accessibility for differently-abled, Gender Justice and Carbon Footprint it leaves through all activities over a year.

Green denotes a world full of all living beings – human, animals, insects and plants as well as all the useful and harmful microorganisms - that can go on forever in peace, happiness and equity. Different countries and sections of people may perceive different shades for the greenness.

With severe climate change calamities getting unfolded all over the world now with increasing frequency, a change in life style is what is warranted. Towards that goal there shall not be any onlookers; there shall only be doers.

Students as future citizens of any country are the ones going to be affected most adversely, if we are unable to ensure sustainability of our life support systems. The possible for the unpredictable situations that would arise is therefore in their remediation immediate agenda of work, and so they would respond

immediately. They have also the ability to influence their families and the general public more effectively than even a learned motivator.

Teachers play an undeniable role in imparting knowledge to the students and the nature of future living on this planet is shaped by their hands. Hence, teachers are in a position to facilitate knowledge and promote the learners to achieve better awareness about what is happening in and around them. Teachers as professionals and influential individuals, supported by the managements of institutions, can play an important role in shaping up students' attitude through training and parading them - to be the role models in their communities. Educational Institutions thus can offer an ideal service in moulding the young minds in their impressionable age, towards promoting the health of nature, understanding the underlying causes of climate change and its impacts, and the conditions required to be maintained for sustaining life on earth.

Green Audit is, therefore to make the entire college and the society understand through the trained students, as to how heavy is their carbon footprint, and help search for remediation and make their campuses and living surroundings 'as green as' one can make it. It is also in search of newer ways to climb up the ladder through continuous efforts in search of the green shade that every one of them has dreamt of. The end result of such an exercise would help their parents and other visitors to the campus in appreciating their responsible behaviour and admire the novel ways in which the campus team has strived to achieve their "shade of green".

Green audit can also be a useful tool for a college to know how and where they are using the most energy, water or other resources. The college can thus plan for the needed changes and ensure savings. It can also be used to improvise their waste minimization strategy. Green auditing and the implementation of mitigation measures will be a win-win situation for the college, the learners and the planet. It can also create health consciousness and promote awareness on environment, ethics and values. Green auditing In such a situation, it is only logical that the college evaluate its own contributions toward a sustainable future for all. As environmental sustainability is becoming an increasingly important issue for the nation, the role of higher educational institutions in relation to environmental sustainability is more apparent. Over a period, the green culture will pervade the society.

In Marian College Kuttikkanam (Autonomous), the Green Audit process involved the creation of a student volunteer corps in the form of Green Guardians Club and an audit team with students, teachers, members from Administration and Parent Teachers' Association, as well as a team of experts who have practiced greening for years including certified and accredited energy and environmental auditors and ecological administrators, through the Nature's Green Guardians Foundation (NGGFn) and Team Sustain Ltd.[with the motto 'engineering green solutions']. Thirty students – Club members - were in addition, trained to conduct the component audits.

The results showed that the austere ways of the college, with the cycles of green audits conducted, have helped in identifying opportunities for a number of refuse, recover, reuse, and recycle strategies for wastes as well as for increased energy efficiency and renewable energy use.

The carbon footprint in 2018 is only at a very low level of 0.311 Ton CO_2 equivalent, which is just one-sixth of the national benchmark for the year. But, the great attention the college community gave to ecological improvements of the campus during the year is probably the highest in the recent history. The outcome of the audit has also pointed out the future directions based on the potential the campus is having. If all of them are implemented, the College can truly be proud of nurturing a Green Campus.

A more concrete strategy for students to interact with the communities around them and help them for building resiliency could be developed in the face of onslaughts from climate change and natural calamities – especially in a hill district such as Idukki.

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Chairman, NGGFn
Former (Founder) Director of S&T and Environment &
Former (Founder) Director of Energy Management Centre
and Former Secretary to Govt. of Kerala (Ex-Officio)
International Energy & Environment Expert/ Consultant to UNIDO & UNEP
Trivandrum, 695035
Dated: 26.12.2018

On behalf of Marian Green Auditing Team:

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Er. Naijo Dominic, Team Sustain Ltd., Kakkanad, Kochi
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Mr. Hari Prabhakar, EMS Auditor ISO 14001 &Director, NGGFn, Trivandrum
Mrs. Ranjini Damodaran, Monitor (Gender issues), NGGFn, Trivandrum +
30 Marian Student Green Guardians (List Appended)

Green Audit 2018: Procedures and Priorities

The National Assessment and Accreditation Council (NAAC), India, insists on having a green audit conducted for every accredited higher educational institution (HEI) mainly because, such an act will help in achieving the following to signal the enhancement of quality of higher education as well as life in India:

- Ensure increased clarity and focus in institutional functioning towards quality enhancement;
- Ensure enhancement and coordination among various activities of the institution with careful ecological consideration and resources conservation in view and in due course institutionalize all such good practices;
- Ensure internalization of the quality culture in education;
- Ensure driving a strong basis for decision-making on institutional issues;
- Ensure that a methodology is developed, tried and established for documentation and internal communication; and
- Ensure that all stakeholders including the students accept a dynamic system for quality changes in HEIs.

Background: For the Green Audit of 2017 of Marian College Kuttikkanam (Autonomous), the Faculty and the Management decided upon bringing changes in the physical and cultural environments, with the participation of students, in tune with the salubrious nature around - minimizing resources consumption and maximizing the performance efficiency in all sectors of activities.

A preliminary random audit indicated that maximum savings could be obtained through interventions in the energy sector – cooking energy, lighting and motive power - and embracing renewable energy with an increased opportunity window. As a part of it, NGGFn Chairman visited the Marian campus on 07. 01. 2017 and advised on the need for a professional energy audit of the campus. This was followed by preliminary audit by a team of three experts from Team Sustain Ltd., Kochi from 31. 01. 2017 to 02. 02. 2017. The draft audit report and the recommendations were discussed among others, with a team of 5 Life Senior Members of IEEE as independent referees, between the faculty of Marian College and the Audit team. The Audit team's study on energy use in the campus later got upgraded into an Investment Grade Energy Audit.

The Audit identified the following opportunities, of which two viz., the UPS system improvement and the Phantom Load elimination were attempted by the Faculty, Staff and Students of Dept. of MCA under competent technical advice.

Table 1

Greening of Marian: Opportunities in Energy from 2017 Green Audit

S. No:	Recommendations	Annual Financial Savings	Investment	Simple Pay Back Period
1	Replace existing multiple single unit UPS systems with larger capacity parallel redundant/ modular UPS systems and Batteries	₹ 3,00,000	₹ 18,00,000	6 years
2	Elimination of Phantom load	₹ 1,30,000	Nil	Immediate
3	Replace Fluorescent Tubes and CFLs with LED lights (in Guest House and Hostels)	₹ 2,47,000	₹ 2,60,000	1.05 years
4	Install 150 kWp Grid Tie Solar Photo Voltaic Systems on Roof Tops	₹ 17,50,000	₹ 1,50,00,000	6 years
5	Install a Biogas System to replace LPG Cylinders in Laundry or Kitchen. Food waste as feedstock	₹ 6,60,000	₹ 16,00,000	2.5 years
6	Install a Solar Pump & Pico Hydro Power Plant to light up the High Mast lamps	₹ 75,000	₹ 5,00,000	6.6 years

In order to identify opportunities to reach optimal level of electricity use, and to cut down on avoidable energy losses, students and employees of Marian assisted the auditors in collecting accurate and up-to-date data on energy use in the campus.

To have these routes to greening understood well by the students, teachers, parents and the community around Kuttikkanam, the College Administration decided to establish an Energy Park within the college premises, in which all feasible forms of renewable energy generation would be tried in a phased manner. Benefits in the energy area as well as improvements in reduction of carbon footprint could be observed, measured and documented by student volunteers in future years.

Procedures:

1) Apart from the efficient use of energy leading to substantial reduction in carbon footprint of the institution (Marian College, Kuttikkanam), the other aspects will also be examined and audited.
2) In the maintenance of biodiversity and green cover in the campus, though the institution is in a far better position than others, being blessed with bountiful flora, an accounting of the richness is intended over the coming years.
3) Planting of trees, though is a continual activity in the Marian Campus, new targets will be set for the coming years.
4) Attempts will be made to minimize the use of polluting fuels such as coal, oil, firewood and petroleum gas.
5) The procedure for Green auditing adopted by the team is to collect basic data on the components of audit, compare them with similar data related to the previous years (where available) as well as with appropriate benchmarks, and showcase improvements as well as the way it has been achieved.
6) With available benchmarks for these criteria for the State/Country, feasible goals will be set for the year ahead, to go up in steps to the best possible level.
7) Collection of basic data would be done by the members of the 'Marian Green Guardians Club' (trained student volunteers), who will act as propagators of Green Philosophy.
8) Standard data sheets on component audits are populated by the groups of Marian GG Club members under group leaders by 'walking through' every nook and corner of the campus, observing activity patterns, studying log books, bills, procedures etc., and occasionally discussing their activities in the company of expert green leaders, mentors, representatives of teaching and non-teaching staff as also the PTA (parent-teacher association).
9) MGGC's role is much larger than the occasional collection of data and their comparison with benchmarks or previous data. The MGGC will meet every fortnight for at least 30 minutes outside the class hours to upgrade their skills and knowledge levels on building a green campus.
10) Occasional lectures/demos/presentations by external experts will be arranged for the benefit of the Green Guardians community within the campus.
11) In the wake of threatening climate change impacts, the benefits of building resiliency through greener ways of lifestyle – within the educational institutions, at home and in community activities and projects – are to be propagated widely within the broad community; first spreading it to fellow students, next spreading it in inter collegiate activities; and finally through co-curricular and extra-curricular activities.
12) Opportunities for students to interact with leaders in the field of arts, culture, science and technology, planning, environment etc., through involvement in public events will be provided during every educational year.
13) The message finally will be conveyed to the society and desirable changes in life styles of the community achieved - through peer and familial pressures.

14) The Final Green Audit Report will be a compilation of all the findings from a number of component audit data and their analysis and interpretation.

Priorities:

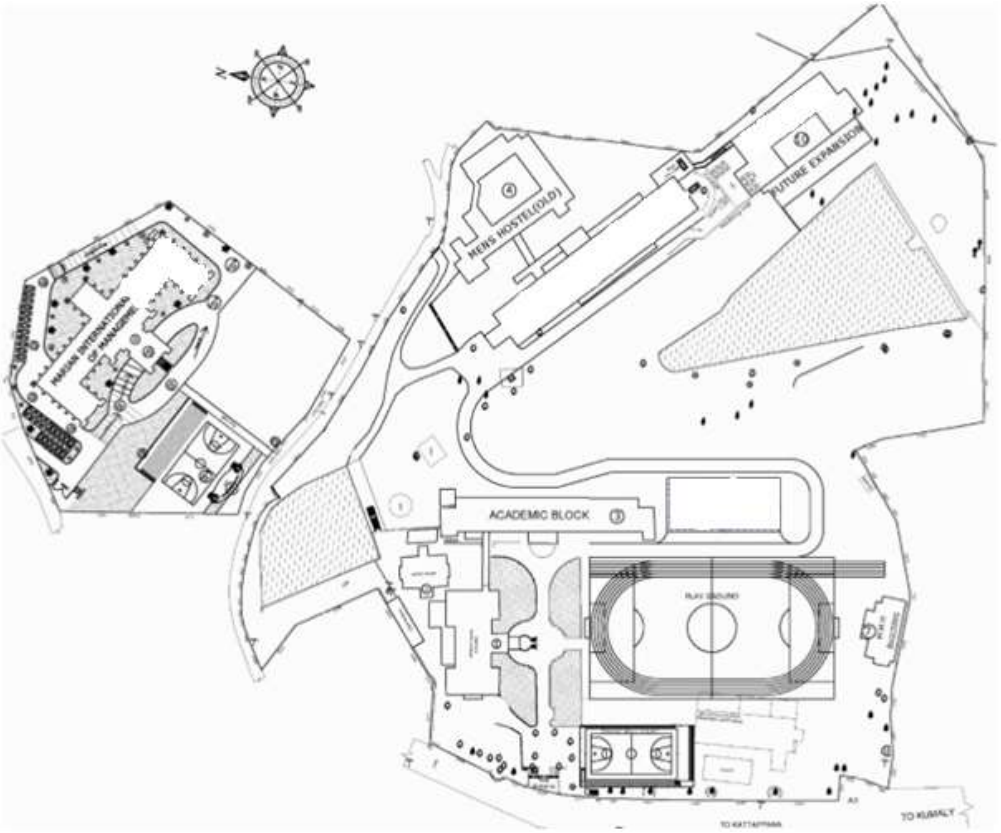
1. While all the listed components are equally important, priority for implementation will be for realizing what is immediately achievable, starting with no cost options first, low cost options next, and then moving forward with proper financial preparation, technical advice and design support, to larger initiatives that have longer 'Payback Periods'.
2. Finally, even with no reasonable payback period in sight, what is good from ecological point of view shall be done at any cost – as sustainable lifestyles are to be learned by students and required to be promoted by the community.
3. With the realization that every affront on the ecological balance of a region has always earned much multiplied recoils from the nature, '*learning to live differently*' is of utmost urgency for the society.
4. What we mean by '*Development*' needs to be re-defined. The training at Marian Kuttikkanam is intended to have the wards imbibe the new eco-culture as easily as fish learn to swim even in a rapid stream.

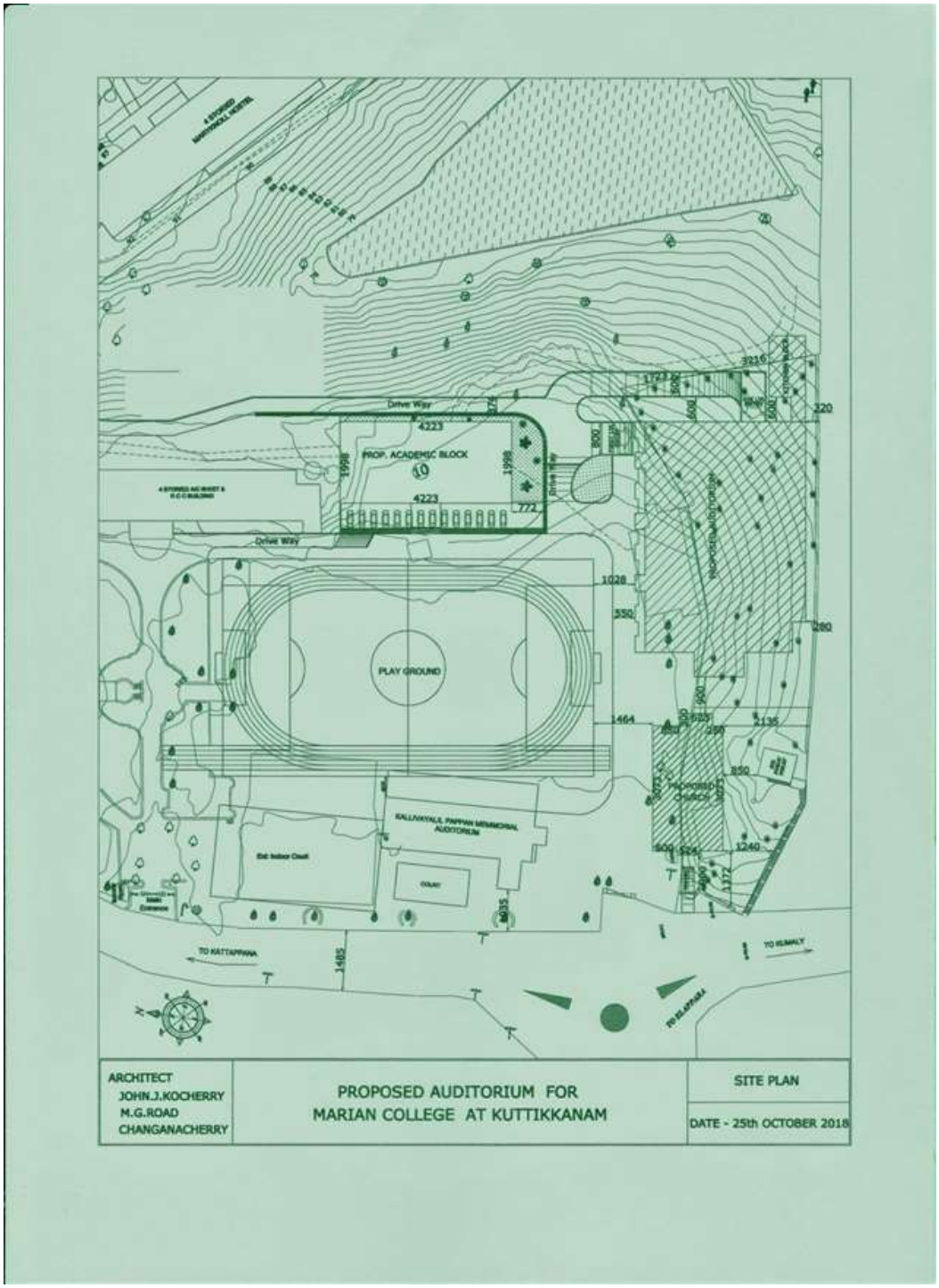
***Post Script*:** The unprecedented floods, landslides and landslips in Kerala – more so in Idukki district – in August 2018 (during the course of 2018 greening initiatives) – notwithstanding the fact that this happened to be the worst in over 94 years - has justified this Marian View and convinced the students of the need to go at double speed towards its envisioned 'Shade of Green'. Many of them voluntarily joined the rescue and rehabilitation teams during the crisis consequent to the above natural calamities.

