The New Miraj Education Society's

Kanya Mahavidyalaya, Miraj

Energy Audit Report

Prepared by

Department of Environmental Science,

Shivaji University, Kolhapur- 416004

2023-24

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Principal's Message

The Institute realizing the need of Green, Energy and Environment Audit for Environment friendly campus is serious for the assessment of the campus for such audits. In the Globalized world, many environmental issues have to face and it has become our prime duty to protect the earth from all types pollutions.

Our institute has framed the 'Eco-Friendly Campus Cell' which takes initiatives to keep the environment of the campus clean and green. Under the guidance of this cell our departments of N.S.S. and N.C.C. organize cleanliness drive regularly. Similarly, various programmes are organized for our students to increase awareness about environment protection and sustainability. The institute has set up Rain-Harvesting and Compost Fertilizer project for waste management.

The roll of HEI institutes in Environment Sustainability is crucial today. Hence our institute not only takes efforts inside the campus but also outside the campus for eco-friendly activities. The collection of e-waste is also done to increase the awareness of society about the dangers of e-waste and plastic.

Along with this programmes, the record is maintained to assess the environmental performance of our institution and to find out solutions for eco-friendly campus. All the programmes are in relation to the objectives to improve the environmental conditions in and around the institute.

So, I am happy that our institution is conducting these audits very keenly under the guidance of a team from the Shivaji University, Kolhapur. It certainly helps us to act in response to the environmental issues in future.

Thank you,

Place: Miraj

Date: **25/04/2024**

KANYA MAHAVIDYALAYA MIRAJ

Principal
Kanya Mahavidyalaya, Miraj.

Dr. U.M.Malkar

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Certificate

This is to certify that the Department of Environmental Science, Shivaji University, Kolhapur has conducted detailed "Energy Audit" of "The New Miraj Education Society's Kanya Mahavidyalaya, Miraj" during the academic year 2023-2024. The Energy audit was conducted in accordance with the applicable standards prescribed by 'Bureau of Energy Efficiency, Government of India'. Their audit involves code compliance, operations, maintenance, occupancy, and building systems etc. and gives an 'Energy Management Plan', which the institute can follow to minimize impact on the institutional working framework. The analysis was based on a review of the rules governing energy efficiency and conservation, on data analysis, and on the findings of survey with key personnel in the campus's administrative management. The performance of college was found to have good quality even though some important aspects like increasing the use of solar energy and energy efficient equipment's are to be considered seriously. In an opinion and to the best of our information and according to the information given to us, said Energy audit gives a true and fair view in conformity with energy auditing principles accepted in India.

Department of Environmental Science, Shivaji University, Kolhapur

Jadhav
Head

Dr. (Mrs.) Aasawari Jadhav
I/C. Head & Assistant Professor
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Chapter I

Introduction

1.1 Energy Audit, a Tool for Environmental Protection and Conservation

An energy audit is a survey that looks at how an organization uses its energy and looks for ways to conserve it. It refers to a method or system designed to lower the organization's energy consumption without lowering output. The audit offers recommendations for additional strategies and techniques for maximizing energy savings. Traditionally, fossil fuels, water, and wind have been used to produce electrical energy. The abundance of fossil fuels and their rates of depletion reinforce the need for alternative energy sources and electric energy conservation. Offering goods or services at the lowest cost and with the least degree of environmental damage is often the main goal of an energy audit and the control of energy consumption (Backlund and Thollander, 2015). Energy audits are required to identify areas for improvement, cost-saving opportunities, understand how fuel is used, where waste occurs, and identify potential savings.

An energy audit is suggested and carried out to ensure that energy-saving methods are adopted and followed in educational institutions and industrial sectors in a sustainable manner. The audit process includes the creation and completion of a questionnaire, a physical inspection of the campus, the observation and analysis of paperwork, key person interviews, data analysis, measurements, and suggestions. Energy audits consider a variety of information, such as potential energy savings, energy management, alternative research, etc. In 2010 (Cabrera et al.), given these details, the audit's specific goals were to evaluate the departments' adherence to relevant laws, policies, and standards, as well as the effectiveness of the sustainability management and control system. It has the ability to have a major impact on both the environmental impact and the organization's operational costs (Singh et al., 2012).

