ST. XAVIER'S COLLEGE
(AUTONOMOUS)
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INDIA.
✆ 2262 0661/65

ENVIRONMENTAL AUDIT: 2019-2020
(Internal)

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XAVIER'S
ENVIRONMENTAL
COMMITTEE

REPORT OF THE ENVIRONMENT AUDIT OF ST. XAVIER'S COLLEGE (AUTONOMOUS), MUMBAI

February 2020

Xavier's Environmental Committee

St. Xavier's College (Autonomous) Mumbai

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ACKNOWLEDGEMENTS

The Xavier's Environmental Committee Team thanks the management of St. Xavier's College (Autonomous), Mumbai for assigning this important work of the Environmental Audit. We appreciate the co-operation to our team for the duration of the audit and preparation of the report.

Our special thanks are due to:

Teaching & Support Staff of St. Xavier's College - For giving us necessary inputs to carry out this very vital exercise of the Environment Audit. We are also thankful to other staff members who were actively involved while collecting the data and conducting field measurements.

And finally, the individuals that we consulted in the making of this report who were generous with their time, their information and their opinions. Their contributions are ultimately what created this audit.

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SECTION I - INTRODUCTION

BACKGROUND TO THE INSTITUTION

St. Xavier's College is a reputed autonomous college affiliated to Mumbai University and has recently completed 150 years of imparting education. It is a leading academic institution in this country, and naturally looks towards improving itself in other areas as well. One of these areas is its impact on its immediate environment, both within and outside the campus.

The building and the architecture of the college hark back to older, and greener times. It is in keeping with this spirit that we aim to make the campus, in all its modernity, sustainable as well. The college has already taken a few initiatives on its own, such as composting of the wet waste as well as installing solar panels to provide green electricity. It also prides itself on being a heritage site, which makes the building even more sensitive to any structural changes that might need to be fitted for upgrading, efficiency etc.

The ideologies that this college was built on, implores it keep on working for the welfare of the people, and make it a better society. It is for this purpose, to create a cleaner environment for the future to live in, that the Xavier's Environmental Committee has conducted an environmental audit of the campus.

The campus has a roster of over 5000 students and approximately 300 staff and faculty members. In addition, the campus has residential spaces for Jesuits and hostel students as well. On a daily basis the campus observes a footfall of about 3000 people, and they have a collective institutional impact on the environment.

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NEED FOR AN AUDIT REPORT ON CAMPUS

Environmental concerns are the most pressing worries that humans around the globe are facing at this point in time. Even in this city and country, the air we breathe, the water we drink and the land we live on are becoming more and more toxic every day. Under these circumstances, all of us need to take initiatives to minimise the damage we cause to the Earth. An organization is a collection of individuals and naturally its impact is much larger than the sum of individual impacts. Similarly, its potential to create change is also much larger.

Therefore, educational institutes need to be at the forefront of environmental consciousness, as they create the next generation of movers and shakers and should mould them in a way that all the students and alumni of the institution are environmentally aware and live sustainable lives. It is imperative that the institution also lead the way in sustainable management and functioning, so as to minimise its adverse impacts on the environment and teach by example and actions rather than merely words. Furthermore, it is no secret that St. Xavier's is an institution in this city that is at the forefront in history, quality and alumni. It is only logical and dutiful that we also lead the way in sustainability and environmentalism.

A student initiative for an environmental audit is an excellent tool for leading the way in environmental sensitivity, raising awareness for the cause as well as making the college an eco-friendly institution.

An internal student audit shall be tailored to the intricacies and specificities of the college instead of following a generic format. It shall take into consideration SPC courses, student associations as well as festivals and events with higher footfall. The management and faculty will also have constant inputs and reports to and from the audit team to ensure that it is holistic and detailed.

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INTRODUCTION TO THE XAVIER'S ENVIRONMENTAL COMMITTEE

The college is a dynamic space with the stakeholders changing every year. There are thousands of people on campus and a diverse range of activities every day. To ensure that all of this happens while minimising the environmental impact of the college, there was a need for a central body that will work towards this goal.

The Xavier's Environmental Committee is a newly formed committee with both students and faculty on board to take care of the task of making the campus more sustainable as well as maintaining a healthy and productive atmosphere for everyone. Therefore, the areas under its purview include not only aspects such as energy, waste and greenery; but also considers sanitation and cleanliness an integral part of its activities. The committee is formed with the intentions of boosting student participation in environmental activities and reminding the biggest stakeholders (staff and students) of their duties towards the campus.

To this end the XEC's major task this year was to conduct an assessment of the college campus in all relevant areas as a starting point for the new committee. The assessment will be complemented with a list of all possible suggestions for improvement which shall be worked on by the subsequent committee members. The committee shall serve as a body to facilitate cooperation between the management and the students to turn this college into a green, sustainable, and healthy campus for all.

To promote sustainable student activities, the XEC has worked on the suggestions that were necessary in our college. It has also created a document with guidelines for all the fests and events taking place in this campus, to minimise their environmental impact along with day to day work.

This document shall contain all the findings of the assessment along with suggestions, on which work can start as soon as possible and hopefully a few implementations will be in place before the beginning of the next academic year. It also contains a brief on the activities conducted by the XEC, as mentioned above, along with potential for improvement so that they may be repeated next year with better results.

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THE XAVIER'S ENVIRONMENTAL COMMITTEE STUDENT TEAM

Chairperson - Suyash Nandgaonkar (*TYBA*)

Heads of Research and Drafting - Maanya Vij (*TYBA*), Manya Chadha (*TYBSc*)

Head of Waste Audit - Kavya Batra (*TYBSc*), Shivika Manchanda (*XIC*)

Head of Sanitation Audit - Maria D'Costa (*TYBSc*)

Head of Energy Audit - Nishant Dewaney (*TYBSc*)

Contributor to Botany Audit - Aditi Nimbalkar (*MSc*)

Heads of Public Relations and Awareness - Kajol Shah (*TYBA*), Preksha Jain (*TYBA*), Toshita Sahni (*SYBA*)

Sub-Heads of Public Relations and Awareness - Siddhi Kamble (*SYBA*), Aysha Coutinho (*SYBA*)

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AUDIT OBJECTIVES AND SCOPE

The broad definition adopted by the International Chambers of Commerce (ICC) in its publication of Environmental Auditing (1989) defines it as — "*A management tool comprising a systematic, documented, periodic and objective evaluation of how well environmental organisation, management, and equipment are performing with the aim of safeguarding the environment and natural resources in its operations/projects*."