The Campus Layout

The sketch of the buildings and facilities in Marian College is given in the following page. The titles of the units or their abbreviations will be used in this report frequently. Marian International Institute of Management Studies (MIIMS) and Guest House (GH) are examples.

Marian College Autonomous, Kuttikkanam
Layout of Buildings





Proposed New Additions [on the right hand side - hatched area]

1. Energy Audit

The 2017 Marian Energy and Sustainability Audit identified immediate and no cost, low cost and high cost options that can be pursued (Table 1 in page 10). Marian College Autonomous decided to act immediately and continue on the listed first three opportunities during the year 2018, which are as follows:

1. Minimise the phantom load in the electrical system. Immediate returns will come with practically no investment.
2. Replace the existing multiple units of UPS system for computers by properly optimized single unit UPS system.
3. Replace existing ordinary tube lights and CFLs with LED lights in the Guest House and in the Hostels. Bring down the consumption without reducing illumination levels or human comfort.

Phantom load is the energy that will be measured by energy meters, even when the equipment is out of use. Computers, LCD projectors, Printers, Photostat machines, Freezers, Fridges, TV units, Water heaters etc. which are normally hooked to the power line all the 24 hours, may be active only for part of the day. When not in use, unless they are isolated by switching off (not stopping by remote electronic controls), a small percentage of the full load will still be consumed and felt by the energy meter.

In Marian Audit, by calculation, it was found out that 63% of the phantom load is contributed by the UPS System and this cannot be fully eliminated. But, by proper optimization of the UPS system, the phantom load which comes to 88 kWh per day, can be brought down drastically. Remaining 37% is seen to come from other equipment, and can be eliminated by simply turning them off when not in use (45-50 kWh/day).

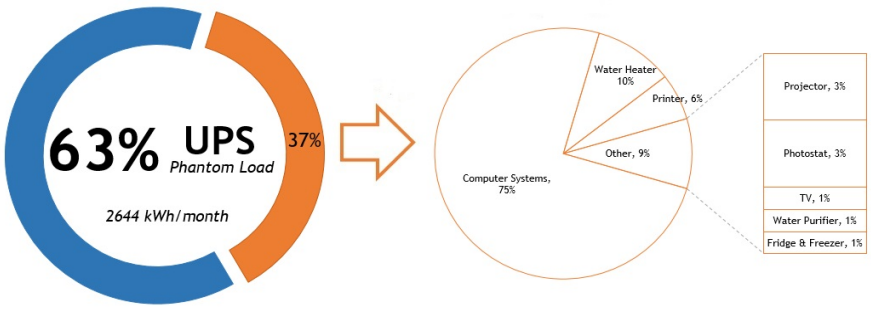


Fig. 1: Locating the Phantom loads

The UPS system having 12 units with total capacity of 90 kVA was distributed as follows - before the current intervention:

7 * 10 kVA UPS in Administrative Block
1 * 10 kVA UPS in Administrative Block
1 * 5 kVA UPS in Administrative Block
1 * 3 kVA UPS in Library
2 * 1 kVA UPS in Library

Most of them were under-loaded and idled for hours every day. Also, the batteries were old and very weak. Failure of any one UPS unit used to totally disable the devices connected to it, till it is set right. With the suggested new system, a single unit of sufficient capacity is connected in parallel mode to all the user outlets, as in the diagram (right) below. This ensured energy savings and unbroken service to all units.

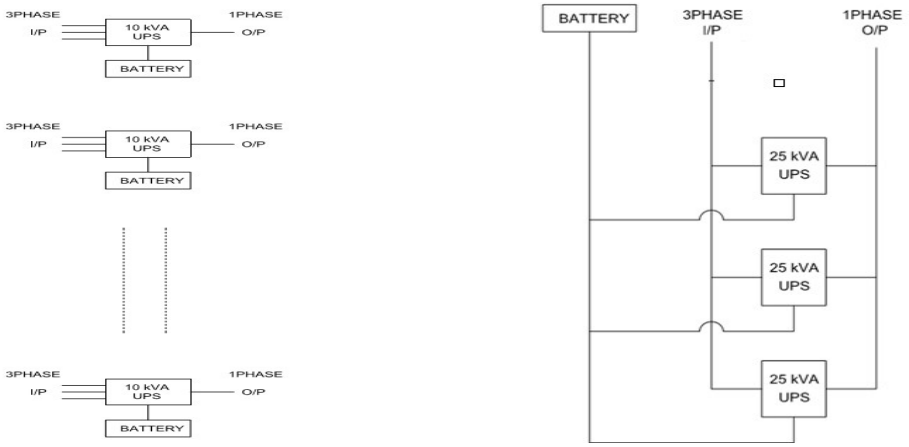


Fig. 2: UPS Optimization

The following housekeeping measures required for achieving the cited gains were introduced during the Audit year:

i. Displayed stickers to switch off equipment - like Computers, Printers, Photocopiers, etc. – when not required; also to isolate them from power supply, whenever possible.
ii. Maintenance schedules for switchboards and distribution boards prepared and followed.
iii. Log Books for recording energy consumption, extent of power failures and running of standby generators were introduced.
iv. Meters for sub-units for monitoring monthly energy consumption in every building to be implemented in the immediate future.

In the case of other equipment, isolation strategy as indicated in the pictorial representation in Fig. 3 is followed:

Providing master control switches for Labs and Library

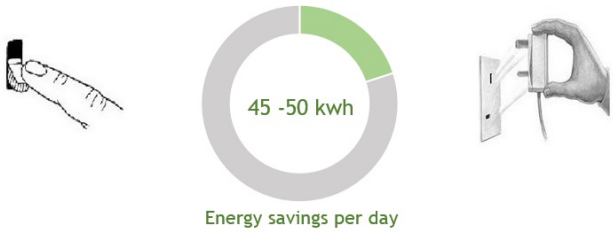


Fig. 3: Eliminating Phantom load thro' proper isolation/switching off

The savings due to phantom load elimination including replacement of all old batteries (building-wise) is in Table 2.

Sl No	Area	Daily Phantom Load (kWh)	Yearly Phantom Load (kWh)
1	Academic block	10.65	3888
2	Administrative building	22.20	8101
3	New academic block	1.32	483
4	Guest house	2.40	876
5	MIIM	11.67	4260
6	Men's UG Hostel	0.62	226
7	Men's PG Hostel	0.98	357
8	Ladies Hostel	0.80	292
9	Kitchen	0.46	167
	Total	**51.10**	**18,653**

Table 2: Daily Energy Savings in each building due to Proper housekeeping and use of better technology

The Marian College Kuttikkanam (Autonomous) has electrical installations in the various buildings and facilities and the connected load exceeds 210 kW as indicated in 27 identified areas. Area-wise details are in Table 3.

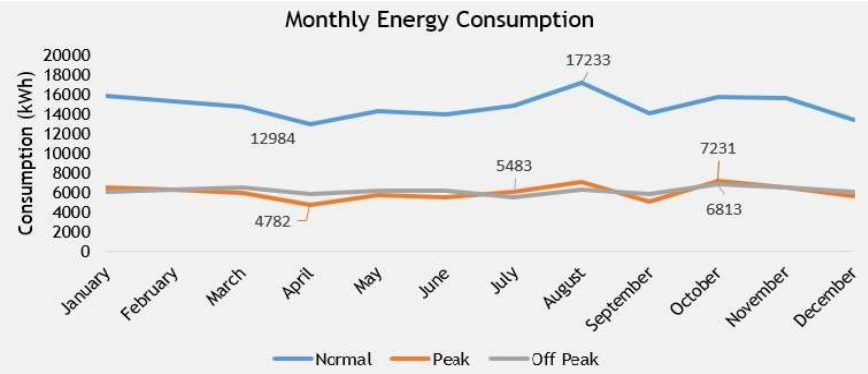


Fig. 4: Electrical energy use. Month wise bill for kWh (units) consumed

Against these connected loads, electrical energy consumption takes place during normal, peak time and off-peak time differently in different sub-areas. Electricity used is charged according to the time of the day (TOD) rates. The energy charge, which is on an average, ~ Rs. 2,40,000 per month is made up of energy consumption during three tariff regimes – normal, peak and off-peak. Major part of it is as energy charges. Cost based on the maximum demand is not high in comparison. So, reducing consumption can bring in large reduction in carbon footprint and savings in money.

No:	Area	Power (Watt)
1	Academic Block (-1)	5,588
2	Academic Block (GF)	7,290
3	Academic Block (FF)	2,376
4	Academic First Floor	2,376
5	Academic Block (-2)	4,596
6	New Academic Block (-2)	840
7	New Academic Block (-1)	1,140
8	New Academic Block (GF)	1,840
9	New Academic Block (FF)	3,080
10	New Academic Block (2F)	3,080
11	MMH GF	1,840
12	MMH (-1) Kitchen	2,496
13	Auditorium	5,260
14	Guest House	33,140
15	Ladies Hostel	18,608
16	PG Hostel	37,760
17	PG Hostel Kitchen	15,069
18	UG Hostel	21,290
19	MIIM (GF)	9,116
20	MIIM (FF)	1,180
21	MIIM (2F)	7,132
22	MIIM (3F)	4,360
23	MIIM (4F)	4,660
24	Administration Block (GF)	5,236
25	Administration Block (FF)	3,300
26	Administration Block (2F)	3,900
27	Administration Block (3F)	3,840
	Total	**210,393**

Table 3: Connected Load (Power)

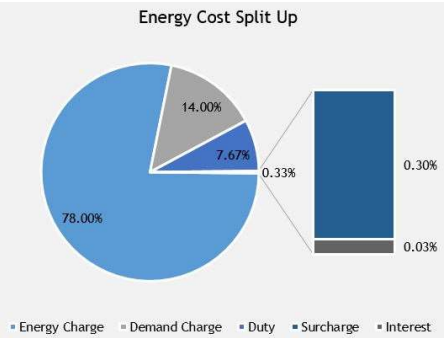


Fig. 5: Comparison of energy charges – Split up into components

Total Electrical Energy Consumption as per Utility Bills

TOD ->	Normal	Peak	Off-Peak	Total
January	15,898	6,497	6,046	28,441
February	15,310	6,362	6,266	27,938
March	14,737	5,993	6,496	27,226
April	12,984	4,782	5,818	23,584
May	14,344	5,712	6,193	26,249
June	14,022	5,496	6,169	25,687
July	14,820	6,035	5,483	26,338
August	17,233	7,066	6,276	30,575
September	14,112	5,092	5,832	25,036
October	15,795	7,231	6,813	29,839
November	15,638	6,517	6,538	28,693
December	13,422	5,672	6,061	25,155
Year Total	**178,315**	**72,455**	**73,991**	**324,761**
Minimum	12,984 (Apr)	4,782 (Apr)	5,483 (Jul)	23,584 (Apr)
Maximum	17,233 (Aug)	7,231 (Oct)	6,813 (Oct)	30,575 (Aug)

Table 4: Monthly Consumption- Units (Energy in kWh) – TOD Tariff Zone wise

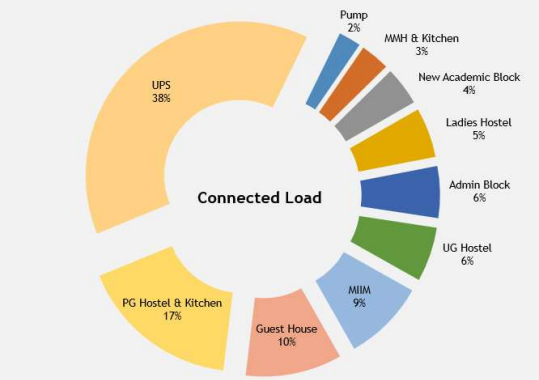


Fig. 6: How the Electrical Connected Load is distributed between various units

For the consumption as in Table 4, the monthly charges are paid

Tariff zone ➔	Normal Rs.	Peak Rs.	Off-Peak Rs.	Demand Charges Rs.	Net Amount Paid Rs.
January	98,567	60,422	28,114	41,000	2,47,663
February	94,922	59,166	29,136	34,400	2,36,660
March	91,369	55,735	30,206	34,400	2,29,680
April	80,500	44,472	27,054	26,000	1,93,823
May	88,933	53,121	26,797	30,800	2,19,393
June	86,936	51,113	28,886	29,600	2,13,650
July	91,884	56,125	25,496	35,000	2,26,519
August	1,24,077	76,312	33,890	34,400	2,91,702
September	87,494	47,355	27,119	32,600	2,10,986
October	97,929	67,248	31,680	34,400	2,48,647
November	96,355	60,600	30,402	33,200	2,39,140
December	83,216	52,749	28,183	34,400	2,14,524

Total for the year: Rs. 27,72,387

Table 5: Electricity Charges Paid

As three fourth of the charges are for kWh consumed, 'energy conservation' potential remains high. If demand can be restricted within the 'contract demand' limit (in kW), the demand charge component of electricity bill every month will remain predictable.

A designated 'Energy Manager' can have a check on additional events and activities every month that may require large energy demands, and ensure that kW energy demand remains within the Contract Demand.

Energy Efficiency Improvement

The next attractive opportunity in the path of greening through energy management is the replacement of fluorescent tubes (1200 mm or 4 ft) and compact fluorescent lamps (CFLs). Hostels and Guest house have the maximum number of 'ordinary four feet tubes'. Reduction in Carbon Footprint will arise due to electrical energy being saved by using LED tubes that require only less electricity for giving the same level of illumination. In this case, 20 W LED tubes can be used instead of 40 W ordinary tubes. 40 W tubes with magnetic choke and starter used to need 56 W (power) to light up. So, savings per tube will be 36 W. During the start of the year, there were 650 tubes to be replaced. These are 'ON' for 2 hours in normal tariff time and 4 hours in peak tariff (6 pm – 10 pm) time. The charge payable for peak time is Rs. 9.3 and the average will be Rs. 5.425. Along with this 10% electricity duty is added up with the unit cost. So, the effective energy cost will become Rs. 10.23 and Rs. 5.97 respectively.