The Energy Conservation Building Code (ECBC), introduced in 2017, establishes minimal standards for the design and construction of energy-efficient buildings throughout India. Additionally, it offers two extra sets of incremental specifications that buildings must meet in order to reach higher than necessary levels of energy efficiency (Gnanamangaiet al., 2021). In an effort to adopt energy-saving procedures in an organisation, the Bureau of Energy Efficiency (BEE) was established in 2002. Affixed to manufactured goods, energy-efficiency labels provide information on the products' energy efficiency (Ingle, 2014). In

order to speed up energy efficiency efforts, BEE has created a system for labelling buildings' energy efficiency that corresponds with their star ratings. The BEE Star Rating Scheme is based on the real performance of the building and equipment in terms of specific energy usage, or "Energy Performance Indicator," by using star ratings to designate products that will be helpful for energy savings in a sustainable manner (Mishraand and Patel, 2016).

Maintaining focus on energy price changes, energy supply availability and efficiency, choosing a suitable energy mix, identifying energy-saving technology, retrofitting for energy-saving equipment, and other issues is made easier with the help of energy audit programs. In general, an energy audit procedure focuses on implementing conservation concepts by providing technically feasible solutions within a set time frame while also considering organizational, financial, and other challenges (Asnani and Bhawana, 2015). It also covered finding ways to save money by lowering operating costs or the amount of energy used for every unit of output. It acts as a "benchmark" (reference point) for energy management in the business to design more energy-efficient use all around (Cabrera et al., 2010).

1.2 Need for an Energy

Audit Energy (both electrical and thermal), labour, and materials are frequently determined to be the top three running costs in every organization. In each of the aforementioned components, energy would invariably rank as the highest manageable cost or potential cost saver, making the function of managing energy a significant area for cost cutting. Understanding how energy and fuel are used in various industries will be made easier with the aid of an energy audit, which will also point up potential wasteful practices and areas for development. The energy audit would provide a helpful direction for programs that are essential for production and utility activities, such as reducing energy costs, preventative maintenance, and quality control. Such an audit program will assist in maintaining focus on variations in energy costs, the availability and dependability of the energy supply, choosing the right energy mix, identifying energy-saving technology, retrofitting for energy-saving equipment, etc. Energy audits often involve providing technically feasible solutions with economic and other organizational concerns within a given time limit in order to make conservation ideas a reality. Finding solutions to cut operational expenses or energy usage per unit of output is the main goal of an energy audit. An energy audit serves as a "benchmark" (Reference point) for managing energy inside a business and also serves as the foundation for developing plans for a more efficient use of energy across the board. The idea of an eco-

campus primarily focuses on sustainable energy consumption and conservation, as well as chances for savings. Additionally, it emphasizes reducing carbon emissions, calculating carbon footprints, purchasing energy-efficient equipment for cost- effective and secure energy supply, promoting and enhancing energy conservation in all buildings, lowering the organization's energy use, lowering waste sent to landfills, and incorporating environmental considerations into all agreements and services deemed to have a significant environmental impact.

Studying auditing for energy management in terms of energy savings and opportunities is possible. Despite the fact that energy is generally invisible, we can observe its effects in the form of heat, light, and power, so we know it exists in wire, pipes, and other non-living elements. Energy use, energy sources, energy monitoring, illumination, vehicle movement, electrical and electronic appliances, and transportation are all covered by this indication. Energy use is undoubtedly a crucial component of campus sustainability; thus, its inclusion in the assessment doesn't call for any justification. While energy is heavily consumed, opportunities for energy conservation may be considered. An energy-efficient light-emitting diode (LED) uses less than 10 W compared to an old incandescent (tungsten) bulb, which shows a good trend toward energy savings. The three ways to reduce energy use that are related to environmental degradation are covered by energy auditing. Following an audit, ideas and recommendations may be made, which are then helpful for reducing energy use. Any organization that cares about the environment must therefore regularly use both internal and external auditors to review its energy usage procedures.