The XEC aims for this audit to not just assess the impact of the campus on the environment and map out consumption, but also to promote eco-friendly and sustainable attitudes amongst students. We would like everyone on campus to take responsibility and make conscious choices. In addition, organizers of major events such as Malhar, Ithaka etc. should ensure that the guidelines proposed by XEC/College are adhered to. The environmental audit comprises five audit reports whose topics are:

1. **Waste-management audit**: The aim is to identify and quantify the waste generated by the college and analyse what composes waste in the campus, and where does the waste go. The objective is to suggest better ways of waste disposal and divert as much waste as possible away from the dumping grounds/ landfill.

2. **Energy audit**: The aim is to estimate energy consumption and infrastructure of the campus and explore new ways to make the campus more energy efficient.

3. **Water audit**: The aim is to explore new ways to make the campus more water-efficient.

4. **Botanical audit**: The aim is to document plant diversity and check the need for increasing the plant cover on campus.

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EXECUTIVE SUMMARY

A major issue college faces is waste management. Waste management is a major responsibility of the consumer and the college has been proactive in taking steps towards it. It has facilities like wet waste composting and MLP collection to reduce its impact on the landfills. There are however no waste reduction measures taken and we propose to make the college reduce its paper consumption by going digital as well as reducing paper cups, as they make up a major component of the waste. To divert as much waste away from landfills, there is a need to maintain effective segregation into wet and dry. The uncontaminated dry waste can further be segregated into its components and then recycled accordingly, which will make the campus a zero-waste campus.

The energy audit looked into the consumption, wastage and efficiency of devices in college. The audit found the consumption data of lecture rooms from the student volunteer team of devices in use and devices required to be on their classrooms. The wattage of devices in college was done by personally going and looking at the devices and using the wattage values given on the devices themselves. Overall, we can say that the condition of energy consumption of the college is satisfactory but still leaves something to be desired.

The water management audit aimed to analyse water consumption patterns on campus throughout the year. However due to paucity of time, this audit couldn't be executed. For the implementation in future years, this report highlights the methodology that was formulated to carry out this task. The conduct of the audit requires water mapping, annual water bills and accounts, and meter readings. The report ends with a list of suggestions for water conservation techniques (from general observations) that could be incorporated on campus, such as retrofitting of aerators, regular maintenance of plumbing to prevent leakages, installation of efficient dual flushes, surveying the campus for possible rainwater harvesting system, etc.

The botany audit looked into the green cover and the amount of biodiversity present on campus. It also took into consideration the health of all the plants and trees. It was conducted mostly relying on a survey-based approach at a purely observational level. Post the visual survey, a professor from the botany dept was consulted who went over the results and gave appropriate suggestions regarding the kind of species to be planted, the potential spaces to increase green cover, maintenance of plants, etc.

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DEVELOPMENT OF CATEGORIES

As per the review of existing environmental audit reports, there are a few basic areas that need to be looked into when conducting a green audit, namely - energy, waste management and water management. This led to the development of the different types of audits that were conducted to prepare this environmental audit and impact report. Each audit was assigned a head auditor, who designed the methodology to be followed and prepared the final report for each audit.

An audit usually comprises either a measurement of consumption based on accounting mechanisms like bills and meter readings or on the basis of a survey which is purely at an observational level. Within the different categories of audits that follow, a different approach has been used where both these auditing tools have been combined to obtain results that are maximally valid. The data for the audits was mainly collected using survey-based techniques and entering the data onto a centralised portal which could be accessed by the head of the audit. This data was then analyzed with certain research questions in mind, and the results were finally compiled.

While a lot of the audit process was about measuring consumption, there were other elements specific to the campus that developed over the course of the research which in turn became part of the objectives of the audit.

1. For the waste management audit, the audit focused on finding out how much wet and dry waste is generated on average on the campus and the percentage composition of the waste. The auditors also measured how much of the wet waste was composted, where the dry waste was being sent, how much of it was recyclable etc. to formulate relevant suggestions with respect to disposal and even reduction of waste.

2. For the energy audit, the focus was not just on total energy consumption but on whether there were spikes in the consumption during certain periods of time in the year, whether we are using energy efficient appliances, if there was any energy loss that could be recovered by installation of better appliances, etc. These hypotheses were then used to check the situation and give suitable suggestions.

3. In case of the water audit, only suggestions on water conservation and mapping on campus could be made. However, it would be safe to assume that the campus falls within the permissible limits of ideal water use.

4. To assist with the research of other audits, it was required to estimate the green cover and biodiversity on campus. Thus, a botanical audit was also conducted wherein all the species under plantation on campus were compiled and the number of trees and plants was mapped. A botanist was consulted and his opinion on the improvements with respect to the greenery on campus were recorded as a part of this report.

SECTION II - AUDIT REPORTS

WASTE MANAGEMENT AUDIT

INTRODUCTION

An average person in Mumbai generates about 600 grams of waste per day, and there are about 2.2 crore people in this city, implying that the city generates over 1 crore kilograms of waste per day. Any resident of the city would be shocked to see that number, solely because it is unimaginable that there exists a dumping ground large enough in the city to actually get rid of this waste. However, large chunks of land, namely Deonar, have been converted into a toxic wasteland where this colossal amount of waste is thrown into landfills. This has led to a plethora of issues ranging from the formation of toxic fumes to soil pollution and more recently, health issues concerning asthma patients and double the infant mortality rate as that of the city.

St. Xavier's College, Mumbai has recently completed 150 years as a functional educational institution. On a daily basis more than 5000 people have access to the college and therefore the amount of waste generated is considerable. From the data collected during the audit conducted in the month of January 2019 it was concluded that the college mainly generates the following classes of waste:

1. Wet waste; mainly obtained from the kitchen and partly collected from the foyer
2. Dry waste; not including paper, plastic and MLP's but including discarded stationary etc.
3. Plastic bottles
4. Paper cups; when the contents of the dry waste bin were checked 60% of the waste consisted of paper cups
5. Electronic waste
6. Hazardous waste; Includes any hazardous waste generated by the Chemistry, Life sciences, Microbiology Botany, Zoology and Physics labs
7. MLPS, i.e., multi-layer packaging

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METHODOLOGY

The waste audit was conducted over 4 random days. The overview of the day is as follows:

- At 1:00pm, the composting staff along with the volunteers measured the waste that had been made into compost by the staff. They further used the food shredder machine to make the waste compostable and took part in the composting process.
- At 2:00pm, volunteers along with an XEC member, measured the total dry waste generated by the college. It is important to note that the dry waste bin contained a certain amount of wet waste. However, this was ignored because the quantity was very little compared to the quantity of dry waste in the bin. To measure the amount of dry waste generated, the weight of the bin with dry waste was taken and the weight of the bin without any waste in it was subtracted from the aforementioned value. The total number of such bins filled in a day were documented and on the basis of that, the total dry waste generated by the college was finally calculated.