Energy Saving expected by replacing 650 Fluorescent lamps with 20W LED Tube lights is 1560 kWh/month during peak hours and 780 kWh during normal time.
Total: 2340 units/month.
At the above effective rates, cost saved will be:
(1560 x 10.23) + (780 x 5.97) = Rs. 20,615.00 per month.
Annual savings on this account alone is estimated at Rs. 2,47,000.
The cost involved in replacing 650 tubes (Price plus labour cost) is Rs. 2,60,000.
That means, Payback period is less than 13 months; very quick return on investment.

Marian college replaced 300 of these tubes in 2018 and thus saved for the 6 months of operation of the new tubes, a sum of Rs. 57,000 in electricity charges and the respective carbon footprint (dealt with in Chapter 9) as well. Full savings potential can be enjoyed from 2019 onward and on replacing the rest (350) of tubes as well.

In addition, 400 LED bulbs were introduced as replacement for older inefficient lighting devices (other than tubes) during the year. This also helped in bringing down the carbon footprint. On a rough estimate, the energy consumed by these 400 lamps has been reduced to half and the heat radiating from such lamps has also gone down considerably, giving a greener environment.

2. Renewable Energy Use

India is on a path to rapid energy transition, started at a normal pace in 2008 as part of the then announced Climate Change Action Plan for India, with a target of installing 20,000 MW of renewable energy generation facilities including Solar and Wind electricity by 2022. Prime Minister Narendra Modi, after taking over reviewed this target and called upon the people of India to target 175,000 MW of renewable by 2022 – composed of 100,000 MW of Solar PV; 60,000 MW of Wind Power; 10,000 MW of Biomass based power and 5,000 MW of Small Hydro Power and all other renewable energy routes. At the historic 21st UNFCCC (UN Framework Convention on Climate Change) held in Paris in December 2015, India declared its INDC (Intended Nationally Determined Contribution) in which these targets are also explicitly stated. Therefore, it is only natural that through a Green Audit, any Higher Education Institution should identify opportunities for developing Renewable Energy (RE) Sources within its own premises.

The 2017 Green Audit of Marian College Autonomous, Kuttikkanam, has identified the following renewable energy development options for the campus:

	Opportunities - RE	Estimated Cost Rs.	Annual Savings Rs.	Payback In Yrs
1	150 kWp Grid Tie Solar Photo Voltaic (SPV) System on Roof Tops	97.5 Lakh	17.50 Lakh	5.6 Yr
2	5 kW Solar Pump and Pico Hydro Power Plant (Pumped Storage Concept)	5.0 Lakh	0.75 Lakh	6.6 Yr
3	Bio Gas Plant (TMAD) with Food Waste as feedstock (2 chamber, steady temperature type – 6 m^3)	16.0 Lakh	6.60 Lakh	2.5 Yr

Table 6: Renewable Energy Use: Opportunities identified

The 2018 Greening activity for Marian campus tried to prepare the logistics for realizing the above renewable energy options and searched for appropriate technologies and possible subsidies for each. The whole project would be executed in phases subject to availability of funds to invest.

The actions taken during the year consisted of:

1. **First Phase of Solar Photo Voltaic installation**

Completing the installation of 50 kW (first phase) Solar Photovoltaic System on available roofs close to the buildings where electricity is needed in bulk. The two blue strips in the middle (over the Men's Hostel) in the campus were used.

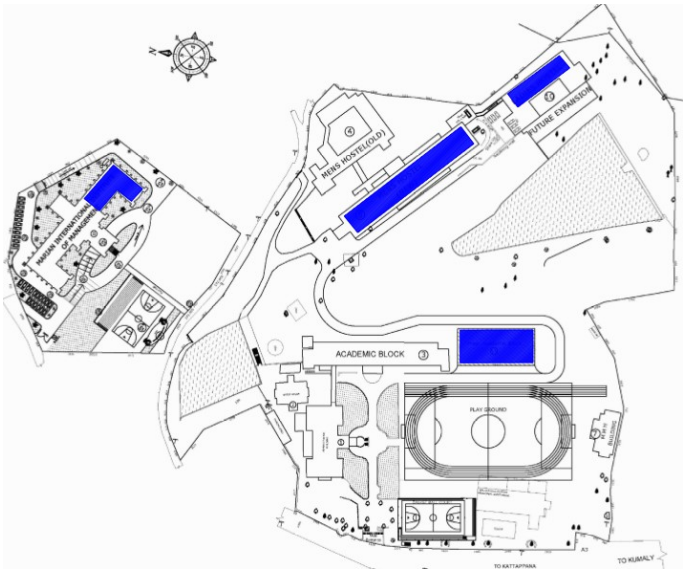
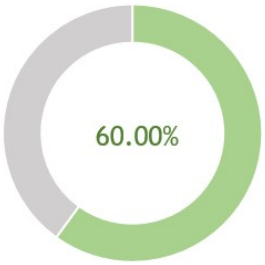


Fig. 6: First Phase SPV system of 50 kW (Blue strips in the middle)

Thin film panels were used which would match the weather profile of Kuttikkanam (high altitude, cool climate, windy, heavy rain and shorter summer conditions). As the college has currently a standby diesel generator and power interruptions are not too frequent, grid-tie configuration was used. All the SPV generation will instantly be pumped to the grid of Kerala State Electricity Board Ltd. Electricity for campus use will continue to come from the KSEB lines. The College is entitled for getting the cost of energy supplied as per the Regulatory Commission authorized 'Time of the Day' rates.

Fig. 7:
Share of Solar PV in
Marian Campus
[With 150 kW SPV]



Analysis of the EB bill data (2016 figures) shows that 325 MWh is the annual consumption of electricity in the campus. In the Kuttikkanam environment, 4 kWh per kW can reasonably be expected from solar PV installation.

For 150 kW, that means generation at 600 kWh/day will result. With the first phase of 50 kW and200 kWh/day, the annual generation will be 73 MWh. Actual generation will be known only after operating for a full year.

Over a period of at least 25 years (with depreciation) average of 193 MWh/year could be expected from 150 kW of SPV. Without income tax (IT) or other benefits, it will take

5 years and 8 months for full payback, whereas if IT benefits are obtainable, the payback will be much earlier - within **4 years and 1 month.**

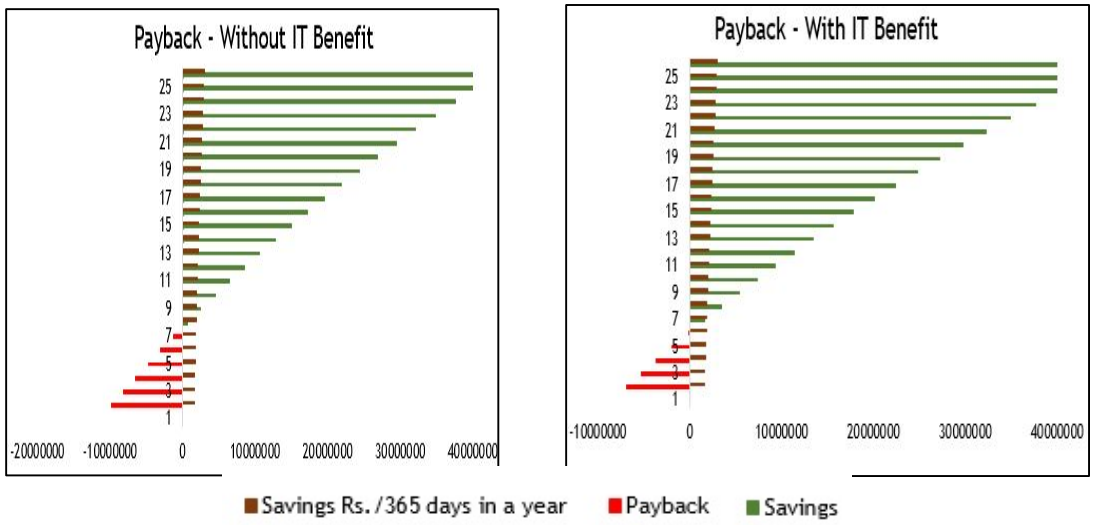


Fig. 8: Solar PV – Techno Economic Evaluation

Total Investment for 150 kWp Grid Tie System		= Rs. 97,50,000
Income Tax Benefit		= Rs. 28,43,110
Actual Investment	= Total investment – IT Benefit	= Rs. 69,06,890
Payback Period		= 4 years and 1 month

During the year 2018, procurement and installation of 50 kW solar grid tie system was completed at a cost of Rs. 25,00,000. On operating them continuously for the year, substantial reduction in Carbon Footprint of the campus will be achieved. Carbon savings achievable per year for the next 30-35 years is estimated in the relevant chapter (Ch. 10) of this report.

2. Pico Hydro Power with Pumped Storage Technology

During 2018, the Pico Hydro (less than 10 kW) proposal site got inspected by the Head of Small Hydro Power Division at Energy Management Centre (EMC), Kerala and College raised a request for subsidy for the Pico unit of 5 kW. There are already two reservoirs in the campus at sufficient height difference and so the Pumped Storage activity can be done during day-time, using a separate dedicated Solar PV system.

The pumped water will be stored in the upper reservoir during day time, to be used for power generation during evening and night hours - to power the high mast lighting system in the campus – that is what is proposed.

The power required is 5 kW. The system will be a demo project that will educate students, parents and the general public on the potential for using hydro sources in multi-utility mode and enhance the benefits to society.

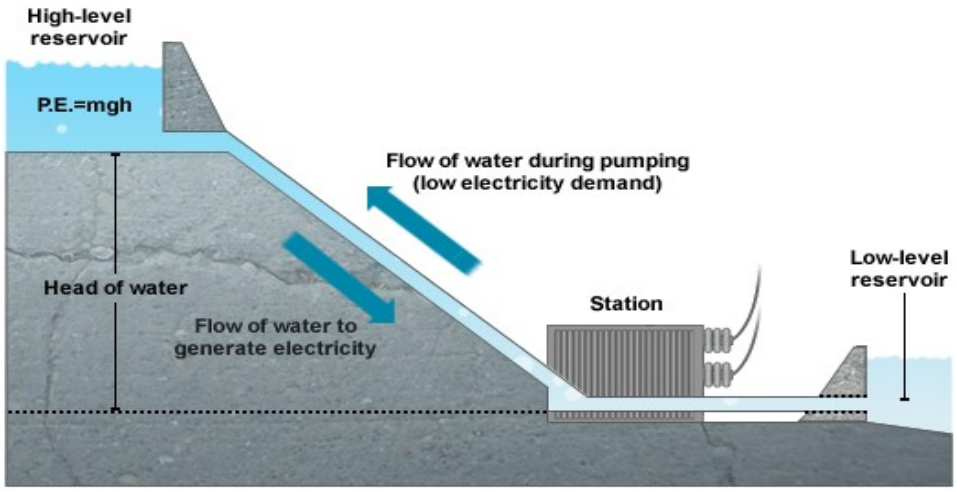
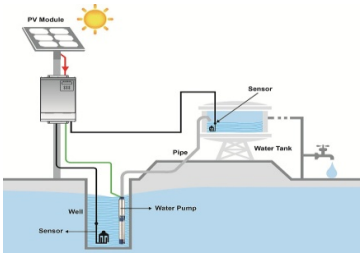
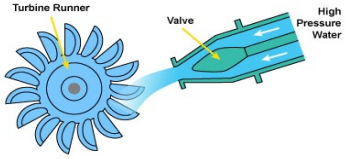


Fig. 9: Micro Hydro Power Unit Concept Diagram



Solar Pumping System
Fig. 10 a,b,c



Pump As Turbine
(Two way PAT)

High Mast Lamps
(Area lighting)

The total investment required for the proposed Pico Hydro Power system with solar pumping will be Rs. 8 Lakh. Out of this, a subsidy of Rs. 1.5 Lakh can be obtained for pico hydro. Likewise, for SPV Pumping system, a subsidy option could be explored. The energy charges for illuminating can be completely avoided for his high mast lighting system. Annual savings can be Rs. 75,000. With subsidy, the payback period can be around 5 years. A detailed project report will be prepared during 2019 for pursuing this opportunity window.

3. Biogas production for Innovative Applications

The idea is to use the food waste in the campus for biogas generation and use it for partially replacing the LPG using units like Laundry Dryers. For this, accurate data on available wet wastes and a more efficient biogas technology are to be obtained. During 2019, detailed project report can be prepared, and project attempted. A preliminary proposal is worked out and projected in this section.

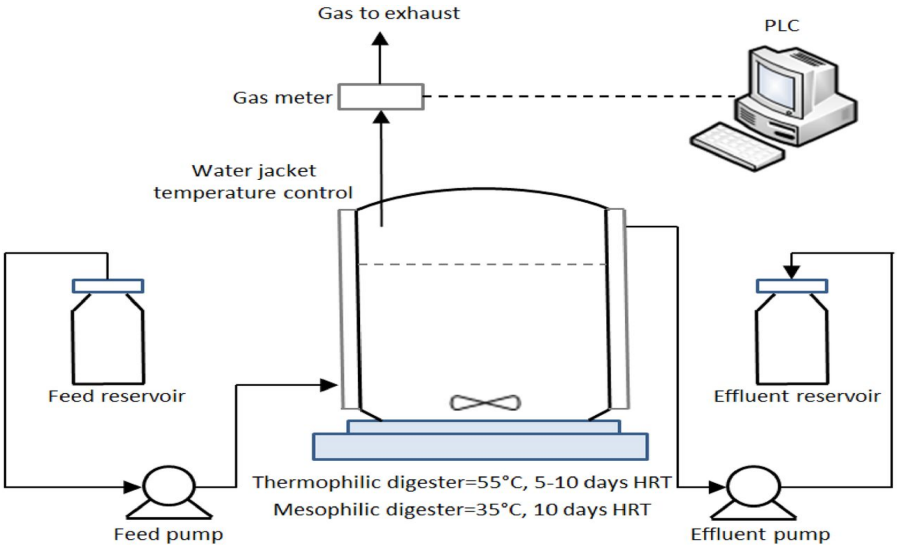


Fig. 11: HPTC Biogas Schema

No. of Persons (food waste source)	700 pax
Daily Food Waste from Mess/day@ 200 g/pax	149 kg
Volume of Digester needed	6.0 m^3
Volume of Storage Tank needed	0.3 m^3
Slurry Output (expected)	0.3 m^3
Application: Replace LPG fired drying at laundry	LPG (2 cylinders) with Biogas

Table 7: Technical Details of Proposed Biogas Digester System (Draft)

As an additional option, night soil from the hostel toilets can be utilized to increase the quantum of feedstock (being connected to the digester). This will provide more biogas (methane as energy giver) and this can be used to replace LPG being currently used for dryers in the laundry.

The proposal is for a dual stage, high performance, temperature controlled (HPTC) anaerobic digester that can use either Thermophilic bacteria (55^0C) with digester residence time of 5 to 10 days or Mesophilic bacteria (35-37^0C) with residence time as that of ordinary biogas plants. As the gas is to be exclusively used for laundry heating and drying requirements, no sentimental objection from students is likely.

This kind of biogas digesters perform better, if the wastes are dealt with in two chambers (German – Rottaler model) instead of the single chamber used in both the Indian floating drum type and the Chinese fixed dome type digesters. The four chemical processes required in cascade such as Hydrolysis, Acidogenesis, Acetogenesis and Methanogenesis do not happen with the same speed. Therefore, it is better to have a separate chamber for the waste to deteriorate and split into molecules (Hydrolysis).