Any organization's energy management strategy depends heavily on the conduct of energy audits, utilizing both internal and external energy auditors. In order to find better ways to control the environment's influence, it is necessary to quantify the impact of energy potential within a business. Measurements of the carbon footprint within the organization based on the quantity of carbon emissions produced by the electrical appliances, vehicles, and human population may be attempted in addition to the audits of the organization's water, liquid, and solid wastes, biomedical and electronic wastes, energy potential, and biodiversity. It calculates the amount of carbon dioxide equivalents inhaled by the company that performs carbon accounting. It is important to understand how much the company is doing in terms of energy management to support sustainable development. Therefore, it is advised that stakeholders measure each organization's carbon footprint in order to help keep the campus environmentally friendly.

1.3 Aims and Objectives of an Energy Audit

An effective technique for creating and implementing an organization's complete energy management plan is an energy audit. A systematic identification of energy efficiency, conservation, and savings opportunities at the audit sites' premises is the goal of an energy audit. The auditing procedure is performed in accordance with the following.

• Examining the energy-saving opportunities and steps taken at the audit sites.

• Identification of new energy-saving options and other conservation strategies.

• Implementing alternative energy sources can help with energy management decision-making and energy-saving opportunities.

• Supplying technical details on how to create an energy balance as well as advice on where to go for it for specific applications.

• Analysis of the campus' most recent electricity bill in detail, awareness of the pricing plan offered by the State Electricity Board and the central government, and detailed calculations of energy consumption.

• List the different ways that energy is used, including electricity, LPG, firewood, gasoline, diesel, and electric stoves, kettles, and microwaves.

• Analysis of the last two to three years' worth of energy bills, the last years‟ worth of LPG cylinder purchases, and the cost of water used for human consumption and plant watering.

• Use of installed laboratory equipment and instruments, incandescent (tungsten) and CFL lighting, fans, air conditioners, cooling devices, heaters, computers, photo copiers, inverters, generators, and cooling apparatus.

• In the organization, alternative or unconventional energy sources are used or installed (photovoltaic cells for solar energy, windmill, energy efficient stoves, Biogas, etc.).

1.4. Benefits of an Energy Audit

- Reduced costs of energy

The most obvious advantage is that the Organization will spend less money on energy costs the less energy it consumes.

- Identify problems

An energy audit can identify any potential problems with the equipment. The auditor might, for instance, discover tiny leaks in the pressurized air system. If these leaks go unnoticed, they could end up costing a lot of money. Additionally, auditors can spot harmful health threats, including carbon monoxide emissions from defectively vented equipment. The company will be able to quickly rectify these kinds of problems with a routine energy audit, ensuring the workers' health and safety.

- Enhanced employee comfort

The organization might learn of modifications made to the insulation and air sealing during the audit. The completion of these improvements will contribute to the creation of a more dependable and efficiently heated or cooled workspace for the employees. Because more contented workers are typically more productive, the organization will not only save money on energy but also potentially enhance general health.

- Specific recommendations

Discovering new energy-efficient devices can be made easier by working with an energy specialist. The expert will create a customized plan and suggest the upgrades that would provide the highest ROI. These could consist of modernized lighting systems, a fresh HVAC system, weatherization techniques like air sealing and insulation, and more. Many of the ideas will pay for themselves quickly with drastically lower energy costs, even though others may have a hefty upfront cost.

- Promote environmental concern

The organization will demonstrate to its clients and staff that it cares about the environment by making efforts to become more energy efficient.

- Rising property value

Making a facility more energy efficient in accordance with an energy auditor's suggestions could also raise its market value. An increased home value is a result of things like solar panels, high-efficiency LED lighting, and weatherization measures.

- Extended equipment life

For optimal energy savings, an energy auditor might advise updating part of the equipment. If the organization decides to modernize, it can anticipate long-lasting equipment as well as energy cost savings. This is because newer, more energy-efficient equipment

doesn't need to work as hard to give the same level of performance as older, out-of-date devices.

- Energy audit assessment

Energy audits will assess the organization "as a whole," with the objective being to consider a variety of potential alternatives rather than just one or two specific initiatives (electrical, mechanical, envelope, and water).