It is suggested that the waste audit be carried forward again as the process is quite simple and can be executed regularly to keep the waste consumption under check. The composition of the waste generated can be determined visually, and periodic checks can be made to ascertain the effectiveness of the suggestions given below. It is recommended the first check be done in 3 months after the college starts, after the major awareness campaigns have been implemented and there is scope for some changes to be observed.

The figures accounted for may not be very accurate, but there were regular visual checks on the dustbins as well and therefore the composition as well as the quantity generated are reliable approximates for the suggestions that follow.

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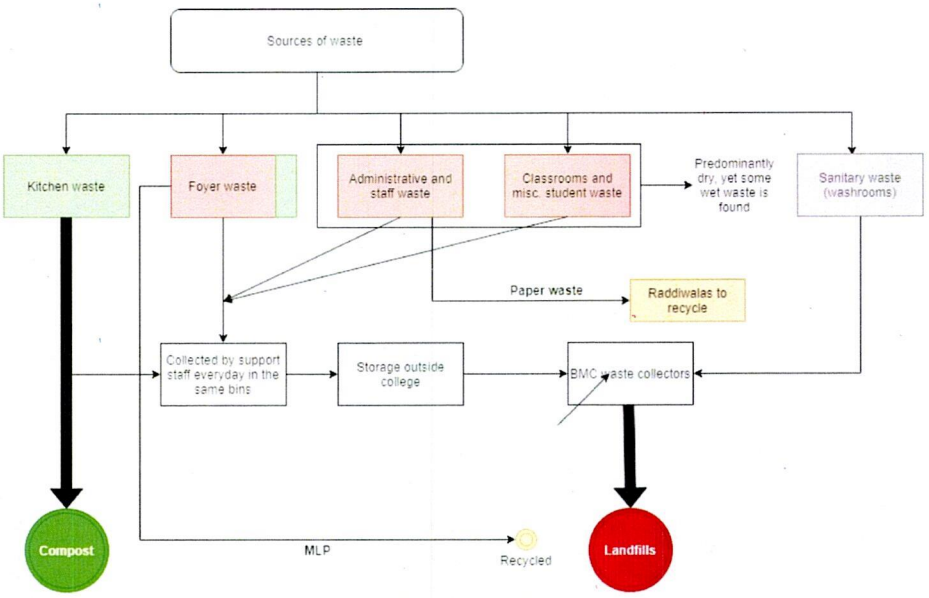
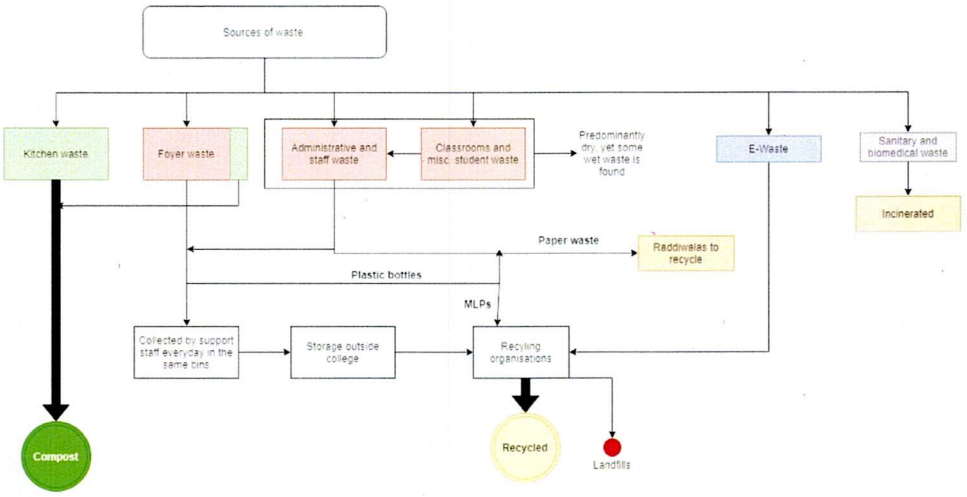
CURRENT FLOW OF WASTE



IDEAL FLOW OF WASTE



Ideally, only trash material, which cannot be recycled should reach the landfills.

Hazardous waste from the laboratories has not been included in this as it is under the consideration of the lab safety and biosafety committee, and is being disposed off using existing guidelines.

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RESULTS AND ANALYSIS

The following streams of waste were identified on an observational level:
Dry Waste: Paper, paper cups, plastics, MLP, tetrapaks, cardboards, flex banners etc.
Wet Waste: Organic waste from kitchen, canteen, residency, pantry of XIC etc
Hazardous Waste: Biomedical waste generated in the medical room and bathrooms (sanitary napkins etc.) and also includes chemicals from the laboratories.
Paper Waste: At photocopier and offices within college. The papers generally go to the recycler and hence do not classify as college waste

Dry Waste-
College waste dump contains mostly dry waste, from the general population except the kitchen. It ranges from 80-100kgs of dry waste. The dry waste reaching the college dump is from all the red bins. It has also been found that approximately 20% of it is also wet waste. This wet waste contaminates the dry waste generated, which makes it unfit for further segregation and recycling. To ensure efficient processing of the dry waste, this 20% of wet waste needs to be eliminated.

The support and janitorial staff also collect the waste generated from cleaning and sweeping in the dry waste bins. This includes compostable waste like leaves. The staff does not segregate wet and dry waste from the respective bins during collection, as they believe that the segregation doesn't matter since the bins largely contain dry waste anyway.

Furthermore, dry waste is collected from the classes which includes MLPs and coffee cups that the students consume in class even though food and beverages are prohibited. Hence, this waste may also contain wet waste.

Wet Waste-
On an average 80kgs-90kgs of wet waste is being generated from the canteen and juice center. The green bin waste is collected and sent to the composting area where a person from the support staff segregates the green bin waste, separates bottles, paper cups etc. Everyday minimum 2 and maximum 4 crates of compost are being prepared, thereby channelizing the organic waste from the landfills. Each crate measures 30kgs which after a month or so gets composted to form 10kgs of compost.

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Existing waste management:

1. There is a compost facility available for the disposal of wet waste. The staff adds about 70-80kgs of waste to the compost daily.

2. The college has made a separate bin for MLP collection. It aims to send this waste to an organization named Safai Bank. They ensure that the MLPs are burnt at a certain temperature and therefore the release of Dioxins into the environment is controlled.