After hydrolysis in an occasionally openable chamber as above, the liquid content from it can pass through a second chamber for production of methane gas. If the chamber is heated to the required temperature (living temp. of the bacteria), roughly 25-30% more gas could be obtained.

In addition, the 30-35% CO_2in the biogas can be converted to CO and added to the Methane stream, providing extra energy output.

Fig. 12: Model HPTC Waste based Biogas System (*Not in Marian*)

However, having identified the various alternative opportunities in this area, it is required to prepare a detailed cost-benefit analysis and decide on a low investment, high benefit solution and based on the total volume of the wastes, decide upon the size of this Biogas Plant.

This work may be done during 2019 and a project undertaken for implementation.

4. Cooking Energy Savings: Potential

During 2018 Green Audit initial days, the team examined the energy requirements in the hostel kitchen and checked for any energy leakages. While electricity is used for refrigeration, baking and other applications, cooking energy for the meals, tea & coffee making etc. comes from LPG (19 kg) cylinders and a kiln fired by firewood. The steam produced from this biomass route is piped to various cooking units. Minor leakages were noted and the management was notified. These leaks were immediately stopped and the inefficient kiln was examined for possibility of introduction of a Gasifier plant that would require much lesser quantity of firewood. At present, annual biomass fuel (firewood) required (in 2018) is 35,957 kg (~ 36 Tonne/year) at a cost of Rs. 1,00,680. Further, the 'syngas' obtainable will be of high calorific value and hence, it can be used to completely eliminate LPG use for cooking. In all, the total quantity of firewood required will come down considerably (to at least 50%).

During 2019, a project report can be prepared that will advice the authorities to reduce the purchase of firewood and LPG through a very efficient and reliable cooking energy supply system based on wood gasification.

3. Water Audit

Marian College Autonomous Campus in Kuttikkanam is in a hilly terrain and the area is blessed with copious rains, never drying tanks and ponds – big and small. Even with a 1748 strong student community (55% girls) with nearly 1181 students in the hostels (men's and ladies') as well as 25 pax among the 170strong faculty, non-teaching personnel and top management officials combined, and on an average 10 guests staying daily throughout the year in its premises, water has never been a problem since the College Campus was populated in 1995, as the tanks were systematically fed with an extensive rain harvesting scheme.

The College has not kept separate data on water used exclusively for flushing, Utensil washing, Face washing, Floor washing etc. However, the Green Guardians have collected separate data on water use in the campus. The College can generate data on these aspects and the efforts to conserve water from the year 2019 can be intensified.

The 2018 Green Auditing of Marian College noted that the Campus on the whole, consumes 50,00,000 Litre of water every month. College does not buy or depend upon public water supply from outside the campus. The water tank with rain water harvesting in the campus is capable of supplying its entire requirement of water. The water quality, as proved by testing at regular intervals, is that there is no water problem in the campus either on quality or on quantity.

The water consumption per day of 1,17,000 Litre is pumped out from the fresh water pond (protected natural tank) by electric pumps, filtered, and purified before being used. Three pumps of HP (2.5+5.0+7.0) operate for 2.5 hrs a day. Of the campus electric energy consumption, 4% can be attributed to pumping. The water availability per capita/day works out to 100 LPD. This is adequate and does not show any wastage.

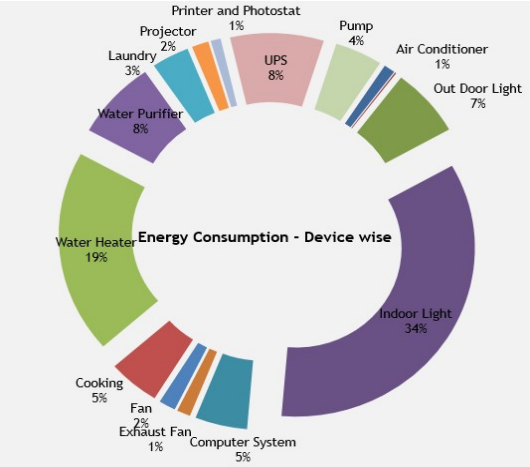


Fig. 13: Energy required for water pumping is at 4 per cent of total electricity use

Observations:

Conservation of water through effective rainwater harvesting and recycling of gray water are considered as essential activities by the College community right from its inception and practiced vigorously. The total roof area of the buildings (other than IIMS block) is 8300 sq. m. (89,340 sq. ft.).

Building Name	Utility	Plinth Sq. m.	Floors	Roof Type
1. Main Bldg. (Admin)	Office, Library, MCA	702	G+4	Sheet
2. Guest House	Guest Stay	225	G+2	Concrete
3. Academic Block	Class Rooms	943	B+G+1	Sheet
4. Academic Block (New)	Class Rooms	730	B+G+5	Sheet
5. UG Hostel	Student stay	1006	G+2	Sheet
6. PG Hostel	Student stay	1514	G+5	Sheet
7.Ladies Hostel	Student stay	747	G+3	Concrete
8. Auditorium	Event Floor	773	G	Sheet
9. MMH Block (Old)	Class; Lab	298	B+G	Sheet

Table 8: Main active building areas and Roof Rain Water Harvesting potential

The average annual rainfall in Peermade, Idukki is 2295 mm. For a 10-sq.ft. roof area getting 1 mm rainfall, rain harvest will be1 litre. Taking this as an empirical guide, 8934 x 2295 = 20.5 million litre is the rainwater availability from the roof tops. The top tank from which all the water requirements are met, has a storage capacity of 40 million litre of water. Fish grow unhampered in this tank and the water source is well protected and maintained with high esteem.

The College has a Water Purification Plant of 7,00,000 Litre capacity. In addition, the waste (gray) water is treated in its STP plant of 50,000 Litre capacity and reused for gardening and toilet flushing.

The water conservation and management policy as well as recycling strategy of Marian Kuttikkanam have been working quite satisfactorily for years and it is capable of educating the students not only from the same region, but also from other areas spread across the state and also from rest of India and abroad, on efforts required on the water front. Kerala with 3000 mm average annual rainfall suffers water shortage in several of its 14 districts every year for as high as five months, mainly due to lack of proper water conservation efforts at local levels, widely by the public. In the midst of global threats related to water shortage in the years to come – even including India and Kerala – the Marian water management practice is a shining example and a point education for any future citizen.

4. Natural Environment – Biodiversity Audit

The Marian College Campus, Kuttikkanam is spread over 27 acres of land, along the Kottayam – Kumily (KK) Road, right at the Kuttikkanam road junction separating the routes to Kumily (36 km to Kumily with Thekkady Wildlife Reserve on the way; one hour ride) and Elappara (10 km, 20 mts ride). With very pleasant climate, Peerumedu (Peermade) region starts from Kuttikkanam and the entire campus is ever green 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.

Notwithstanding the green bonus available naturally to the campus, during the 2013 Green Audit of the campus initiated by Ms. Miriam Meera Abraham, Conservation officer of Bombay Natural History Society (BNHS Mumbai) and Mr. Haris Parengal of Gandhigram Rural Institute, Madurai, Tamilnadu, an attempt was made to plan for the preparation of a Biodiversity Register for the Campus.

As a result, during that time a list of 133 butterfly species that could form a butterfly garden in the campus was prepared. For each of the identified butterfly category, the names (scientific and common name) of the host trees were also identified. Some of the trees seen commonly in the campus and in the neighbourhood are hosts to multiple varieties of butterflies.

In subsequent greening efforts, the initiative of labelling the trees with their botanical names and names in local language was continued and more number of trees added to enrich the biodiversity of the campus. The labelling process is now completed; but, with several trees grown up with added standing biomass, the bigger trees will have to be measured at breast height and tree data entered in a register. This activity will be taken up by the Marian Green Guardians Club and the Marian NSS during 2019.

In view of the plan to construct a large modern auditorium at the edge of the campus facing Kuttikkanam road junction, the programme of developing the butterfly garden is kept in abeyance. This temporary disturbance will be over very soon.

It is planned to complete the detailed audit of trees with qualified botanists leading the effort, by the end of 2019. A few photographs of the campus where the greenery has been maintained and nurtured during the year are appended.

Of the nearly 440 tree/plant varieties suggested for the campus, the current year's work on examination of the suitability of plants for introduction, a preliminary list of 100 plants has been prepared. Certain plants indicated in the 2013 list are known to have the potential to grow wildly or grow as deterrents to the growth of existing fauna and flora. A further scientific screening of the list will therefore be done in consultation with Peermade Development Society (PDS), Peermade, and Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JN-TBGRI), Trivandrum.

During 2018, 900 more trees and plants were added. They are: Fruit trees – 50; Coffee Plant – 500; Pepper Vine – 300; and big trees – 50.

Plan for Increasing the Biodiversity:

Common Name	Botanical Name	Common Name	Botanical Name
1. Alpam	*Thotteasiliquosa*	51. Kariyilanji	*Smilax sp.*
2. Aaduthodaapaala	*Aristlochiaindica*	52. Kaattumathivaal	*Kanavaliagladiata*
3. Aranamaram	*Polialthialongifolia*	53. Kizhangupayar	*Vignaangulata*
4. Aathachakka	*Annona reticulata*	54. Kashumaavu	*Anacardiumoccidentale*
5. Arootha	*Rutagraveolens*	55. Kurunthotti	*Sidarhombifolia*
6. Aanathakara	*Cassia alata*	56. Kurinji	*Strobilanthus sp.*
7. Aavarthaki	*Cassia auriculata*	57. Kozhinjil	*Tefrosiapauciflora*
8. Akathi	*Sesbania grandiflora*	58. Koorkkila	*Stachyphrynium spicatum*
9. Aaryavela	*Cleome rutidosperma*	59. Loovika	*Flacourtia sp.*
10. Aavanakku	*Ricinuscommunis*	60. Manoranjini	*Artabotrishexapetalus*
11. Aal	*Ficus sp.*	61. Mulakunaari	*Alseodaphnesemicarpifolia*
12. Chembaka	*Micheliachembaca*	62. Mullilam	*Zanthoxylumrhetsa*
13. Cheruneduna	*Polyalthialongifolia*	63. Manjathakara	*Cassia siamea*
14. Cherunaaraka	*Citrus limon*	64. Mullakathi	*Sebaniabispinosa*
15. Chakrathakar	*Cassia tora*	65. Manjavela	*Cleome viscosa*
16. Cherani	*Cassia mimosoides*	66. Malambayin	*Drypetusoblongifolia*
17. Chooral	*Calamusrotang*	67. Mula/Bamboos	..
18. Chappangam	*Caesalpiniasappan*	68. Manjaadi	*Adinantherapavonina*
19. Chittamruthu	*Tinosporacordifolia*	69. Muthukku	*Adeniahondala*
20. Cherucheera	*Amaranthesviridis*	70. Marotti	*Hydnocarpuspentadra*
21. Chamatha	*Butea monosperma*	71. Maavu	*Mangiferaindica*
22. Eshwaramulla	*Aristlochiaindica*	72. Murikoottipacha	*Asystasia sp.*
23. Eenthappana	*Phoenix sp.*	73. NarumPanal	*Uverianarum*
24. Ellukootti	*Litseachinensis*	74. Narakam	*Citrus sp.*
25. Grasses/Pullu	..	75. Nanjinar	*Gnidiaglauca*
26. Inja	*Acacia pannata*	76. Neermathalam	*Cratevaadansonii*
27. Irul	*Xyliaxylocarpa*	77. Neerthippali	*Phyla nodiflora*
28. Ilavu	*Bombaxceiba*	78. NaiVenga	*Ougeiniaoojenensis*
29. Ilantha	*Ziziphusmauritiana*	79. Odivodukki	*Blepharisasperima*
30. Ilamulachi	*Kalanchoepinnata*	80. Ornamental Plants	..
31. Karandavalli	*Aristolochiabracteolata*	81.Paanal	*Glycosmisarbeorea*
32. Kulamaavu	*Perseamacrantha*	82. Ponnaveeram	*Cassia occidentali*
33. Karpooramara	*Cinnamomumcamphora*	83. Puli	*Tamarindusindicus*
34. Kaattuvazhana	*Cinnamomummalabathrum*	84. Passion fruit	*Passifora edulis*
35. Karuva	*Cinnamomummacrocarpum*	85.Poodappazham	*Passiforafoetida*
36. Kaanakaitha	*Miliusatomentosa*	86.Poovarasu	*Thespesiapopulnea*
37. Karappa	*Cinnamomumzylanicum*	87.Peenari	*Nothapodytesnimmomiana*
38. Koovalam	*Aegle marmelos*	88.Poothilanji	*Drypetesroxburghii*
39. Kariveppu	*Murrayakoenigii*	89.Ponnaamthakara	*Cassia sophera*
40. Kaattunaarakam	*Atlantiaracemosa*	90. Pezhu	*Careyaarborea*
41. Kaakkathudali	*Thoddaliaasiatica*	91.Parvathichedi	*Barleria sp.*
42. Kaaturubber/Kanala	*Evodiaroxburghania*	92.Seethapazham	*Annona squamosa*
43. Kovidaaram	*Bauhinia racemosa*	93.Ungu	*Pongamiapinnata*
44. Kanikonna	*Cassia fistula*	94.Vazhana	*Cinnamomum sp.*
45. Kaattukazhanji	*Moulluvaspicata*	95.Varimaram	*Chloroxylonswietenia*
46. Kareeram	*Capparisspinosa*	96.Vidukanali	*Acronychiapendunc*
47. Karthotti	*Cappariszeylanica*	97.Vaaka	*Albissiasp.ulata*
48. Kakkathondi	*Cadabafruiticosa*	98.Vellakkashavu	*Drypetesvensusta*
49. Kaattakathi	*Capparissepiaria*	99.Vallippala	*Tylophoraindica*
50. Kaattupoovarasu	*Hibiscus cannabinus*	100.Vanpayar	*Vigna cylindrical*

Table 9: Shortlisted Plants and Trees for Biodiversity

The College campus is spread over an area of 8.3152 hectare (excluding the International Institute of Management Studies) or 20.55 acre (at 2.47105 acre per hectare). The total area is 27 acre. Out of this, 0.80 ha (2 acre) is set apart as play ground. The area used for agriculture/gardening is 1.2 ha (or 3 acre). A part of the campus on the lowest reach is virtually lush forest, kept undisturbed. In rest of the area, tree plantation is resorted to as a routine measure.

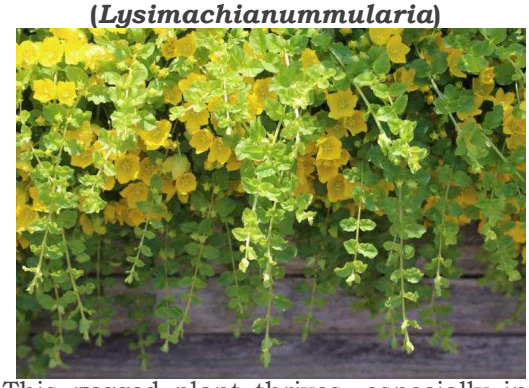
The open canal from the upper pond to the lower pond has on both its banks, trees planted ensuring adequate biodiversity. The hostels and the academic areas are on either side of this stream, ensuring an eco-friendly green environment as view from inside to the open.

As a part of the greening through vegetation plan, it is suggested that in the IIMS area, an attempt can be made to try out the Japanese technique called 'Miyawaki method of Afforestation" (due to Akira Miyawaki) for developing natural forests with high biodiversity within a very short period. The plant species in this will be mostly native plants and after 3 to 5 years, no special attention is needed to be given for the fast and lush growth of vegetation and allied other living organisms to appear.

It is also proposed to plant at least 25% of the trees and plants covered under the short listed plant list (Table 9) in this report during the year 2019. Students and their parents may be got involved in this campaign during the coming year, and if the parents turn enthusiastic to continue this practice in years beyond 2019 as well. The afforestation practice in our country so far has been to plant one or a very limited number of tree species in large number and celebrated based on the numbers involved. Enhancing bio-diversity will be given high attention in future planting exercises.