- Energy audit possibilities

In addition to informing on opportunities, the audit will provide information with a financial analysis. Prioritization based on monetary gain and return on investment will then be possible. It gives technical details about the suggested energy-saving measures.

- Analysis of the energy audit's quality

A high-quality audit will utilize statistical techniques to analyses previous energy use and identify potential problems. To better comprehend the environmental advantages of the decisions, provide information with emissions analysis. Recognize where your energy goes and what needs the most of your attention. Provide benchmark data so that we can compare our energy consumption to that of others.

Chapter II

Methodology

2.1 Background of the New Miraj Education Society's Kanya Mahavidyalaya, Miraj Energy Audit preparation:

Considering all this situation and adding national holidays in the total closed days, the audit process was carried out in three phases. For preparation of audit, the earlier data was compared with the present. At first, all the secondary data required for the study was collected from various sources, like concerned departments. A broad reference work was carried out to clear the idea of Energy Auditing. Different case studies and methodologies were studied and the following methodology was adopted for present audit. The methodology of present study is based on onsite visits, the personal observations and questionnaires survey tool. Initially, based on data requirement, sets of questionnaires were prepared. The surveyors then visited all the departments of the college and the questionnaires were filled. The generated data is subsequently gathered through various sections of college and used for further analysis. From the outcome of the overall study, a final report is prepared.

- Energy Auditing Process
- Planning
- Choosing audit team
- Inspecting site/ Collection of data
- Analyzing results of audit
- Evaluating audit

2.2 Survey by Questionnaire: Baseline data for Energy Audit report preparation was collected by questionnaire survey method. Questionnaires prepared to conduct the Energy Audit in the college campus is based on the guidelines, rules, acts and formats prepared by Ministry of Environment, Forest and Climate Change, New Delhi, Central Pollution Control Board and other statutory organizations. Most of the guidelines and formats are based on broad aspects and some of the issues or formats were not applicable for college campus. Therefore, using these guidelines and formats, combinations, modifications and restructuring was done and sets of questionnaires were prepared for energy audit. All the questionnaires comprise of group of modules. The first module is related to the general information of the concerned department, which broadly includes name of the department, month and year, total

number of students and employees, visitors of the department, average working days and office timings etc. The next module is related to the present consumption of resources energy. There are possibilities of loss of resources like water, energy due to improper maintenances and assessment of this kind of probability is necessary in Energy Audit. One separate module is based on the questions related to this aspect. Another module is related to maintaining records, like records energy bill, equipment warranty specification, etc. For better convenience of the surveyor, some statistics like, basic energy consumption characteristics for electrical equipment etc. was provided with the questionnaires itself.

2.3 Onsite visit and observations: The New Miraj Education Society's Kanya Mahavidyalaya, Miraj has vast built-up area comprising of various departments, administrative building, teachers, sports complex and health center. All these amenities have different kind of infrastructure as per their requirement. All these buildings were visited by the surveyors and the present condition is checked with the help of the questionnaires. Personal observations were made during the onsite visit. All the amenities were clubbed in as per their similarities and differences, which makes the survey and further analysis easier.

After collection of secondary data, the reviews related to each environmental factor were taken by the energy audit team. The data was tabulated, analyzed and graphs were prepared using computer. Depending upon the observations and data collected, interpretations were made. The lacunas and good practices were documented. The Energy Management Plan (EMP) was prepared for the next academic year in order to have better environmental sensitization. Finally, all the information was compiled in the form of energy Audit Report.

2.4 Data analysis and final report preparation: A proper analysis and presentation of data produced from work is a vital element. In case of Energy Audit, the filled questionnaires of the survey from each group, were tabulated as per their modules, in Excel spreadsheets. The tabulated data is then used for further analysis. For better understanding of the results and to avoid complications, averages and percentages of the tables were calculated. Graphical representation of these results was made to give a quick idea of the status. Interpretation of the overall outcomes was made which incorporates all the primary and secondary data, references and interrelations within. Final report preparation was done using this interpretation.