3. Separate bins have been placed around the college for the collection of wet and dry waste.

4. Hazardous waste from labs is disposed of appropriately. If there are harmful chemicals there are existing known guidelines as to how to get rid of such waste. In our college there exists a lab safety and biosafety committee.

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RECOMMENDATIONS

1. Ideally, only trash material, which cannot be recycled should be collected by the BMC, which is Currently there is no channeling of dry waste so the entire waste goes to the landfill. A collaboration with recyclers shall help.

2. Instead of buying sawdust for composting, the gardener can be instructed to collect dry leaves and use it as a source of carbon, an essential for composting.

3. Segregation is not always taking place at source. Wet gets completely separated from the dry, only because of the composting initiative. The onus should be on the students.

4. Repetitive and effective PR campaigns must be undertaken with the highest priority to ensure that effective segregation takes place. The suggested PR campaigns have been mentioned in the PR section.

5. Specific instructions and equipment must be provided to the support staff for them to segregate when cleaning up after the students and the general college.

6. The canteen and the kitchen must be mandatorily made to send all their wet waste to the composting facility, without any leakages.

7. Use of the dustbin for leftover food, alongside the used-dishes collecting bin has to be encouraged. This shall ensure that wet waste from the plates can be easily collected and sent for composting. If segregation is not carried out properly, a more effective way could be providing large bins to the kitchen staff to dispose of leftover food when washing and giving it for compost.

8. An e-waste bin has been installed near the Physics lab but one of the XEC members has found wrappers and fruit peels. Clearly waste management education should be a part of the curriculum.

9. There must be more effective placements of the e-waste bin, as well as the general dustbins as follows. There must be separate bins with instructions for the administration to collect paper waste separately
    A. Signages provided on the bins with instructions and visual representation of the bin at eye level should be regularly checked and replaced if missing or damaged.
    B. The present locations of the bins have to be maintained as students can locate bins easily.
    C. There must be segregated bins in all the departments as well
    D. New and appropriately sized bins should be brought to provide for usage during high footfall events

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E. Bio-medical and sanitary waste must have appropriate bins in the washrooms along with equipment for support staff to collect them separately.

10. A top priority must be having contracts and tie-ups preferably with a recycler that shall be collecting all dry waste at once, which shall be segregated at their facility.

11. There is also the possibility of in-house segregation every day, as the quantity of waste generated isn't unmanageable. Dry waste could be segregated into paper, plastic, e-waste, rubber etc. and sent off to individual recyclers on a regular basis. The storage space behind the chapel can be used for it. The same system can then be used for fest waste management.

12. Bio-medical waste must be sent to an incinerator and disposed off properly, there is a possibility of tying-up with the waste disposal facilities of the hospital next door.

13. Direct instructions and equipment provided to the support staff so that they can segregate plastic bottles and paper (which is collected separately) so that it can be sold to the *kabadiwalas* on the same day. This shall ensure a win-win situation for all parties involved and provide economic incentives for waste management.

14. Hazardous waste- Biology, Microbiology, Chemistry labs generate hazardous waste in the form of used chemicals. Each department handles it individually. A common facility of collecting this hazardous residue can be introduced in the labs and can be kept separately in the college dump.

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WASTE REDUCTION SUGGESTIONS

1. Carry your cup campaign to reduce the plastic cups produced as they constitute the biggest waste component by visual ranking

2. Contractual basis with the coffee vendor to provide economic incentives to reduce paper cups by selling coffee with paper cups at a higher price than without.

3. Reduction of paper waste by digitising all college processes especially ones requiring booking classrooms, unnecessary forms like LORs, additional exams, transcripts, classroom bookings, reducing the necessity of letterheads.

4. Banning all paper plates if possible, and constraining the disposables only to the paper cups, as that shall prevent additional contamination of the dry waste.

5. Strict ban on all consumption in the classrooms enforced by the faculty.

6. Creating awareness of the regular checks being carried out by college and publicity of the safety of the water coolers to promote the usage of reusable water bottles instead of disposable.

7. Promote and provide more avenues for digital and paperless PR.

8. Provide digital student portals to manage all student activities without paper.

9. All the faculty members could provide scans and PDF copies of all reference material instead of keeping it at the photocopy centre. The students who wish for a hard copy can print it themselves, instead of paper being the first option.

10. All assignments and papers should be turned in digitally via Turnitin or similar services, as this shall provide it with better correction tools and less paper waste. This is necessary because anecdotal accounts of the photocopy centre suggest that thousands of sheets of paper are being printed every day, which could be reduced.

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ENERGY AUDIT

INTRODUCTION

The term Energy Audit can mean a lot of things based on the context of the place being audited and the depth of details of the audit itself, but in general, an Energy Audit is a study of a given location's electrical energy consumption and wastage of said energy. These are the two broad objectives of the current audit as well. The detailed objectives are given as follows:

1. Find consumption of individual rooms in college and thus rank them.

2. Find wastage of energy in each room and thus rank them.

3. Find efficiency loss of each room and thus rank them.

4. Rank rooms based on efficiency loss and consumption.

5. Make recommendations based on this data.

There are a couple of terms that need to be defined before we move on to the actual methodology and data.

Consumption: Number of electrical units (in KWh) used up in the audit timescale.

Wastage: Number of electrical units used up (in KWh) without obvious need. For example: A fan being on when it is not needed.

Efficiency Loss: Number of extra power units (in KW) in rooms when lower wattage versions are already in use in other parts of the College.

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METHODOLOGY

Firstly, the following data could not be gathered for the whole college due to the restrictions of time and manpower. The area covered in this audit is thus as follows:

LR01 and 2, LRs 11-14, LRs 20A-20G, LRs 22-27, LRs 31-38, LRs 41-44, LR 50s and 60s, SCAVI, MMR and Seminar Room (SCAVI, MMR, Seminar room's ACs are not considered for efficiency loss due to the different AC tonnage requirements of these rooms and thus they cannot be compared in the way lights and fans can be compared.)