In addition, the following eight 'Evergreen Ground Cover plants' may be added to increase the greenery in the campus with very little time spent on planting as well as for maintaining. They bring a wide variety of colours, leaf shapes and texture to the fore, for viewers/students to feel relaxed and refreshed. Better plant them in areas that are not easy to reach. If planted in spring or early summer, they will grow well as ground cover plants without much of after care.

1. Trailing Periwinkle (*Vinca minor*)  This plant yields beautiful periwinkle blossoms that have a lovely scent. It will quickly spread well in the garden. Will grow just as strong and dense in full sun, or in partial shade. On top of a rock wall, where it will cascade down like a waterfall.		**2. Dragon's Blood (Red Sedum) Family *Crassulaceae***  Dragon's Blood loves the sun. It has a beautiful deep red color depending upon more absorption of sunlight. When it is fully established it becomes a good perennial standing up to 8-inches height. It grows quickly and will tolerate dry soil and temperature variations.

3. Creeping Phlox (*Phlox subulata*)  This low-lying ground cover plant blossoms in an array of outstanding colors. It needs to be trimmed regularly, especially if you are using it along a pathway or as a border.	**4. Creeping Thyme (*Thymus Serpyllumcoccineus*)**  Red creeping thyme is tolerant of heat, as well as being drought tolerant. It grows close to the ground and thrives in full sun. It is ideal for planting around stepping stones, or along borders.
5. Big Root Geraniums (*Geranium macrorrhizum*)  This plant needs to be planted in well-drained soil which help kill fungus gnats and thrive in dry/medium moisture and full sun. Apple geranium are very drought tolerant ground cover plants for hot areas.	**6. Golden Creeping Jenny (*Lysimachianummularia*)**  This rugged plant thrives, especially in wet areas, in partial shade. Growing in an area with full sun, it gives more vibrant colors. Vibrant yellow flowers are also available. This plant can quickly cover large areas.
7. Mazus (*Mazusreptans*)  This plant needs only low-maintenance. Performs best when planted in partial shade; will also grow in full shade. Keep moist during hot weather.	**8. Sweet Woodruff (*Galiumodoratum*)**  This plant grows in densely shaded areas. Maintaining it is simple. Add some Epsom salt, but do not need to fertilize it; water it in times of drought.

5. Transportation and Environmental Quality

These are days when people of all walks of life – students as well – being social, have to meet other people, visit places of work and pleasure and continue to be connected, and resort to a highly mobile nature of life. For higher education, one cannot think of joining the nearest institution only, as the interest of the pupils on the choice of subjects of study vary very widely and families look for the best institution where their wards can study and grow up into responsible citizens of this country. May be, they could also be looking for greener pastures even in foreign countries when they are in search of rewarding job opportunities. This necessarily involves travelling at daily, weekly or monthly intervals from home to the higher education institutions and hostels. The mode of transportation will be mostly bus or train. Kuttikkanam has no rail service in its vicinity, being part of high ranges. In some cases, travel is by bicycle. In some other cases, it may be motor cars and very rarely airplanes. Other than bicycles, other modes require fossil fuels to propel them – like Petrol, Diesel, Gas or Aviation fuel. These fuels have heavy carbon foot prints – meaning the green house gases (GHGs) or carbon emissions in the form of CO or CO_2, Sulphur compounds, Nitrogen oxides etc. tends to become heavy. This has a direct bearing on the Global Warming and consequent Climate Change (CC).

The purpose of Green Auditing is to make every stakeholder understand the depth of damage each one inflicts on earth and its atmosphere, and as part of festivities and luxuries they seek to strive for remediation through simple living and greener travel. Accurate assessment of such environmental damages is highly involved with temporal measurements and continuous monitoring. At the UN Framework Convention on Climate Change (UNFCCC-21) in December 2015, India too has committed to bring down the Carbon Foot Print of our country on the global environment. In short, every citizen – be it a student, teacher or parent, or anybody else not connected with it directly, should know this burden on environment and try to bring their impacts to 'near nothing' through remedial actions wherever possible.

Emission of climate changing gases through transport system – both public and private – is very high in India and India stands third in respect to GHG emitting resource utilization globally, as well at 6th place in the list of accumulated emissions after industrialization for 160 years starting from 1850. But, if we take per capita emissions, India is not a heavy polluter – it stands at 10th position and the quantum is less than one-third of the world average. The students and teachers of Marian College, Kuttikkanam have however felt that they are also duty bound to lower the onslaught of increased carbon footprints and protect the natural environment in the region – which at present is certainly the better among the best.

A survey was conducted to find out the transportation carbon footprint of the College. The summary of the data sheets generated can be seen in Table 10.

The terrain in Kuttikkanam is such that no student or staff can think of using bicycles. However, two members of the non-academic staff are in the habit of using bicycles between buildings in the campus or up to the gates.

Transportation Footprint

For assessing the carbon footprint due to transportation related to the functioning of the College and studies of the students, the following specific details were gathered through survey.

Sl. No.	Details: Type	No. of vehicles	No. of students	Total km Daily run to & fro
1.	Motor bike/Scooter (Single/Shared)	20	30	80
2.	Auto Rickshaws used	3	5	5
3.	Own Car (Single/Shared)	15	40	80
4.	Taxi Car (Shared)	Nil	Nil	Nil
5.	Private Van/ Mini Bus	Nil	Nil	Nil
6.	Public Transportation/Bus	--	583	60 km
7.	Cycling to College	Nil	Nil	Nil
8.	Walking to College	NA	5	1

Table 10: Mode of Transportation for Students and Staff of College

1) The hostel mates travel to their homes once in a month normally, and at the beginning and end of every Semester. This is usually by bus (public) or cost shared shuttle jeep.

2) Members of staff (25 of them) who stay within the campus, generally use public transport once in a week for going to and coming back from home. Occasionally, shared taxi services are also availed.

3) Parents and occasional visitors generally use public bus, rarely own car or very seldom hired taxi.

4) Within the campus, students do walk regularly, and since all buildings are generally close to each other, in the pleasant environment inside the campus, nobody ever wants to use powered vehicles.

The management encourages the students to use public transport for all travel to outside destinations and for returning to campus as it is safer, economic and faster.

The Carbon footprint for each of the items is worked out separately in Chapter10.

6. Waste Audit

The campus produces and disposes solid waste through its day-to-day operations. There can be difference between individuals, between certain day's activities, and between holidays and work days, as well as between seasons. An average figure per person per day is however worked out by observing their activities for a week by student volunteers at the disposal area through sample survey approach, quantifying the measured wastes and then averaging.

In India, through certain research studies on waste generation in academic campuses from time to time, environmentalists have arrived at some empirical coefficients for assessing GHG emissions from solid wastes. These will be used in evaluating the green auditing data on wastes in Marian Campus.

Summary of Data Sheets on Wastes with Auditors' Remarks is given in Table 11.

Sl. No.	Type of Waste Practice	Qty. kg. per day	Type of Disposal	Remarks
1.	Food Waste by students & Staff	0.05	Other Agencies	Converted to Animal feed
2.	Food Waste: Canteen + Hostel	15.0+ 50.0	Other Agencies	Converted to Animal feed
3.	Paper Waste by Student, Staff	0.05	Burning	Need to Change
4.	Paper Waste Bulk: Canteen +Hostel	0.50 1.00	Burning Burning	Need to Change
5.	Plastic Waste – Individual	0.05	Burning	Stopped
6.	Plastic Waste – Bulk: Canteen + Hostel + Office	1.00 1.00 0.05	Burning Burning Burning	Stopped; Send for processing
7.	Glass & other utensils: Canteen + Hostel + Office	0.05 0.05 0.05	Landfill Landfill Landfill	Okay
8.	Electronic Waste: Canteen +Laboratories	0.05 0.10	Other Agencies	Okay

Note: (i). *Carbon footprint calculations are in Chapter 9; (ii). With the introduction of HPTC Biogas plant, food wastes can be converted to energy and manure; (iii). Being of small quantity, no alternative solution for recycling is possible. The landfill practice followed is secure; (iv). Burning or incinerating paper is not an advisable practice. Many local bodies and almost all HEIs have adopted this practice. Simple paper recycling and converting into ornamental pieces will have to be introduced.*

Table 11: Summary of Waste Audit

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

Adequate numbers of garbage bins are provided in every room and in every floor in every hostel as well as in the academic area and guest house, and the students are using them as and when required. Table 12 below shows the distribution of bins in hostels.

Hostel Name	Number of students	Number of Toilets	Number of Floors	Number of Rooms	No. of garbage bins per building	No. of garbage bins per floor
Paul Iby hostel	296	31	3	57	60	17
Mary Knoll hostel	184	80	5	124	130	32
SH hostel	162	53	4	37	50	12
Marian Girls hostel	390	125	3	80	100	33
Amala Girls hostel	149	25	3	30	40	13
Total	1181	314	--	328	380	--

Table 12: Distribution of Garbage Bins in the Hostels

The practice of burning the paper waste, which is the usual practice needs to be discontinued and better options tried. Using waste paper for creating decorative materials is one option. The other is to make them into paper pulp and obtain handmade cards with colouring and decoration and encourage using them as Greening Cards, Sign Boards, etc.

The quantities are not very huge, and if composting is resorted for wet wastes, there is scope for the use of them in the process. The MGG Club can discuss this issue with the teaching staff and adopt any or many of such options for future practice.

Recycling & Reuse of Water

The gray water from bathrooms and utensils wash etc in the campus is treated in a 50,000 LPD STP (treatment plant) and reused for gardening and for toilet flushing etc. This amounts to nearly 50% of daily water consumption in the campus. The drinking and water used for cooking, bathing etc are passing through a water purification plant of 7 lakh litre capacity, drawn from the rain water harvesting collection. This is a positive for carbon footprint reduction.

Ash from use of Firewood for Cooking

The firewood used per day in the biomass kiln is only about 100 kg per day. The ash available from the kiln is currently used for gardening and landfill, being small in quantity. There is no smoke pollution, as major cooking is using LPG and the kiln does not support smoke generation. By introducing biomass gasification, the situation can be further improved.

7. Health Audit

The very purpose of greening of educational campuses is to ensure that the students study and grow up in a healthy environment, giving out the best of their physical and intellectual contributions to the society.

The method for assessing the physical well being of the educational institution has been decided as follows: 1. Examine the prevalence of sickness leave, if there are any; 2. Examine the first aid and medical facilities available for resident students and staff; 3. Evaluate the atmospheric quality, drainage systems and land pollution – if any within the campus; and 4. Assess the achievements of students in sports and games, especially in inter collegiate and inter-university contests.

1. The team could not find any sickness leave or absences of students related to illness for the auditing year or for the previous few years for which records are available. In addition, students both boys and girls are actively associating themselves in outreach programmes, NSS camps, and cultural programmes hosted by the college within the campus. They have also organized a number of energy conservation training camps for village housewives, community survey in tribal villages etc during the year. There were no incidents of pollen allergy also in the campus successively for years. Even colds and flu's are very rare with the staff and students.
2. Medical facilities: College has a Allopathic Medical Doctor (available anytime on call in addition to regular medical examination services. First Aid cum Medical boxes including common medicines for minor ailments with trained paramedical person to dispense, are available in every hostel and academic area (round the clock service). The Government Hospital, Peermade which is only 4 km from the college is the designated hospital for the students, staff and their families. In addition, in the event of any need for hospitalization is required, the best private medical facilities available at the nearby town Mundakkayam (20 km) are also the assigned hospitals for the campus residents and day scholars. Transportation facilities are available on call at any time of the day and night. The PDS (Peermade Development Society) under which the institution is functioning, has a well-equipped Ayurvedic hospital nearby and pharmaceutical production (Ayurvedic) unit attached to it close by. Counselling facilities are available and in addition interaction by Counselling Mentors are frequently made available.
3. Regarding the land, water and air pollution status, the campus is totally free of any waste heaps or leaching waste deposits anywhere within the campus. During the year due to SPV installation and Auditorium site prospecting, certain materials were temporarily dumped in the campus for a few weeks. On completion of such installations, these were removed without any delay. With undulating open land, and sloping naturally, having well designed drainage systems, there are no cesspools of water or wastes anywhere in the campus. The campus cleaning staff members have a light job, as the students practically do not indulge in littering or spoiling the surroundings.

As is true of the Peermade environment, the ambient air quality in the campus is conducive to healthy living. This aspect is a natural blessing, but it has been enhanced through the Green Protocol followed by the College in all its activities.

4. Achievements in Sports & Games:

The following credentials indicate good health status of Marian Students:-

i. Marian Roll ball Team - Winners in Mahatma Gandhi University Intercollegiate Rollball Competition 2018-19
ii. Marian Roller Hockey Team - Second position in Mahatma Gandhi University Intercollegiate Roller Hockey Tournament 2018-19
iii. Marian Table Tennis Team – First position in South zone and Third position in Mahatma Gandhi University Inter Zone Intercollegiate Table Tennis Tournaments 2018-19
iv. Marian Basketball Team - WINNERS in Idukki District Senior Basketball Championship 2018-19
v. Marian Basketball Team - Runners up in all Kerala Intercollegiate Basketball Tournament for Marian Trophy 2018-19
vi. Marian Badminton team - Runners up in all Kerala Intercollegiate Badminton Tournament for Marian Trophy 2018-19
vii. Marian Badminton Team – First Position in South Zone and Third position in Mahatma Gandhi University Interzone, Intercollegiate Badminton Tournament 2018-19
viii. Hary Johns of II BCA – Second position in Mahatma Gandhi University Intercollegiate Taekwondo Competitions
ix. Akhil P. Murali of III BBA - Represented Kerala State "Under 21 Basketball" team and won Bronze Medal in *Khelo* India National Championship 2018-19
x. Febal Siby of II BCOM - Represented Kerala State Roller Sports Team in All India Inter State Roller Sports Championship 2018 - 19
xi. Luckachen Mathews of II BCOM represented Kerala State shooting team in National Shooting Championship 2018-19
xii. Arun Anilkumar of II MCOM - Represented Mahatma Gandhi University Badminton team in Inter University Badminton Tournament 2018-19
xiii. Thomas Sebastian of III BCOM and Akhil P. Murali of III BBA - Represented Mahatma Gandhi University Basketball Team in Inter University Basketball tournament 2018-19
xiv. Arjun Suresh of II MM; Aju M. R. of I MMH; Pranav Sunny of III BCOM; Febal Siby of II BCOM; and Milan Roy of I BCOM - Representing Mahatma Gandhi University Rollball Team for All India Inter University competition2018-19.

In general, Health Auditing of 2018 shows highly positive results for this Green Campus.

8. Accessibility and Gender Justice

During the Audit Year (2018), student strength of Marian College Kuttikkanam is 1748. Of this, 967 (55%) are girls. Students who stay in hostels are 1181 (480 boys plus 701[59%] girls). Teaching staff strength is 108 (63 male and 45 (42%) female). The non-teaching staffstrength of 38 is divided into 28 male and 10(26%) female. Support staff numbering 12: 8 male and 4 (33%) female. Total Staff strength is 158 with 59 (37%) female. Total campus strength is 1906 {880 M + 1026 F [54%]}.

Accessibility: There is only one physically handicapped student studying this year, against 7 four years ago. All the buildings and their passage ways have been made accessible. Ramps are constructed for entry to all buildings. However, there are no lifts anywhere, except in the International Institute for Management Studies building. It is noticed that the handicapped student does not feel any inconvenience for movement throughout the campus.