Chapter III

Observation and Result

3. The New Miraj Education Society's Kanya Mahavidyalaya, Miraj, Energy Consumption Audit Report (June 2023 to May 2024): comprehensive analysis

3.1.1 Introduction

The Kanya Mahavidyalaya, Miraj, of The New Miraj Education Society had its energy usage statistics analyzed in this thorough audit report on energy consumption. From June 2023 to May 2024, the data—which is based on energy billing records are available. The purpose of this study is to shed light on trends in energy use, pinpoint high-use regions, and give suggestions for improving energy efficiency on college campuses. Electricity is provided by the Maharashtra State Electricity Board, while liquid petroleum is the principal energy source used. The main energy users on campus are the computer labs' electronic appliances as well as the classroom, offices, and other types of equipment.

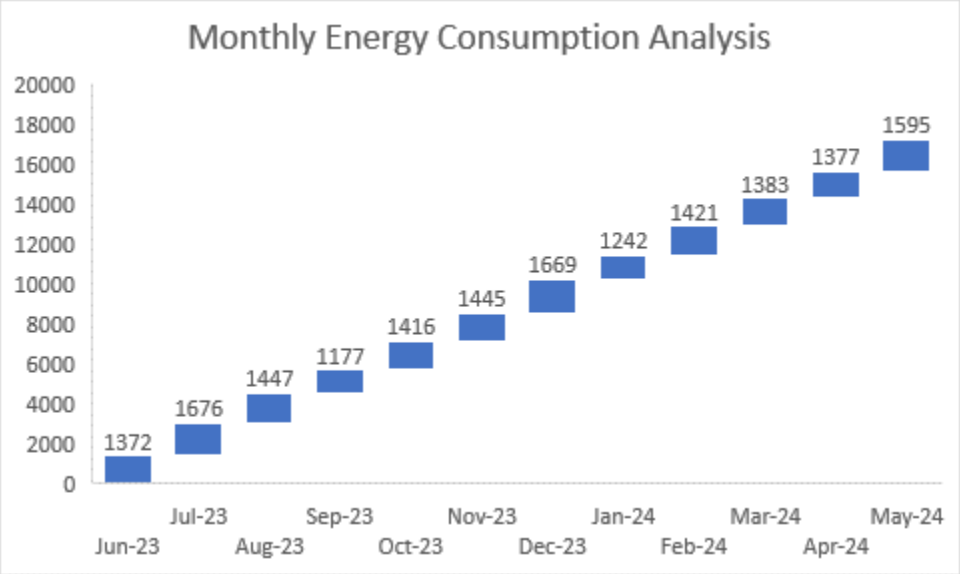
3.1.2 Methodology: The methodology employed for the energy audit involved meticulous data collection and analysis. Monthly data for energy consumption in units (kWh), sanctioned and connected load in kilowatts (kW), and corresponding billing amounts were sourced from institutional records and utility bills. This comprehensive dataset formed the basis for understanding trends and making informed recommendations.

3.1.3 Energy Consumption Data Overview

Table No. 3.1 The monthly energy consumption data for the given period, expressed in kWh, is summarised in the following table:

Sr. No	Month	Sanctioned and Connected load (kW)	Units
1	Jun-23	19	1372
2	Jul-23	19	1676
3	Aug-23	19	1447
4	Sep-23	19	1177
5	Oct-23	19	1416
6	Nov-23	19	1445

7	Dec-23	19	1669
8	Jan-24	19	1242
9	Feb-24	19	1421
10	Mar-24	19	1383
11	Apr-24	19	1377
12	May-24	19	1595



Graph No. 3.1 Graphical presentation of total units in year 2023-24

The amount of energy used in June 2023 was 1,372 kWh. The summer break, which reduces activity on campus and, consequently, energy demand, is the reason for this very mild usage. Peak use occurred in July 2023 (1,676 kWh), probably as a result of the start of the academic year. This increase was caused by people using air conditioning, lighting, and technological equipment more frequently in anticipation of the new term. The use dropped to 1,447 kWh in August 2023. This decrease is in line to the way campus life stabilized after the first rush at the beginning of the academic year. The amount of energy consumed decreased significantly to 1,177 kWh in September 2023. Holidays or fewer academic activity at this time may be the cause of this decline. October 2023 saw a rise in usage to 1,416 kWh, most likely as a result of getting ready for midterm exams and other academic obligations. With a minor increase and a regular pattern, the energy consumption in November 2023 was 1,445 kWh, demonstrating continuous academic activities. Due to end-of-semester activities and prolonged usage of heating systems during the winter, consumption increased to 1,669 kWh