The data for consumption was found by student volunteers who were in one of these rooms for a lecture. They would note down the number of fans, lights, projectors and ACs in use and how many of these devices needed to be on during this period of time. They would then log this on a database software. We had a student auditing force of 32 students. The time period for this Audit has been the month of **January 2020.**

The wattages of the different devices in each of audited rooms was found personally by the author of this report over the course of the month of January, 2020. This was done by looking at the labelled wattages of these devices. We assumed no wear and tear wattage increases and no wattage use drops due to any faulty wiring as that would have required much more invasive methods which are undesirable for an audit of our kind. We do however recommend these values to be found out by future auditors. The methodology of the analysis of data is as follows:

The consumption values in KWh are found quite simply. From the data submitted by volunteers the number of devices in usage is found. The average wattage value of that particular device is used for the particular room to find the total wattage used. Then this value is multiplied by the length of a single lecture ($5/6^{Th}$ of an hour) to find the consumption in KWh. Thus, the equation for consumption is given below:

$$Consumption\ in\ KWh = \frac{5}{6} \times \left[\left(W_{fan} \times N_{fan}\right) + \left(W_{light} \times N_{light}\right) + \left(W_{AC} \times N_{AC}\right) + \left(W_{projector} \times N_{projector}\right)\right]$$

Where, W=Average wattage in KW

N=Number of devices in use.

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The wastage values in KWh are also found in a similar way. In this case instead of using the number of devices in use, we use the difference between the number of devices in use and the number of devices required. Thus, the formula becomes:

$$\begin{aligned} Wastage\ in\ KW \\ &= \frac{5}{6} \\ &\times [\{W_{fan} \times (N_{fan} - R_{fan})\} \\ &+ \{W_{light} \times (N_{light} - R_{light})\} \\ &+ \{W_{AC} \times (N_{AC} - R_{AC})\} \\ &+ \{W_{projector} \times (N_{projector} - R_{projector})\}] \end{aligned}$$

where,

W=Average Wattage in KW

N=Number of devices in use.

R=Number of devices required to be in use.

The Efficiency loss is not found in units of energy as the previous two values but rather in units of power. This is found by looking at the different wattages of devices and finding the difference between that and the lowest wattage for that particular type of device already in use in college. For example: if a room has a light with wattage 32W but in the college there are lights with wattage in 20W then that counts as efficiency loss. Thus, the equation of efficiency loss of a particular room becomes:

$$Efficiency\ loss\ in\ KW = \sum N_{device} \times (W_{device} - L_{device})$$

where,

N=number of inefficient devices i.e number of devices with wattage more than the lowest wattage

W=Wattage of inefficient device in KW

L=Lowest Wattage for that device in KW

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RESULTS AND ANALYSIS

First, we see the actual result of our mapping of the locations mentioned. The values of wattages were found to the best of our ability.

Based on the above data**, 68% of the lights in classes are low wattage LEDs** while **26% are CFLs, while 5% are high wattage LEDs.**

Thus, college boasts a high usage of LEDs in college. The use of high wattage LEDs in LR1 and LR2 is highly wasteful as the natural lighting in these rooms is sufficient for the use of low wattage LEDs like the ones already in use in other rooms of the college.

The following is the ranking of the above rooms on the basis of consumption.

Rank	Room	Consumption in KWh
1	12	551.8233333
2	31	253.9791667
3	20D	234.15
4	SCAVI	210
5	41	184.470275

Secondly, we see Wastage Rankings:

Rank	Room	Wastage
1	MMR	10.533
2	11	4.2291667
3	SCAVI	3.95
4	2	3.081677
5	12	2.8125

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Thirdly, we see Efficiency loss rankings:

Rank	Room	Efficiency Loss in KW
1	2	0.36
2	1	0.28
3	25	0.235
4	23	0.23
5	27	0.225

Lastly, based on the efficiency loss rankings and consumption rankings, here are the rankings of rooms based on maximum benefit after making all devices maximally efficient in these locations.

Rank	Room	Total loss of Energy over surveyed time in KWh
1	24	2.875833333
2	25	2.545833333
3	12	2.533333333
4	41	2.035
5	20D	1.563333333

The efficiency of ACs in college deserves a little study too, given the fact that ACs in general are high wattage devices. The SCAVI and MMR ACs have a 3-Star rating which is sufficient but obviously can be improved. The AC's in the Seminar Room and most of the XIMR AC's do not have any ratings on them which suggests that these are old machines. Given that they are old and don't have ratings on them suggests they might be highly inefficient. Thus, these ACs should be replaced as soon as possible.

Regarding the electricity infrastructure of college, in locations not explicitly stated above, the condition of lights and fans differs slightly. The lights in most corridors and hallways in the college

are LEDs, which is ideal. There are a few CFLs scattered here and there and they should be changed, but they are few and far apart. In the Foyer too, majority of the lights are LEDs and hence energy efficient. The fans in the foyer, however, are not low-wattage fans and are also not well maintained. This is undesirable as the wastage in foyer is generally high due to most fans being on all the time. Thus, the fans should be replaced by more energy efficient models to cut down on this wastage. The floodlights in the first Quadrangle are also LEDs and since they are seldom used, this is the perfect way to handle the need of high-power lighting in that location. The use of lighting in the woods and garden area between the foyer and the Hall seems to be using CFLs. Given the fact that the same light can be provided using LEDs which are easily available and cheap, they should be replaced if they are in fact CFLs. Similarly, it seems like some old fashioned CFLs are being used to light up and the stairway outside the reference library and these do not provide a lot of light. They are also highly inefficient and thus must be replaced. Both the libraries seem to be using efficient devices except the fans in Reference library, but given the fact that they are only slightly inefficient, this is insignificant.

The efficient working of the solar cells is essential to an energy efficient campus and thus must be a priority of the college. If possible, the college's dependence on the power grid should be decreased by increasing the use of solar panels and regular maintenance.

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CONCLUSION

We can conclude that the overall Energy situation of the college campus is satisfactory and most of the issues stem from electrical wastage rather than appliance inefficiency. Therefore, measures should be taken to reduce wastage, by focusing on electrical waste reduction PR campaigns.

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RECOMMENDATIONS

1. Documents and records of all devices and appliances need to be maintained and updated regularly.

2. The use of LEDs should be increased and only low wattage LEDs should be used as the use of high wattage LEDs (such as in LR1 and LR2) is unnecessary. Therefore, only LEDs with a wattage of 20W or 25W should be used.

3. All Future purchases of equipment must be done only on a need-only basis. Natural ventilation and light should be taken into account. Therefore, only 3 stars or more ACs, 20 or 25W LEDs and lowest wattage suitable fans should be used.

4. All CFLs in hallways and the Garden must be changed to LEDs.

5. The Solar Cells should undergo regular maintenance.

7. To avoid wastage the faculty /students must observe and decide at their own discretion as to how many devices need to be on, taking into account natural lighting and ventilation.

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WATER MANAGEMENT AUDIT

INTRODUCTION

Water forms an invaluable part of our lives and is crucial for survival. It holds that human water consumption is becoming increasingly reckless and we are currently experiencing a dearth of freshwater or groundwater that is readily available for consumption. Hence, it is imperative that we use our water judiciously, making water consumption and conservation a major focus point in today's date.