Gender Justice: As is seen above, being a mixed college, 55% of the students are women. Among the teaching staff also, 42% are female teachers. Girl students are well secure in the campus and fully empowered. The team had monitored the empowerment and the confident nature of the girl students on more than 12 occasions within and outside the campus on events participated by them. The Marian Green Guardians' Club membership of 30 is equally divided among boys and girls and its coordinator is a middle level female staff member.

In academic records, project activities and in outreach programmes, girl students are showing exemplary leadership with better abilities to interact with rural, tribal and disadvantaged communities and groups. The Participatory Rural Appraisal conducted at Kombukuthy Tribal Village jointly with IEEE (Institute of Electrical and Electronics Engineers (New York), Life Member Affinity Group of Kerala in 2018 and the several humanitarian technical activities conducted there (32 km from the College in Kottayam district (Koruthode Panchayat), the girl students from Marian among students from three engineering colleges around showed exemplary participation and merged with the rural community perfectly well.

During several cultural programmes hosted by the college, like The All Kerala Artists Camp conducted by the Kerala *Lalitha Kala* Academy with 70 artists of both genders including 15 transgenders and 5 professionals, the hospitality and camaraderie expressed by girls and boys of the campus were highly praised by the Academy Chairman and other senior artists. Some of the Green Audit team members were observers to this event at Marian.

Further, freedom of girls after college hours were examined to find out whether they have any constraints for participation in combined study, co-curricular and extra-curricular activities etc. It was found that girl students can spend time at play ground or canteen and shopping centres of their own choice till 5.45 pm every day. Those who want to spend time in Library, time up to 8 pm is granted. Apart from these, it is observed that the girl students are equally smart or even smarter than the boys.

The role played by girls in campus events as well as their role in taking care of plants and trees in the campus are also at a high level of enthusiasm and energy. The girl students in the Media Studies department as well as in the Social Work and Computer Science departments in particular have been very active and they have energetically involved in execution of a number of minor projects in the campus and with communities around.

On the whole, the air in the campus is gender neutral with high level of opportunities thrown to students of both genders – ensuring merit based opportunity for the inspired.

9. Outreach and Societal Commitment

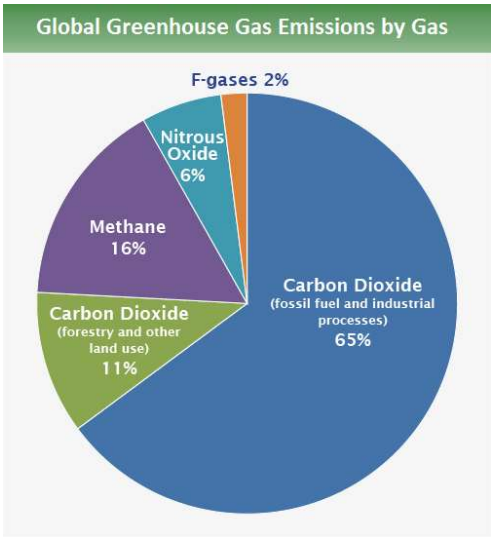
Marian College students are regularly engaged every year in outreach activities including NSS camps, Nature camps, Public awareness camps, Women training camps, Interaction and awareness sessions with school children, training for plantation workers and their families etc., with a view to fulfilling their societal commitment towards creation of a better environment to live for all and for extending the green way of living to the rural population. In addition, the College hosts 2 or 3 public events within the campus, where society leaders, literary and cultural personalities, scientific, technological and managerial experts participate as residing delegates for a number of days extending to even 5 days at a stretch. State Artists' Camp conducted by Kerala Lalitha Kala Academy was one such event. School Children's Eco Camp "Thejas" by Energy Conservation Society was another in which such interactions within Peermade region could be facilitated.

For spreading energy conservation ideas and adopting LED lighting by rural communities, during 2018, Marian organized LED bulb and LED tube assembling workshops for women in different local body regions in the district. With 4 such one day camps during the year at Mundakkayam, Erumeli (Aryanjilimannu), Paloorkavu, and Marian NSS camp, 44+30+48+30 (152 in all) students and 100 village women were trained to assemble LED bulbs from components and also repair faulty lamps. Staff and Students of Marian also joined such camps organized by Archana Women's Centre, Ettumanoor in the Kottayam district. Also, jointly with the IEEE Kerala Section volunteers and engineering student volunteers from three neighbouring technical colleges, 4 interaction cum handholding workshop days were participated by selected students of Marian in the tribal village (432 families) called Kombukuthy (in Koruthode Panchayat) during the year.

Through the environment camps and also through students' interaction in their own villages spread across the State, people are encouraged to indulge in tree plantation so as to reduce the carbon footprint of the community as a whole. These work as excellent remediation for climate change impacts that spread to the whole society. Thus at least 1000 trees have been planted outside the campus as a result of planned outreach activities of the college during the year. The impact is much higher, but there is no easy way to monitor such secondary output of the greening activities.

10. Carbon Footprint

Carbon Footprint is the amount of carbon dioxide released into the atmosphere as a result of the activities of a particular individual, organization, or community. An acceptable definition for carbon footprint is: Carbon Footprint is the total amount of greenhouse gases produced directly and indirectly for supporting human activities, usually expressed in equivalent tons of carbon dioxide (CO_2).The most common greenhouse gases (GHGs) in our environment are carbon dioxide, water vapour, methane, nitrous oxide and ozone.



[Source: IPCC 2014]

Of all the greenhouse gases, carbon dioxide is the most prominent greenhouse gas, comprising 76% globally as seen above. In USA, during 2016, this percentage of CO_2 in GHGs was 81%. The release of CO_2into the earth's environment through human activities is commonly known as carbon emissions and this total impact is called carbon footprint.The name Carbon Footprint as a concept description originated from the discussion on 'Ecological Footprint' advanced by William E. Rees and Mathis Wackernagel in the 1990s, while assessing the ability of earth to meet the excessive demands of its population, where the demand on resources was increasing enormously.

The Carbon Footprint (CF) is in fact, only a part of the ecological footprint. For creating awareness on the damages to environment on account of our own activities, the carbon footprint part was popularized by a campaign of BP (British Petroleum) in 2005. Carbon footprints measure only the emissions of gases that cause climate change and therefore are more accurately assessed than the ecological footprints. While there are more than a dozen popular softwares/tools as CF calculator, freely available on the internet and used by individuals and institutions to estimate and then remedy the damages, recently a comparative study by Christopher Weber of Carnegie Mellon University in USA has pointed out that the calculation of carbon footprints for many products that we use often, is problematic.

For example, let us look at the mobile phones and more so, the smart phones that a large percentage of the world population now use. The data required for it will include CF on its production, shipment, technology used to make it, how many hours of use you have and what all functions of the device are utilized etc. That precludes the possibility of our ability to accurately calculate the carbon footprint.

Calculating the carbon footprint of an institution, industry, product, event, or service is therefore a complex task and its acceptance is to be understood appropriately for the purpose for which the resultant knowledge is to be applied. One tool currently popular is the LCA (Life Cycle Assessment) approach which looks at the product's impact for the whole life period of it. The ISO (The International Organization for Standardization) has for this, a standard called ISO 14040:2006 that has also the framework for conducting an LCA study. Another method is through the Greenhouse Gas (GHG) Protocol and the set of standards it has for tracking GHG emissions.

The Carbon Footprint calculation of Marian College Autonomous, Kuttikkanam, for instance, is only to know 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. Here, the College can "err on the safe side", meaning: can attempt excess remediation, after roughly knowing the damages it is inflicting. 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 the campus flourish as a 'Greener Campus'.

Having noted that tedious procedures involving continuous monitoring throughout the year to obtain a precise measure of potential damages to the environment is not warranted, the audit can employ empirical measures that will quantify the ecological footprint to reasonable accuracy and suggest simple remediation measures that will help neutralise the impacts completely and take the positives even a shade higher than that is required. As the major contributors of damaging impacts are the increased population, their nature of consumption, and transportation requiring fossil fuels, the approach taken for this Green Audit will be to use empirical constants on the quantities arrived at for the major contributors. Also, remediation will be based on expanding the potential positives present in the campus. Creating awareness to the entire campus community on these and getting them to volunteer to contribute will be an effortless change in lifestyle, on which the institution as a whole can feel proud.

Data Obtained from Component Audits

Component Audits are in the foregoing chapters from 1 to 9. It was stated therein that the carbon footprints of each category of activity will be covered in Chapter 10. These component audit findings are capable of giving the following data:

1. The area covering the higher education institution/college
2. The total number of persons (students, teachers, other members of staff, visitors including parents and guests) involved in normal functioning of the institution
3. The number of persons resident in the campus
4. The type and number of vehicles normally used for transportation
5. The forms and quantity of energy used in the campus and their origin
6. The amount of water, food materials, stationeries etc. consumed and energy used for providing them
7. The amount of wastes including food waste
8. Amenities provided in the campus and their contribution to emissions

On the positive side:

1. The biodiversity in the campus and their potential to remediate GHG emissions
2. The carbon positive (renewable) energy generation within the campus
3. The amount of recycling/reuse of resources
4. The type of waste management resorted to
5. Water harvesting, water management and waste reduction approaches

Assumptions:

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 remediation 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. The carbon emitted by a car while consuming 1 litre of petrol as 2.3 kg $CO_2$and if 1 litre of diesel as 2.68 kg CO_2
3. Average kilometre covered by a car per litre of petrol as 20 km
4. The km run by a bus in high ranges taken as 4 km/L of diesel (In plains 5 km)
5. For per capita carbon footprint calculation, a bus is assumed to have 50 passengers
6. An auto rickshaw running in the region is assumed to get 16 km/litre of petrol
7. Two wheelers are expected to get 50 km/litre of Petrol
8. Carbon absorption capacity of one full-grown tree as 6.8 kg CO_2
9. Carbon absorption capacity of semi-grown trees as 50% of that of full grown
10. Carbon absorption of bush plants varies widely according to the species
11. Certain bushes absorb as high as 49,000 g CO_2 per plant, whereas some others absorb as low as 150 g CO_2 per plant. As a general guide, the per-plant carbon absorption is assumed as 200 g CO_2
12. The carbon absorption capacity of a 10-sq.ft. area of lawn is 1 g CO_2per day
13. A person uses about 550 litre of pure oxygen each day (according to Arbor Day Foundation)
14. Paper is assumed to be of density 80 gsm (average)
15. Firewood is assumed to have not more than 10-20% moisture before burning
16. Events & Festivals contributed CF in the campus based on no. of events, pax participating and extent of festivities with high emission levels

Carbon Footprint Assessment Required:

The following activity related carbon footprints are to be assessed based on data available from component audits in the previous chapters.

1. Carbon Footprint due to energy use
    a) Electricity use including for water pumping, water purification and waste water treatment
    b) Use of Fossil fuels like Diesel, Petrol, LPG etc.
    c) Use of Firewood
2. Carbon Footprint due to production of Wastes
    a) Food Waste
    b) Paper use & waste
    c) Waste water
    d) Other wastes (e-wastes, hazardous wastes etc., if any)
3. Carbon Footprint due to Transportation needs
    a) Day scholars commuting between home and college
    b) Staff & Students – weekly travel to and fro home
    c) Use of Cars & Taxis by Staff, Parents, Management and others
    d) Auto Rickshaws (3-wheelers) hired
    e) 2 wheelers – students and Staff
4. Carbon Foot print due to Events and Festivals within the campus

Remediation Available or Created

1. Due to increased use of renewable energy (RE)
    a) Solar PV electricity
    b) Solar Hot Water
    c) Wind energy
    d) Biogas
    e) Micro Hydro Power & Other
2. Due to energy efficiency improvement
    a) Replacement of old tube lights
    b) Replacement of incandescent bulbs & CFLs
    c) Replacement of Fans/Motors etc
    d) Up grading of UPS network
    e) Phantom load reduction
    f) Other means
3. Due to waste reduction, recycling and waste to energy projects
    a) Waste Reduction
    b) Recycling
    c) Waste to Energy
4. Due to innovations in transportation
    a) Sharing of Vehicles
    b) Adopting Means of low CF travel options
    c) Others like introduction of electric vehicles/Solar auto rickshaws, boats etc.

5. Due to biologic means
   a) Conservation of existing greenery
   b) Tree plantation & Biodiversity conservation (new)
   c) Gardening, including lawns and hedges
6. Due to 'Outreach' for Promotion of Green Living

The CF calculated by the above consideration has to be brought into a Balance Sheet, where the Remediation available is shown as compensation provided. The difference between these will indicate the amount of remediation to be planned and implemented in the coming years.

Calculation of Carbon Footprint source-wise

Sl. No:	Source	Rate	Quantity x Days/year	Total Quantity	Annual Eqvt. CO_2
1	1.a. Electricity use (For India)	0.82 kg/kWh	--	325 MWh	266.6 T CO_2
2	1.b. Fossil fuel use	2.68 kg CO_2eq/kg	LPG + Diesel	2x19x365 kg + 1000 L	39.8 T CO_2
3	1.c. Firewood	1.65-1.8 kg CO_2eq/kg	--	36 T	59.4 T CO_2
4	2.a. Food waste	1.9 kg CO_2eq/kg	65.05x300	19.515 T	37.1 T CO_2
5	2.b. Paper waste	1.725 kg CO_2eq/kg	1.55x365+ 595000 sheet	2880 kg	4.7 T CO_2
6	2.c. Water waste	0.298 kg CO_2eq/kL	1500x365	547.5 kL	0.2 T CO_2
7	2.d. Plastic/Other	6.0 kg CO_2eq/kg	2.10x365	766.5 kg	4.6 T CO_2
8	3.a. Bus - students	2.68 kg CO_2eq/L	583x250x60 /4x50	43,725 L	117.2 T CO_2
9	3.b. Staff, St/week	2.68 kg CO_2eq/L	150x40x200 /4x50	6,000 L	16.1 T CO_2
10	3.c. Cars, Taxis all	2.30 kg CO_2eq/L	80x250x15	1,500 kg	3.5 T CO_2
11	3.d. Auto rickshaw	2.68 kg CO_2eq/L	75x365	1,711 kg	4.6 T CO_2
12	3.e. Two wheelers	2.30 kg CO_2eq/L	1600x300	9,600 kg	22.1 T CO_2
13	4.Events,Festivals	Approx.	1000x3x1.5	4,500 kg	12.1 T CO_2
14	5. Construction	Lump sum	--	5 MWheq	4.1 T CO_2
	Total				**592.1 T CO_2**

Having assessed the maximum carbon footprint in terms of Tons of CO_2 equivalent, the next step is to assess the remediation available and see how far it will compensate for the damages to the environment.

Remediation for Carbon Footprint

Sl. No:	Source	Rate	Quantity x Days/year	Total Quantity	Annual Eqvt. CO_2
1	1.a. Solar PV electricity	0.82	50 kW SPV	73 MWh	59.9 T CO_2
	1.b. Solar Hot Water	kg/kWh	1000 L	failed	--
	1.c. Wind energy		None	Nil	--
	1.d. Biogas		None	Nil	--
	1.e. Micro Hydro Power, other		None	Nil	--
2	2.a. Replacing old tube lights		300 x 4'	3.28 MWh	5.0 T CO_2
	2.b. Replacing bulbs & CFLs		400	1.92 MWh	3.0 T CO_2
	2.c. Replacing Fans, Motors		None	--	--
	2.d. UPS Upgradation		11751 kWh	11.8 MWh	9.7 T CO_2
	2.e. Reduce Phantom load		6902 kWh	6.9 MWh	5.6 T CO_2
3	3.a. Waste Reduction	0.26	5000 kLx12	60000 kL	15.6 T CO_2
	3.b. Recycling	kg/kL	50 kLx365	18250 kL	4.8 T CO_2
	3.c. Waste to Energy		None	--	--
4	4.a. Sharing of vehicles		None	--	--
	4.b. Low footprint options		Yes, small	--	--
	4.c. Electric/Solar vehicles		None	--	--
5	5.a. Greenery forest retained	3408 kg	Per acre/yr.	12 acre	40.8 T CO_2
	5.b. Tree planting, Biodiversity	22kg/yr.	900 added	50%	9.9 T CO_2
	5.c. Gardens, Lawns etc.	2200 kg	Per acre/yr.	2.4 acre	5.3 T CO_2
6	6. Outreach activities	22kg/yr.	1000 trees	50%	5.5 T CO_2
	Total				**165.1 T CO_2**

Carbon Footprint Analysis and Evaluation

The per capita carbon footprint for the Marian College Kuttikkanam (Autonomous), is 311 kg (or 0.311 T) of CO_2 equivalent [592.1 T /1906 persons].