in December 2023. Consumption dropped to 1,242 kWh in January 2024, maybe as a result of the winter break and less activity on campus. With the start of the new academic year and regular campus activities, energy consumption increased to 1,421 kWh in February 2024. With a consumption of 1,383 kWh in March, regular academic activities are consistent with stable usage. The energy consumption in April showed very little variation, staying constant at 1,377 kWh. May saw an increase in energy consumption to 1,595 kWh, most likely as a result of getting ready for final exams and using air conditioning units more frequently as the temperature rises.

According to the data, the beginning of the academic year and end-of-semester activities, respectively, corresponded with the peak energy consumption months, July and December, respectively. January and September had the lowest consumption, which makes sense given the slower-paced academic schedules. The administrative building uses a lot of energy because it uses a lot of lights, air conditioning, and office supplies. The building's energy consumption is largely constant throughout the year, with only slight variations based on outside weather and administrative workload. The use of electronic appliances in computer labs and classrooms is the main cause of the Arts and Commerce Department's high energy usage. This department's irregular energy use concerns the academic calendar, peaking during challenging coursework and examinations. Because of the use of lighting, the support services add to the total energy consumption. With minor increases during times of high student activity, the energy demand in these areas is generally constant.

3.1.4 Energy Efficiency Recommendations

Finding possible areas for energy savings and efficiency gains can be aided by routine energy audits. A detailed inspection of all lighting systems, HVAC (heating, ventilation, and air conditioning) systems, and electrical appliances should be part of these audits. An important way to significantly decrease energy use is to swap out old, inefficient appliances for new, energy-efficient models. Modern, energy-efficient HVAC systems should be installed in place of outdated ones, and LED lighting systems should be upgraded. Adding motion sensors and timers to the lighting system can help reduce the amount of light that is used unnecessarily. Places like restrooms, hallways, and conference rooms are examples of spaces where this works especially well. HVAC systems can operate more efficiently with proper maintenance and optimisation. This entails using programmable thermostats to control heating and cooling in accordance with occupancy schedules, maintaining appropriate

insulation, and cleaning filters on a regular basis. Educating employees and students about energy-saving techniques can help to promote an energy-efficient culture. Considerable energy savings can be achieved by taking easy steps like turning off lights and appliances when not in use and making the best use of natural light. It is advisable to investigate the viability of implementing renewable energy sources, like solar panels. The campus's carbon footprint can be decreased and electricity usage from the grid can be balanced by renewable energy. Lowering energy costs and improving overall energy efficiency can be achieved through peak load demand management and reduction techniques like load shifting and staggered use of high-energy equipment.