Most green buildings undergo a water audit to analyze consumption patterns and check if there could be more efficient plumbing, metering, etc. that could be installed. Hence, we also decided to conduct a water audit of the college to make suggestions on how to better the water management system on campus.

However, due to the paucity of time and no records and resources, we were unable to conduct a thorough water audit of the college. Nevertheless, we have compiled certain observations and put together a few recommendations that could be taken up by the administration and students on this front.

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METHODOLOGY

As mentioned earlier, the audit on water management wasn't executed. The methodology we had planned to follow for the same is given below, for future audit purposes.

Requirements:

1. Map of water sources in the building to be able to segregate the areas where water is used based on the source. Example: borewell, gray water recycling facility, etc.
2. Water bills and accounts for at least one whole year to analyze consumption patterns for spikes, anomalies, etc.
3. Meter and sub-meter records of different sources and of different areas of water consumption.

We could also statistically test if the mean water consumption of our campus differs significantly from the ideal mean water consumption of campuses in similar areas, as there are many reports recognized internationally that discuss the same. If the former is significantly higher than the ideal stipulated amount, it indicates the need for a better water management and conservation system.

Similarly, we would also be able to visualize the trend of water consumption during large events organized by the college, helping us to better understand the water need during those specific days and consequently make appropriate suggestions to enhance the efficiency of the water system.

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RECOMMENDATIONS

The following are some suggestions that we would like to see incorporated in the college system to ensure proper mapping and conservation of our water resources, based on general observations and conversations with the administration.

1. Comprehensive map of the source of water and the flow of water from there.

2. Metering at each source point and sub-metering at the important and major areas of consumption. Example: Submetering in the foyer bathroom, drinking stations, labs, etc. This metering would prove to be useful for future audits and to see our consumption patterns which in turn will help us to recommend places where we could cut down on consumption.

3. Retrofitting of aerators on faucets and hand sprays in the bathrooms to reduce redundant water spray by up to 50%.

4. Installation of efficient flushes such as dual flushes wherein water can be used based on the user's judgment, reducing the amount of water that is wasted.

5. Conduct a survey to check for the feasibility of a rainwater harvesting system since we get a lot of rainfall during monsoons which can be reused sustainably.

6. Expand the grey-water recycling plant to satisfy the demand of the boy's hostel.

7. Look into the installation of more efficient drip irrigation systems instead of watering using a pipe.

8. Regular preventive maintenance to check for leaky pipes and faucets, old plumbing equipment, etc. to ensure reduced wastage of water.

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BOTANY AUDIT

INTRODUCTION

The objectives of the botanical assessment were:

1. Create a list of all plant species in the college campus
2. A general assessment of the green cover in the campus with respect to the diversity and number of plants and plantation area
3. Identify potential to increase the plant cover and quality

METHODOLOGY

The list of species in the campus was created by visually identifying all the plants. This was the most efficient method due to limited manpower. This may lead to a few discrepancies, and it is suggested that the list be verified once again next year. However, the observations are as accurate as possible to the best of our knowledge. For the observations and opinions part, the botany department was consulted to go over the list and provide their insights based on their general observations since they are regularly present on the campus.

	Scientific Name	Family
1	Acacia auriculiformis	
2	Acalypha amentacea	Euphorbiaceae
3	Acalypha hispida	Euphorbiaceae
4	Acalypha indica	Euphorbiaceae
5	Adathoda vasica	Acanthaceae
6	Adenanthera pavonina	Fabaceae
7	Aglaonema crispum	Araceae
8	Alstonia scholaris	Apocynaceae
9	Alternanthera ficoidea	Amaranthaceae
10	Annona reticulata	Annonaceae
11	Annona squamosa	Annonaceae
12	Araucaria heterophylla	Araucariaceae
13	Artocarpus heterophyllus	Moraceae
14	Azadirachta indica	Meliaceae

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15	Bombax ceiba	Bombacaceae
16	Bougainvillea galabra	Nyctaginaceae
17	Caesalpinia separia	Caesalpiniaceae
18	Canna indica	Cannaceae
19	Caryota urens	Arecaceae
20	Cauropita guianensis	Lecythidaceae
21	Chlorophytum comosum	Asparagaceae
22	Cocus nucifera	Arecaceae
23	Codiaeum variegatum	Euphorbiaceae
24	Cordyline fruticose	Asparagaceae
25	Cordyline terminalis	Asparagaceae
26	Crossandra infundibuliformis	Acanthaceae
27	Cynodon dactylon	Poaceae
28	Cyprus rotundus	Cyperaceae
29	Delonix regia	
30	Dieffenbachia amoenia	Araceae
31	Dracaena deremsis	Asparagaceae
32	Dracaena fragrans	Asparagaceae
33	Dracaena reflexa	Asparagaceae
34	Duranta plumieri	Verbenaceae
35	Ecbolium viridae	Acanthaceae
36	Emblica officinalis	Rutaceae
37	Eranthemum roseum	Acanthaceae
38	Euphorbia hirta	Euphorbiaceae
39	Euphorbia pulcherrima	Euphorbiaceae
40	Ficus bengalensis	Moraceae
41	Ficus benjamina	Moraceae
42	Ficus glomerata	Moraceae
43	Ficus hispida	Moraceae
44	Ficus religiosa	Moraceae
45	Gliricidia sepium	Papilionaceae
46	Graptophyllum pictum	Acanthaceae
47	Hibiscus rosa sinensis	Malvaceae
48	Hydrocotyl rotundifolia	Apiaceae

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49	Ipomea convolvulus	Convolvulaceae
50	Ixora coccinea	Rubiaceae
51	Jatropha gossypifolia	Euphorbiaceae
52	Justicia gendarussa	Acanthaceae
53	Lagerstroemia sp.	Lythraceae
54	Lantana camara	Verbenaceae
55	Licuala grandis	Arecaceae
56	Lindenbergia indica	Orobanchaceae
57	Livistonia chinensis	Arecaceae
58	Livistonia rotundifolia	Arecaceae
59	Mangifera indica	Anacardiaceae
60	Manilkara hexandra	Sapotaceae
61	Michelia champaca	Magnoliaceae
62	Millingtonia hortensis	Bignoniaceae
63	Mimusops elengi	Sapotaceae
64	Monstera deliciosa	Araceae
65	Morinda citrifolia	Rubiaceae
66	Moringa oleifera	
67	Murraya paniculata	Rutaceae
68	Musa acuminate	Musaceae
69	Nephrolepis exaltata	Lomariopsidaceae
70	Nerium oleander	Apocynaceae
71	Nyctanthes arbor-tristis	Oleaceae
72	Nymphoides hydrophylla	Menyanthaceae
73	Ocimum sanctum	Lamiaceae
74	Oplismenus burmani	Poaceae
75	Oxalis corniculate	Oxalidaceae
76	Oxalis triangularis	Oxalidaceae
77	Paspalum conjugatum	Poaceae
78	Pedilanthus tithymaloides	Euphorbiaceae
79	Philodendron	Araceae
80	Phyllanthus emblica	phyllanthaceae
81	Phyllanthus niruri	Phyllanthaceae
82	Plumeria alba	Apocynaceae