According to Economic Survey, Govt. of India 2009 - 10, the per capita emission for an Indian was 1.2 ton CO_2 eq. per annum. In the same report, it was projected that this will go up to 2.0 – 2.5 T of CO_2 by 2020 and to 3.0 – 3.5 T of CO_2 by 2030. For the year 2018, the Marian College Kuttikkanam, the Carbon Footprint per capita at 0.311 T CO_2 is even less than one-sixth of the national average. The campus is thus **a Green Campus**.

CF Balance

The remediation gap between the assessed footprint and available remediation is 592.1 – 165.1 = 427 T CO_2eq for 2018. On closer examination, major contributors to it are:-
1. The use of Purchased Electricity (266.6); 2. Daily bus journey by 583 day scholars (117.2); and 3. The use of firewood, LPG and diesel (99.2) - together, a total of 483 T CO_2eq.

SWOT Analysis and Future Directions

SWOT, the four-letter acronym for the four parameters that this analysis examines, is very common in management studies to identify strengths, weaknesses, opportunities, and threats related to project planning or running an initiative like a business, industry or campaign. Strengths and Weakness are actually internal traits of the institution or the person, and Opportunities and Threats arise from the external environment. And, all these influence the intended activity.

- ***S****trengths* are aspects of the initiative that will give it some positive advantages
- ***W****eaknesses* are factors that will adversely affect progress of the project
- ***O****pportunities* are the exploitable windows helpful for the success of the initiative
- ***T****hreats* are elements in the environment that could cause trouble for the project

SWOT approach was introduced originally at the Stanford Research Institute, USA, during the 1960s. For community work and educational activities, it can be useful as a tool to identify positive and negative factors within the organization that will promote or inhibit successful implementation of social services and social change activities. The SWOT analysis for any activity, however, is only an initial part of the planning process and is not a tool that will give a final solution. Here, the objective is to find out the shortest route for bringing down the carbon footprint of the education institution, and for making it possible to be a "net positive" green campus.

After the SWOT analysis is completed, the stakeholders of Marian College should turn the SWOT list into a series of suggestions to consider objectively and critically before finalizing a successful strategic plan.

Strengths and Weaknesses (These are internal - within the organization– factors)

- Human resources : Staff, students, volunteers, PTA, nearby NGOs, public
- Physical resources : One's location, land, building, equipment
- Financial : Grants, funding agencies, other sources of income
- Activities and processes: Green Protocol, programs run, services being rendered
- Past experiences : Learning tools, reputation of the College in the community

Opportunities and Threats (These are external – group/community/societal – factors)

- Future trends : What is in the horizon and awaited shortly
- The economy : Own, local, national, or other
- Funding sources : Own, donors, governments, subsidies and incentives
- Demographics : Change of players like students & staff joining and leaving
- Physical environment : Location sensitivities, political support, public opinion
- Legislation : Change in government policies, regulatory controls, rules

While conducting this SWOT analysis, the team has tried to understand the group of people involved in the regular working of this accredited educational institution through listening campaigns, interviews with staff and students, as well as through brainstorming exercises with the Marian Nature's Green Guardians Club members who are student volunteers.

Authentic data collection was also resorted to using a specially prepared questionnaire (Appended). Results of such a 'needs and assets' assessment is used to arrange the SWOT matrix presented.

The following are the objectives that were set in mind as obtainable from the SWOT analysis for helping the college management to prepare a strategic plan for making the campus greener than before and simultaneously for creating awareness among the students on the need for a national effort to bring down calamitous consumption:

- Decide on the directions that will be most effective to proceed with
- Reveal possibilities and limitations for the intended change
- Identify barriers that will limit the objectives
- Explore new solutions to problems
- Re-look at plans to navigate the students and staff to get the best results

The management should take the SWOT analysis observations as a starting point, and only for discussion with staff members, students and parents, as it is only a snapshot of all the four parameters at this particular moment in time. As both the internal and external environment are liable to change from time to time, it is also necessary to review the scenario just before implementation begins. Yet, it is a pointer to proper decision making, as it gives a preliminary idea on whether or not the objectives are achievable.

Future Directions and Search for New Opportunities

The search for opportunities to make the campus greener than before lands at the three large sources of carbon footprint: Electricity use, Use of fossil fuels and burning of firewood for cooking and heating, and Bus journey of students who are day scholars. These cannot be totally avoided or nullified, but the impacts can be reduced.

The CF factor of Electricity in India in 2018 is at 0.82 kg/kWh because 65% of electricity used in India comes from fossil fuels such as coal, oil and gas. In Kerala, 90% of electricity produced internally is hydropower, but 70% of all electricity used is imported from national sources which are heavily carbon loaded. So, the option is to increase the use of renewable energy and if possible produce more of solar electricity within the campus – on its rooftops. Already 50 kW installation is set up within the college and there is prospect for adding more. The energy audit part has found out that by increasing the SPV generation to 150 kW installed, 60% of electricity needed (in million units) can be produced internally – carbon free. With energy efficiency improvement continued, almost 30% of electricity required now can be reduced. There is scope for pico-hydro power and wind electricity production in the campus. If pursued, these will almost neutralize the CF burden on this account in the coming years.

It is impossible to completely wipe out the need for bus travel by students, as their not staying in hostels is related to socio-economic conditions of their supporting families. It is the reputation of the college that is bringing in more and more students from places distant from the campus to study in Marian Kuttikkanam. The cool and cozy, dust free environs of the college is also found to be yet another attraction. However, with increased outreach, the campus is prompting families through students from various parts of the state, country and from abroad, to go for greener lifestyles.

Reduction in the use of firewood and LPG can be minimized by introduction of wood gasifier system and increased use of biogas produced in the campus from its own wastes as a double edged tool – environmental protection and renewable energy use. So, of the three streams, two are easily erasable economically and within a short period.

On the remediation side, energy efficiency improvement measures such as accelerated introduction of LED bulbs and tubes, replacement of older fans with BLDC (brush less direct current) fans, older low star rated air conditioners with inverter ACs, replacement of refrigerators with inverter fridges, changing of older pumps etc. can be continued in a phased manner.

Planting of trees can continue unabatedly within the campus and extended to offshore sites in villages and towns connected with the students and staff of the college. The location and climatic conditions in the campus is most ideal for tree growth. However, biodiversity development as indicated in the relevant chapter will add extra benefit of attracting symbiotic living forms with the planted trees, ensuring sustainability of the ecosystem in the campus.

It is also appropriate to have an up-to-date Green Protocol adopted for the campus and vigorously pursued, including for events.

SWOT Matrix for Marian College 'Super Green' Initiative

S	W
Strengths ➢ The college community believes in having a Green Protocol followed ➢ The campus has maintained green status from the very beginning ➢ Energy Park project to support renewable energy development isrunning since 2017 ➢ Students are helping in having a litter free campus ➢ Rainwater harvesting, recycling of gray water, proper waste disposal etc. in action can be expanded ➢ Marian Nature's Green Guardians Club is established and active ➢ Proper community links for outreach activities are in position	**Weaknesses** The courses offered by the college are very diverse and sensitization and awareness work has to be carried out through different departments Certain actions for remediation are impractical due to the terrain as connectivity is ensured only by winding hill roads (transportation) Due to high altitude, certain technologies like solar water heating are less efficient in the campus Students remain in the college for only 3 years and therefore, initiatives require frequent training
O	**T**
Opportunities ❖ There is ample opportunity for expanding renewable energy projects, for which costs and benefits are worked out to fully wipe out the carbon footprint gap ❖ There is scope for maximizing the energy efficiency drive in continuation to the one followed during 2017 and 2018 ❖ New constructions in the campus can be following the Green Building way to achieve resources conservation ❖ Tree plantation with Biodiversity expansion in mind can start right away with the plans already drawn	**Threats** o The students remain in the campus only for 1, 2 or 3 years and so, retraining and campaigns are to be repeated every year, adding to cost o Increase in the number of day scholars from distant regions tend to increase the carbon footprint o With technological changes, there is increase in e-wastes, for which safe disposal set up is yet to come o Climate change induced reduction in water availability and increased dependence on food supply from distance places could defeat plans for reduction in carbon footprint o Raised per capita consumption

Green Audit Certificate

This Green Audit has been conducted for Marian College Kuttikkanam (Autonomous) 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 aspects of working 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.

In order to meet the objectives of the audit, the methodology did combine physical inspection of the campus on several work days and holidays, with analytical reviews of relevant documents and activities, as well as interviews with the Manager, Principal, and selected Staff and students of the College.

This audit is conducted to ensure that a Green Policy is followed and implemented in the campus across all academic and non-academic departments and the body of students undergoing studies in Marian College Kuttikkanam, (Autonomous), so as to make all stakeholders aware of the need for individual efforts in perpetuating green living habits among the people of our country.

Marian Green Audit 2018 has found that the institution's per capita carbon footprint is only 0.311 ton of CO_2equivalent, a level far below the national average, with status as Green and a commitment to continue its green practices with approved remediation practices also in position.

Prof. V K Damodaran
For NGGFn - Team Sustain Audit Team
31 December 2018

I agree with the data presented in this report, as true, and further express my willingness to implement the recommendations of this audit report after internal review, even if any or many of them are in excess of the relevant mandates.

Rev. Fr. Prof. (Dr.) Roy P. Abraham [seal]
Principal
Date:

Green Audit Compliance Statement

Overall Objective	Main Objectives	Compliance Status
Ensure that a Green Policy is formulated, enforced and reviewed	1. Ensure that there is a competent Green Officer from an external agency, who will provide guidance on Environmental Impact studies	Included
	2. Ensure that the Green Policy/ Protocol is reviewed annually, progress monitored and achievable and measurable targets set for the future course	Ensured
	3. Ensure that the Green Policy is enforced, regardless of whether it exceed mandates of the law	Enforced
	4. Ensure that every member of staff and student community commits to the greening of the institution	Commitment ensured
	5. Ensure that Green Audit is conducted annually, action taken on the basis of its reports and recommendations given under them	Green Audits conducted and actions taken on its recommendations

Prof. V. K. Damodaran
For NGGFn Green Audit Team
26. 12. 2018

Sample Data Sheets

Format Prepared by

ENERGY MANAGEMENT CENTRE – KERALA (EMC),
CENTRE FOR ENVIRONMENT AND DEVELOPMENT (CED)&
NATURE'S GREEN GUARDIANS FOUNDATION (NGGFn)

TOWARDS GREEN CAMPUSES

[CARBON NEUTRAL EDUCATIONAL INSTITUTIONS]

GREEN AUDIT: FORMAT FOR DATA COLLECTION

Data on various factors shall be collected in a participatory mode by the students and staff of each educational institution and shall be entered into a 'mobile app' developed for the purpose. The app will analyse and offer suggestions for reducing the carbon footprint of EIs in various sectors. However, for education on Green Auditing, the data will be manually collected, processed and analysed to have carbon accounting as well as for suggesting remedial actions.

EXPECTED OUTPUT AND OUTCOME

- Calculating carbon foot print and carbon sequestration comparison with less effort
- Awareness to students about carbon footprint and measures to control it
- Create a carbon neutral ecosystem among the students
- The EI authorities may act on the suggestion to make the campus a carbon neutral (green) campus

I. GENERAL PARTICULARS OF EDUCATIONAL INSTITUTION

It contains a registration form for the Educational Institution (EI) to enroll. After the enrollment the forms for survey will be mailed to the registered email ID from server. Educational Institutions can take printout of these forms and collect data with the help of students and teachers.

Enrollment form

Name of Educational Institution	:	
Address	:	
Name of Local Body (Specify whether Gram Panchayat/ Municipality/Corporation)	:	
Educational district	:	
Revenue District	:	
Name and Designation of the Head of the Institution	:	
Phone number	:	
E-mail ID	:	
Name and Designation of the Coordinating Teacher	:	
Phone number	:	
E-mail ID	:	
No of students selected for conducting the Survey and Data Collection(Green Guardians Club)	:	

II: GETTING DATA READY TO ENTER IN THE MOBILE APPLICATION

It is better to keep the data ready to enter in the application before you start using the application. You may fill all the columns manually in the following format by collecting data specifically on various aspects, for which additional forms are also developed.

III. BASIC DATA

Current Academic Year (18-19/19-20/20-21)	:	
Total number of students in the EI during the Current Academic Year	:	
Total number of Teachers in the EI during the Current Academic Year	:	
Total number of other staff in the EI during the Current Academic Year	:	
Total number of students in the EI during the Previous Academic Year	:	
Total number of Teachers in the EI during the Previous Academic Year	:	
Total number of other staff in the EI during the Previous Academic Year	:	
Number of Working Days during the previous academic year	:	

Details of Land and Buildings

Building/ Block Name	Utility	PlinthArea (Sq. m.)	No. of Floors	Roof: Concrete Flat/ Sloppy, Tiled, Sheet etc.

Total Area of the Campus (ha)	:	
Area of Playground (ha)	:	
Area under open air Auditorium (ha)	:	
Area on Agriculture/Gardening (ha)	:	
Barren Area (ha)	:	
Area: Other purposes (specify)(ha)	:	
Area under Tree cover (ha)	:	Shall be arrived at by reducing the total areas for different uses as mentioned above from total area of the campus

I. ENERGY

DATA ON ELECTRICITY CONSUMPTION

Energy is a central element to assess the sustainability of physical infrastructures especially considering that buildings on campus are the largest consumers of energy. The major energy consumption area is the use of electricity for lighting and other purposes like, fan, AC, pumping water, using equipment in labs, canteen, office etc. According to CEA (2014), the carbon intensity for electricity production in India is calculated as 0.82 kg/1 kWh. This factor is used for calculating the emission from electricity consumption. Electrical equipment used in various places shall be counted and the electricity use (in kWh) will be calculated by multiplying the watts of the appliance and number of hours using it. The value is then over checked with the electricity bill it shows great variations and finally the calculation was made based on the electricity bill which included the energy used for water pumping and various equipments used in the lab. The results obtained will be later used framing recommendations.

Electricity Source (%)

KSEB	SOLAR	WIND	BIO-GAS	OTHERS (Specify)

Details Electricity consumption from KSEBL during the last academic year Or the last 12 months - (In certain areas only 6 bills)

(If more than one connection, collect those also in the same format)

Consumer No.	Name of building and main use	Bill period (from date to date)	Units Consumed	Amount Paid Rs.

Building and Floor wise data on Electricity Consumption

Values of all the electrical appliances including fan, air conditioner, motor, light, computer etc. are collected in this module and the carbon footprint can be calculated.
Use Form No. 1 to collect Data from Individual rooms (pump house data to be taken separately)

Building Name: Floor (-1, 0, 1, 2, 3, 4):

Room category*	Total number of rooms in this category	Enter Appliances details			
		Name of Equipment with type(Bulb, Tube, Fan, Heater, TV, Computer, Printer etc.)	Power (Watt)	Nos.	Average use (hours/ day)

*Classrooms, staff room, office room, Lab, Toilet, Veranda, Library, Canteen, Store, Hall/Auditorium

Pumping

Details of pumps operated

Water Source*	Power (HP)	Average Hours Working Per Day	Discharge/Hour (Litre)

*Open Well, River/Pond, Ground water, KWA water, Recycled water etc.)