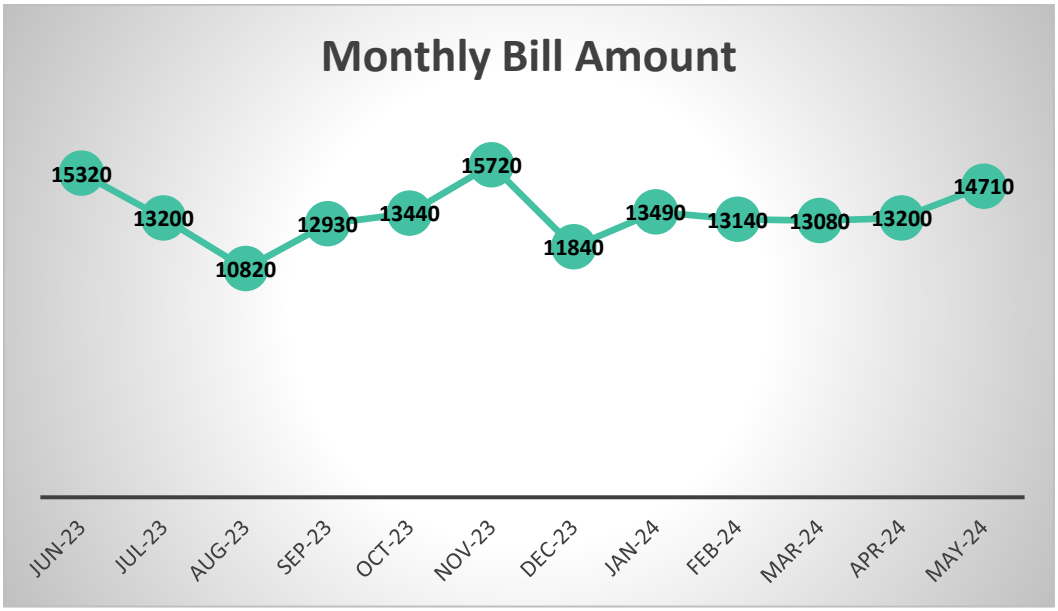
Seasonal variations and the academic calendar are closely linked patterns found in the energy consumption data of The New Miraj Education Society's Kanya Mahavidyalaya, Miraj. The college can save a substantial amount of energy, lower operating expenses, and support environmental sustainability by putting the suggested energy efficiency measures into practice. To maintain continuous improvement and adherence to best practices in energy management, regular monitoring and assessment of energy usage will be crucial. This thorough audit report on energy consumption gives a clear picture of the patterns of current energy use and practical recommendations for improving energy efficiency on campus. The New Miraj Education Society's Kanya Mahavidyalaya can establish a standard for sustainability and energy efficiency in educational institutions by taking a proactive approach to energy management.

3.1.5 Bill amount

Table No. 3.2 The monthly bill amount corresponding to the energy consumption are as follows:

Sr. No	Month	Bill Amount
1	Jun-23	15320
2	Jul-23	13200
3	Aug-23	10820
4	Sep-23	12930
5	Oct-23	13440
6	Nov-23	15720
7	Dec-23	11840

8	Jan-24	13490
9	Feb-24	13140
10	Mar-24	13080
11	Apr-24	13200
12	May-24	14710



Graph No. 3.2 Graphical presentation of monthly bill amounts in year 2023-24

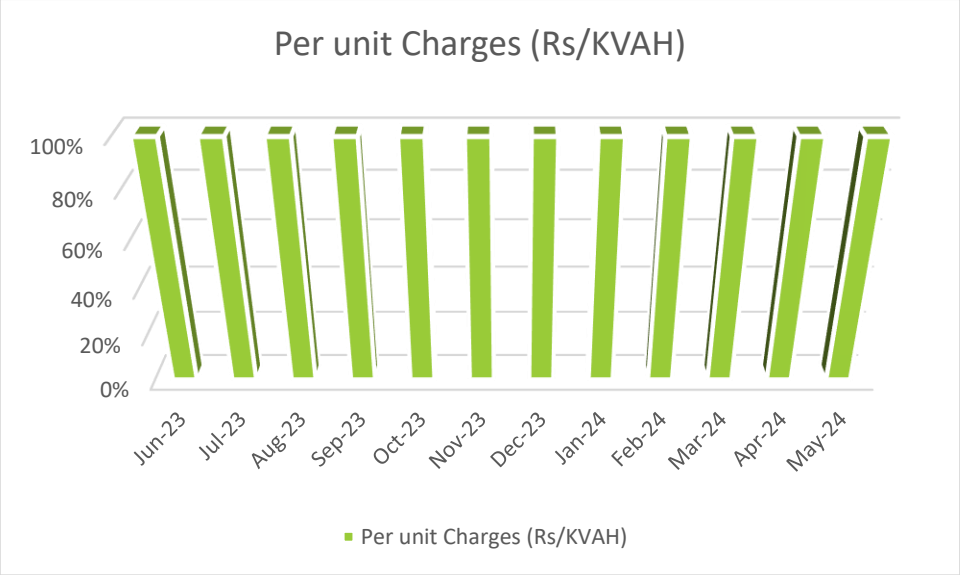
The following table shows the monthly electricity bill amounts for Kanya Mahavidyalaya, Miraj, which is owned by The New Miraj Education Society, for June 2023 through May 2024. The amounts on the bills vary from season to season and from academic year to academic year, reflecting variances in energy consumption. The highest bill, 15,320 INR, was probably incurred in June 2023 because of the arrival of summer and the increased use of air conditioning systems. The bill dropped to 13,200 INR in July to mark the beginning of the academic year. August had the lowest bill amount, 10,820 INR, which may have been the result of less activity on campus. In September and October of this year, the bill went up once more to 12,930 INR and 13,440 INR, respectively, in line with the return of regular academic operations. November's bill was the highest of the semester at 15,720 INR, possibly because of increased heating needs and increased campus activities in the final weeks of the term. The bill dropped to 11,840 INR in December, suggesting that there might have been a day of rest. The bills for the months of January and February were 13,490 and 13,140 INR,