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83	Plumeria obtuse	Apocynaceae
84	Polyalthia longifolia	Annonaceae
85	Polyscias guilfoylei	Araliaceae
86	Pongamia glabra	Fabaceae
87	Portulaca grandiflora	Portulacaceae
88	Portulaca oleraceae	Portulacaceae
88	Pseuderantheum reticulatum	Acanthaceae
90	Psidum guajava	Myrtaceae
91	Rhoeo discolor	Commelinaceae
92	Ricinus communis	Euphorbiaceae
93	Roystonia regia	Arecaceae
94	Rungia diffusa	Acanthaceae
95	Samanea saman	Mimosaceae
96	Sansevieria roxburghiana	Asparagaceae
97	Saraca asoca	Fabaceae
98	Schefflera arboricola	Araliaceae
99	Scindapsus aureus	Araceae
100	Sida cordifolia	Malvaceae
101	Solanum diphyllum	Solanaceae
102	Stanotaphrum standatum	Poaceae
103	Syngonium podophyllum	Araceae
104	Syzigium cumin	Myrtaceae
105	Syzigium jambos	Myrtaceae
106	Tabernaemontana divaricate	Apocynaceae
107	Tabernemontan heyeana	Apocynaceae
108	Tamarindus indica	Fabaceae
109	Terminalia catappa	Combretaceae
110	Thespesia populnea	Malvaceae
111	Turnera ulmifolia	Turneraceae
112	Vernonia cinerea	Asteraceae
113	Vitex negundo	Verbenaceae

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RECOMMENDATIONS

1. Most of the species in the campus are not native. It is recommended that they be gradually replaced by more native species which are well suited to growing in coastal conditions.

2. The Botany department should be consulted when planting more trees and a list of appropriate species should be obtained.

3. Instead of mostly vegetative plants, more flowering trees which will add to the natural beauty of the campus, as well as attract fauna like butterflies should be planted.

4. The compost should be effectively utilised and consulting with the Botany department, proper guidelines for maintenance should be created and followed strictly.

5. From there on, there is the possibility of creating a garden or small plantation above the ground, such as near the Caius lab.

6. The kitchen garden planned should be constructed as soon as possible, using the compost of the college. The food grown here can be utilised for the residents and create a virtuous food-waste-food cycle.

7. As mentioned in the water audit, drip irrigation should be installed in as many places as possible to save water as well as for effective maintenance.

8. The pruning of the trees should only be restricted to pre and post monsoon, or as directed by the Botany dept. for effective and scientific maintenance, as undue pruning before the summers will lead to poor plant health.

9. The plant health observed around campus is satisfactory with no bugs and parasites being observed.

10. Name plates identifying the plants on the campus should be prepared.

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TEAM FEEDBACK AND SUGGESTIONS FOR AWARENESS

The 2019-2020 team had its ups and downs when it came to finding an optimal PR strategy. Face to face interaction was found to be the most useful and effective tool especially when it comes to informing people to change behaviours for the better which was observed after the foyer gimmick with interactions with students.

When working on raising awareness, reduce paper waste, laminated posters to back what the committee stand for. The shift to paperless PR requires greater awareness about the XEC and a large following on social media and outreach programs. An intense and penetrative PR strategy and plan is required to encourage students to follow XEC online for updates and to make suggestions. This must involve a group of people and representatives who ensure outreach to each stream.

The team should focus on diversifying outreach programs and workshops to reach students enrolled in other courses especially commerce and masters etc. It is also important to make the team more inclusive with members from other streams and batches as well to ensure tailored PR strategies and target as wide an audience as possible.

Innovative environment education, including technology where possible, could make it easier to collect feedback from students and active efforts to implement solutions when feasible, eg use hashtags and tags for the exec on Instagram stories when an environment issue (no segregation, lack of sanitation in bathrooms etc) is faced on campus.

Have the new team take up some of the suggestions that were ideated upon throughout the year but due to feasibility of time constraints could not have been implemented in this year, such as:

1. Collect interesting bits of information from various sources as fillers to keep the Instagram page active and engaging. Information can be about what other campuses worldwide are doing to become more sustainable, apart from other general data.

1. Have an 'Environmental Conference' where papers can be presented from multiple disciplines on any topic related to the environment. Papers already written for Samvaad, Arthniti, Uncommon Sense, etc can also be given a platform to present.

2. Make a WhatsApp group with representatives from each course and year on campus to ensure that all environment and student responsibility related information is disseminated to everyone on campus.

3. Conduct a social experiment on campus, applying cognitive psychology principles, to study environment- related behaviour of students.

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4. Hold debates (could be student versus faculty) and other interactive discussions on pressing environmental matters.

5. Encourage innovative student meets such as Saturday open mic Evenings where students can express their creativity around environmental themes.

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SECTION III

APPENDIX

1. Template for calculation of Replacement Cost Returns

Price of ideal device = P

Total number of devices to be changed = Q

Current Price of Electrical Consumption for a Month = C

Projected Price of Electrical Consumption for a Month after Change = R

Months till replacement costs are equalled = $\frac{P \times Q}{C - R}$

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2. Table 1.1. *Table of appliances and corresponding wattages in audited regions*