2. TRANSPORTATION

A big carbon challenge for many educational institutions is transportation—viz., how to get students and employees to and from campus efficiently and inexpensively when mass transit options don't offer convenient connections or when service is infrequent. The data on number of people using vehicles, type of vehicle, average km travelled etc. are to be collected through sample field survey/vehicle operation log books. The emission calculation is made based on the direct emission data fromtest running available - 2.3 kg CO_2/litre (petrol); 2.68 kg CO_2/litre (diesel) [DEFRA,2016].

Educational Institution Bus Operated during the Year (Academic/Calendar)

Bus No.	Average No. of Students Using	Total distance travelled during the Year (km)	Diesel Consumed (Litre)

Students/Staff coming in Own/Hired Vehicle
(Use Form No. 3 &4 for Survey)

1. **Motor bike/scooter (single, shared)**
   a. No. of Motor bike/scooter :

   b. No. of Students :

   c. Total km travelled/day (To and fro):

2. **Auto Rickshaw**
   a. No. of Auto Rikshaws used :

   b. No. of Students :

   c. Total km travelled/day (To and fro):

3. **Own Car (single, shared)**
   a. No. of Own cars :

   b. No. of Students :

   c. Total km travelled/day (To and fro):

4. **Shared Taxi Car**
   a. No. of Taxi cars :

   b. No. of Students :

   c. Total km travelled/day (To and fro):

5. **Private Van/Mini Bus/Bus**
   a. No. of Van/Mini bus used :

   b. No. of Students :

   c. Total km travelled/day (To and fro):

6. **Public Transportation (Bus & Train)**
   a. No. of students :

   b. Total km travelled/day (To and fro):

7. **Students Cycling to School/College**
   a. No. of students :

   b. Average km travelled by person/day (To and fro) :
   (Conduct a random survey in about 10% of students)

8. **Students Walking to School/College**
   a. No. of Students :

   b. Average km travelled by person/day (To and fro) :
   (Conduct a random survey in about 10% of students)

Result:

Per head carbon emission/year under different modes of transport

OTHER FUEL USE

LPG

No. and type of LPG Cylinders used during the year in different places							
Canteen		Hostel		(specify) Other places		(specify) Other places	
Commercial	Domestic	Commercial	Commercial	Domestic	Domestic	Domestic	Domestic

Wood

Wood used/day in different places					
(specify) Place/Purpose	Kg	(specify) Place/Purpose	kg	(specify) Place/Purpose	Kg

Kerosene

Kerosene used/day in different places					
(specify) Place/Purpose	Litre	(specify) Place/Purpose	Litre	(specify) Place/Purpose	Litre

Biogas

Biogas used/day in different places					
(specify) Place/Purpose	Hours	(specify) Place/Purpose	Hours	(specify) Place/Purpose	Hours

***Note**: For Wood, Kerosene, Biogas etc. check whether they are used on all working days, and if not, arrive the per day use figure by taking the ratio of total working days during the year and correct the values accordingly.*

3. WATER AND WASTE WATER

Water is used personally by every staff and student, and is also for various other public purposes. Water use puts direct pressure on sustainability of natural resources. In addition, pumping, purification and treatment of water adds to emissions. The water used for different activities can be arrived at through sample survey or based on actual measurement records. Carbon footprint of water consumption in the campus can be calculated and added to the emission burden from waste water, the water disposal mechanisms etc. after analysis.

Data for Water Consumption

Gardening

Water Source*	Hours of use/Day	Flow/Hour (Litre)

***** Open Well, River/Pond, ground water, KWA direct, KWA pumped, recycled direct, recycled pumped

Flushing

No.	Water source (As given for Gardening)	No. Person using the toilet[1]	Water Used/use (Litre)[2]
1			
2			
3			
4			
5			
6			
7			

[1] *Total number should tally with the total staff/students in the institution*

[2] *Ascertain based on the capacity of flush tank, if any, or by conducting a random survey among both male and female students*

Hand/Face/Utensil Wash by staff and students

Place No.	Water source	Total persons using the space	Average time taken/ person (minute) [2]	Water flow/ min. (Litre) [3]	Waste Water Disposal [4]			
					Drainage (%)	Open space (%),	Treated &reused (%)	Soak pits (%)
1								
2								
3								
4								
5								
6								

[1] *Total should tally with total no. of students*
[2] *Use Annexure 4 for detailed field data collection*
[3] *Use a measuring jar*
[4] *Conduct survey at each place*

Washing utensils in other places
(Noon meal preparation place, Canteen, Hostel, Lab etc.)

Place of use	Water source	Use/day (minutes)	Water flow/ minute (Litre) [3]	Waste Water Disposal			
				Drainage (%)	Open space (%),	Treated and reused (%)	Soak pits (%)

Floor Wash

Place: Kitchen, Toilet, lab etc.)	Water Source	Use/Day (Litre)	Waste Water Disposal			
			Drainage (%)	Open space (%),	Treated and reused (%)	Soak pits (%)

Water Loss

The major sources of water loss: area, leakage of pipes, taps, flushes etc.

Water loss through pipe break

Place of break	Water source	Water loss /minute (Litre)

Water lost through Tap/Flush leakage

Place of leakage	Water source	Water loss /minute (Litre)

4. SOLID WASTE MANAGEMENT

The campus produces and d solid waste through its day to day operations. The average quantity of solid waste generated by a student shall be by arrived quantifying it in the disposal area or through sample survey. There are some studies in India with respect to GHG emission from solid wastes in landfill. The emission details will be calculated using the coefficient arrived through these studies

Solid Waste Data Collection

Individual Food waste by Students and Staff

Average generation/ person/day(kg)[1]	Waste disposal[2]					
	Compost (%)	Biogas (%)	Through local body/ other agencies (%)	Burying **(%)**	Throwing to public place (%)	Burning (%)

[1] *Use Annexure form- 4 for primary data collection*

[2] *Conduct survey at disposal places*

Food waste - Bulk generation area

(Canteen, Hostel, Noon meal preparation area etc.)

Place	Total Waste generated/ Day (kg)[1]	Waste disposal[2]					
		Compost (%)	Biogas (%),	Through local body/other agencies (%)	Burying **(%)**	Throwing to public place (%)	Burning (%)

[1] *Arrive through direct observation*

[2] *Conduct survey at disposal places*

Paper Waste by individual staff and students (kg)

Average generation/ person/day (kg)[1]	Waste disposal[2]					
	Compost (%)	Through local body/other agencies (%)	Burying(%)	Throwing to public place (%)	Burning (%)	Reusing (%)

[1] *Use Annexure form - 4 for primary data collection*

[2] *Conduct survey at disposal places*

Paper waste - Bulk generation area

Specify area like canteen, hostel etc. (kg)

Place	Total Waste generated /Day (kg)[1]	Waste disposal[2]					
		Compost (%)	Through local body/ other agencies(%)	Burying **(%)**	Throwing to public place (%)	Burning (%)	Reusing (%)

[1] *Arrive through direct observation*

[2] *Conduct survey at disposal places*

Plastic Waste by Individual staff and students

Actuals (kg)

Average generation/ person/day(kg)[1]	Major items	Waste disposal[2]				
		Through local body/other agencies (%)	Throwing to public place (%)	Burying **(%)**	Burning (%)	Reusing (%)

Use Annexure form- 4 for primary data collection

[1] *Conduct survey at disposal places*

Plastic Waste -Bulk generation area

Specify area like canteen, hostel, office etc. (kg)

Place	Total Waste generated /Day (kg)	Major items	Waste disposal				
			Through local body/other agencies (%)	Throwing to public place (%)	Burying **(%)**	Burning (%)	Reusing (%)

Glass and other Utensils - Bulk generation area
Specify area like canteen, hostel, office, lab etc.

Place	Total Waste generated /Day (kg)	Waste Disposal			
		Through local body/other agencies (%)	Throwing to public place (%)	Landfill (%)	Recycle/ Reuse (%)

Electronic Waste - Bulk generation area
Specify area like canteen, hostel, office, laboratory etc (kg)

Place	Total Waste generated /Day (kg)	Major items	Waste Disposal				
			Through local body/other agencies (%)	Throwing to public place (%)	Landfill (%)	Burning (%)	Recycle/ Re use (%)

5. ADMINISTRATION

STATIONERY USE DURING THE YEAR UNDER AUDIT

1. White Paper - Sheets (A4 Size) (Nos.)	:	
2. Pen (Nos.)	:	
3. File Pads (Nos.)	:	
4. File Cover (Nos.)	:	
5. Printer Cartridges (Nos.)	:	
6. Paper Cups (Nos.)	:	
7. Paper Plates(Nos.)	:	
8. Other single use paper items(kg)	:	
9. Plastic Cups (Nos.)	:	
10. Plastic plates (Nos.)	:	
11. Other single use plastic items(kg)	:	

6. LAND USE

The carbon sequestration potential is to be arrived at by calculating the annual carbon storage rate of the trees in the green areas. The above-ground biomass (AGB) of each tree species will be worked out using the standard Allometric equation (Brown, 1997), from which the carbon sequestration potential will be arrived at through standard equations. The annual carbon sequestration potential of other green areas are also to be arrived at through standard equations.

TREE DATA

Eudicots (Dicotyledons)

Use Form No. 5 for Field Data collection and enter number of trees in each girth class

Plants above 15 cm girth alone is needed

Girth at Breast Height (cm)	No. of Trees	Girth at Breast Height (cm)	No. of Trees	Girth at Breast Height (cm)	No. of Trees

Marian College Kuttikkanam (Autonomous)

Green Audit Team

TEACHERS

1. Rev. Fr. James Kozhimala, Manager & Spiritual Director, Marian College
2. Rev. Fr. Dr. Roy Abraham P., Principal, Marian College, Kuttikkanam
3. Dr. Binu Thomas, IQAC Coordinator, Marian College Autonomous, Kuttikkanam
4. Dr. (Mrs.) Suzanna Oommen, Coordinator, Marian Green Guardians Club

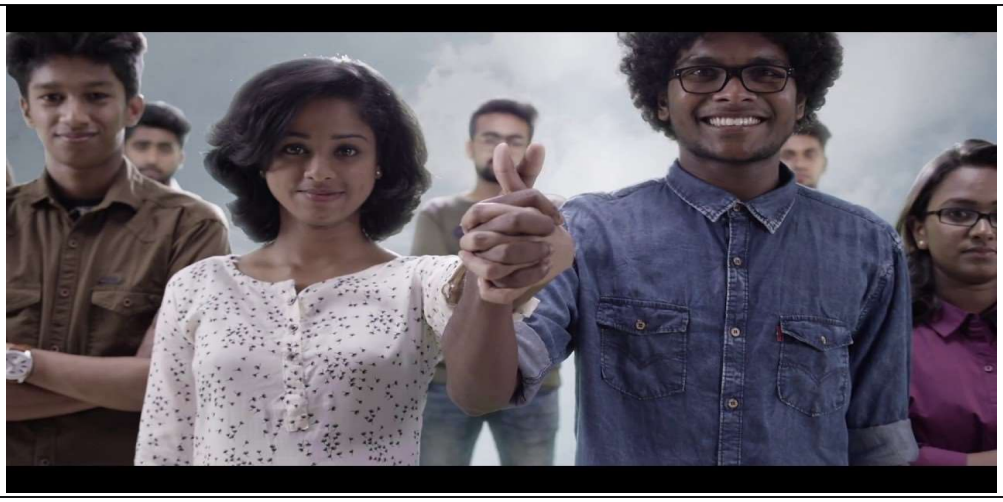
STUDENTS

1. Christeena Varghese, Economics
2. Joseph Madathil, Economics
3. Vinod Rajan, Maths
4. Melvin Antony, Commerce
5. Milana Mathew, Economics
6. Christy Mathew, Commerce
7. Tiya John, Economics
8. Anupa Mathew, Economics
9. Nikitha Jojo, Social Work
10. Geetha N, Social Work
11. Rose Mary Andrew, Commerce
12. Allen Oommen Thomas, Social Work
13. Arun S Mannakam, Social Work
14. Emil Joseph, Social Work
15. Akhil Reji, Economics
16. Lena Lijo, Commerce
17. Jesley Jolly, BCA
18. Jerin T Thomas, BCA
19. Riya John, BBA
20. Ashmi Maria Jaice, Social Work
21. Shruthi Rajesh, Maths
22. Ashwin A. Binu, Social Work
23. Jacques Jude Gerald, Economics
24. Ebin P Eldhose, Economics
25. Harikrishnan G J, BACE
26. Amrutha Mary Jose, BACE
27. Prince Philip, Commerce
28. Tiya Mary Andrews, Commerce
29. Nevin Joshy, BBA
30. Julie Mol Joji, Social Work

EXTERNAL EXPERTS

1. Prof. V K Damodaran, Chairman, Nature's Green Guardian Foundation & UN Consultant
2. Er. Madhu Krishnan, CEO, Herbal Heritage Homes, Peermade (NGGFn)
3. Mr. Hari Prabhakar, EMS Lead Auditor & Director, Nature's Green Guardians Foundation
4. Mrs. Ranjini Damodaran, Monitor (Gender Issues), NGGFn

Photo Gallery

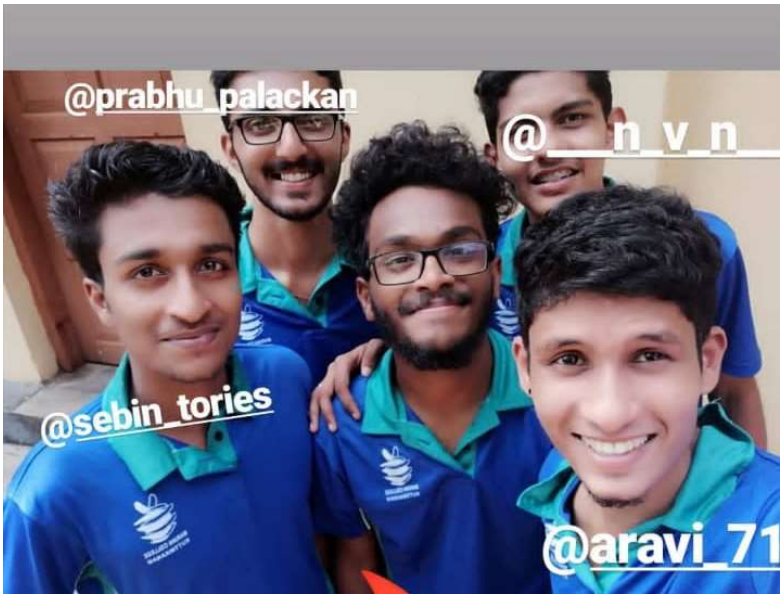


College Main Entrance, Campus Green, Motto – We are committed

Management Studies side – Windy side

Campus activities

Campus activities



Water Source; Social Service & Marian Table Tennis Winners

Marian Roll Ball team All India Inter University Champions

Marian Basket Ball team

Bronze Medal winners in Khelo India National

Febal Siby in All India Inter State Roller Sports Championship 2018- 19

Luckachen Mathews in Kerala State shooting team to
National Shooting Championship 2018-19

Arun Anilkumar in MG University Badminton team for
Inter University Badminton 2018-19

Badminton Team – First Position in South Zone and Third position in Mahatma Gandhi University Inter zone Intercollegiate Badminton Tournament 2018-19

Hary Johns at Second position in Mahatma Gandhi University Intercollegiate Taekwondo Competitions