Room	Fan Wattage	No. of Fans	LED1	No. of LED1	LED2	No. of LED2	CFL	No. of CFL	LED3	No. of LED3
1	53	6	20	0	25	0	36	0	60	7
2	53	7	20	0	25	0	36	0	60	9
11	53	6	20	0	25	16	36	0	60	0
12	53	5	20	0	25	16	36	0	60	0
20G	60	6	20	0	25	5	36	0	60	0
20F	60	4	20	0	25	4	36	0	60	0
20E	60	5	20	0	25	4	36	0	60	0
20D	60	6	20	0	25	5	36	0	60	0
20C	60	5	20	0	25	4	36	0	60	0
20B	60	5	20	0	25	4	36	0	60	0
20A	60	5	20	0	25	6	36	0	60	0
22	60	5	20	6	25	8	36	7	60	0
23	60	5	20	3	25	7	36	10	60	0
24	60	5	20	5	25	8	36	8	60	0
25	60	5	20	0	25	8	36	10	60	0
26	60	5	20	0	25	8	36	8	60	0
27	60	5	20	0	25	6	36	10	60	0
31	53	10	20	0	25	7	36	0	60	0
32	53	4	20	0	25	6	36	0	60	0
33	53	6	20	0	25	9	36	0	60	0
34	53	6	20	2	25	8	36	2	60	0
35	53	2	20	0	25	2	36	0	60	0
36	53	2	20	0	25	2	36	0	60	0
38	53	2	20	0	25	2	36	0	60	0
41	53	5	20	0	25	2	36	4	60	0
42	53	5	20	0	25	1	36	3	60	0
43	53	5	20	0	25	2	36	0	60	0
44	53	5	20	0	25	2	36	3	60	0
51	70	6	20	0	25	7	36	0	60	0
52	70	6	20	0	25	7	36	0	60	0
53	70	6	20	0	25	7	36	0	60	0
62	53	6	20	1	25	2	36	4	60	0
Seminar Room	60	6	20	0	25	6	36	8	60	0

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3. Table 1.2. *Table depicting rankings based on consumption loss*

Rank	Room	Consumption in KWh
1	12	551.8233333
2	31	253.9791667
3	20D	234.15
4	SCAVI	210
5	41	-
6	11	126.5983333
7	24	108.0633333
8	25	43.59831667
9	MMR	32.025
10	20C	30.2
11	34	14.58666667
12	33	14.175
13	13	13.73166667
14	44	11.35633333
15	20E	10.55833333
16	20A	10.08333333
17	52	10
18	43	9.35
19	27	9.0375
20	1	5.75
21	42	4.433333333
22	Seminar room	4.15605
23	14	2.4125
24	51	2.24
25	62	1.68475
26	20G	1.525
27	32	1.03
28	2	0.89
29	53	0.463333333
30	20F	0
31	20B	0
32	22	0
33	23	0
34	26	0
35	35	0
36	36	0
38	37	0
39	38	0

NOTE: A consumption of 0 does not necessarily mean that these rooms were not used but could be due to the non-availability of data due to none of our volunteers having lectures in these rooms.

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4. Table 1.3. *Table depicting ranks based on electrical wastage*

Rank	Room	Wastage
1	MMR	10.533
2	11	4.2291667
3	SCAVI	3.95
4	2	3.081677
5	12	2.8125
6	25	2.474047
7	41	2.44778
8	24	1.81
9	52	1.775
10	31	1.5041667
11	20D	1.475
12	27	1.203125
13	20A	1.041667
14	Seminar room	0.519285714
15	44	0.457833
16	13	0.445
17	20C	0.25
18	53	0.23833
19	34	0.220833
20	20E	0.1833
21	51	0.18
22	33	0.171667
23	43	0.08833
24	20G	0.0833
25	1	0
26	14	0
27	20F	0
28	20B	0
29	22	0
30	23	0
31	26	0
32	32	0
33	35	0
34	36	0
35	37	0
36	38	0
37	42	0
38	62	0

NOTE: A wastage of 0 does not necessarily mean that these rooms were not used but more likely is due to the non-availability of data due to none of our volunteers having lectures in these rooms.

5. Table 1.4. *Table depicting ranks based efficiency loss*

Rank	Room	Efficiency Loss in KW
1	2	0.36
2	1	0.28
3	25	0.235
4	23	0.23
5	27	0.225
6	51	0.214
7	52	0.214
8	53	0.214
9	24	0.203
10	26	0.203
11	Seminar room	0.2
12	22	0.187
13	12	0.08
14	41	0.074
15	62	0.074
16	34	0.072
17	20D	0.067
18	20G	0.067
19	20A	0.065
20	44	0.058
21	20B	0.055
22	20C	0.055
23	20E	0.055
24	42	0.053
25	20F	0.048
26	33	0.045
27	31	0.035
28	43	0.032
29	32	0.03
30	35	0.01
31	36	0.01
32	38	0.01

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6. Table 1.5. *Table depicting ranks based on total energy loss*

Rank	Room	Total loss of Energy over surveyed time in KWh
1	24	2.875833333
2	25	2.545833333
3	12	2.533333333
4	41	2.035
5	20D	1.563333333
6	1	1.166666667
7	27	1.125
8	52	0.891666667
9	31	0.729166667
10	44	0.676666667
11	Seminar room	0.5
12	34	0.48
13	20C	0.366666667
14	51	0.356666667
15	20E	0.320833333
16	2	0.3
17	20A	0.270833333
18	33	0.2625
19	53	0.178333333
20	42	0.176666667
21	43	0.16
22	62	0.123333333
23	20G	0.111666667
24	32	0.05
25	36	0.008333333
26	35	0
27	38	0
28	20B	0
29	20F	0
30	22	0
31	23	0
32	26	0

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7. Table 2.1. *Table depicting the suggested janitorial washroom duty schedule*

JANITOR	AREA	EQUIPMENT	FREQUENCY	TIME
1&2	FOYER WASHROOM			
	GIRLS	GLOVES	3/DAY	7:30
		TONGS		1:50
		BROOM		5:00
		MOPS		
		SANITATION KIT		
3&4	BOYS	GLOVES	3/DAY	7:30
		BROOMS		1:50
		MOPS		5:00
		SANITATION KIT		
1&3	FOYER	MOPS		
		BROOM		
		GLOVES		
	-food bins		after every 2 hours	
	-dustbins		2/day	8:50
				3:30
	-tables		3/day	7:30
				1:50
				3:30
2	WOODS	BROOMS	1/DAY	8:50
	MAIN BUILDING			
4	GROUND FLOOR	BROOMS	1/DAY	7:50
		MOPS		
		SANITATION KIT		

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	FIRST FLOOR	BROOMS	1/DAY	8:50
		MOPS		
		SANITATION KIT		
5	SECOND FLOOR	BROOMS	1/DAY	8:50
		MOPS		
	FIRST FLOOR	BROOMS	1/day	3:30
		MOPS		
	LIBRARY	BROOMS	1/day	7:50
		MOPS		
6	THIRD AND FOURTH FLOOR	BROOMS	1/day	3:30
		MOPS		
	HOSTEL	GLOVES		
		MOPS	1/day	7:30
		BROOMS		
		SANITATION KIT		

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