respectively, indicating a consistent pattern of use. Bills for the months of March, April, and May were comparatively stable at 13,080 INR, 13,200 INR, and 14,710 INR, respectively. These values were in line with regular academic schedules and seasonal variations. This information gives a clear picture of how academic and seasonal factors affect the college's electricity costs as they change over the course of the month.

3.1.6 Overall unit charges year 2023-24:

Table no.3.3 Overall energy consumption (year 2023-24)

Sr. No	Month	Per unit Charges (Rs/KVAH)
1	Jun-23	11.166
2	Jul-23	7.876
3	Aug-23	7.478
4	Sep-23	10.986
5	Oct-23	9.492
6	Nov-23	10.879
7	Dec-23	7.094
8	Jan-24	10.862
9	Feb-24	9.247
10	Mar-24	9.458
11	Apr-24	9.586
12	May-24	9.223



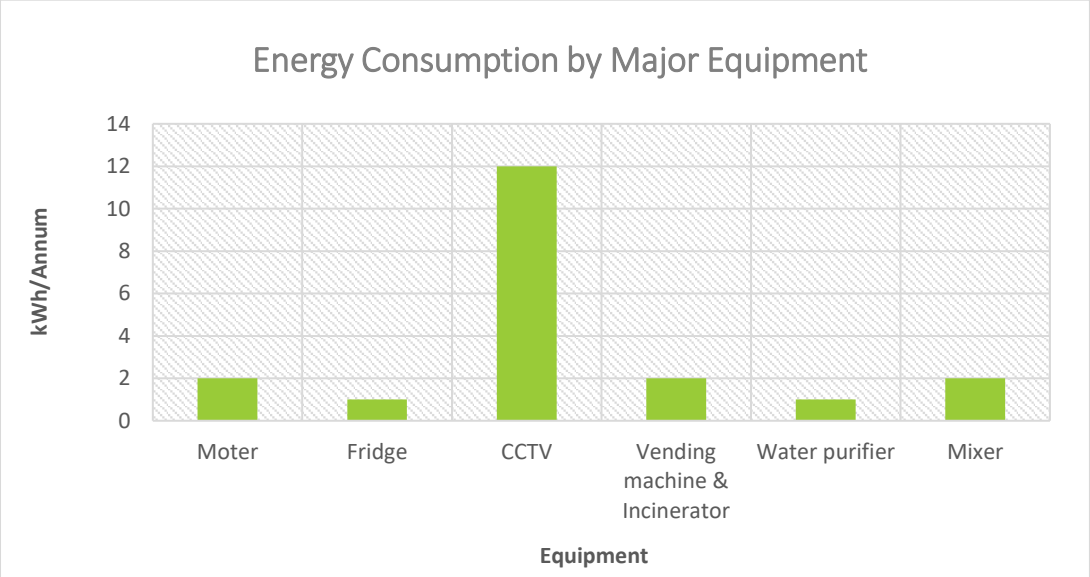
Graph No.3.3 Graphical representation of actual per unit charges from 2023-24

The electricity consumption charges at The New Miraj Education Society's Kanya Mahavidyalaya, Miraj, per unit (Rs/KVAH) from June 2023 to May 2024 are shown in the table. These charges, which represent the cost per kilovolt-ampere-hour (KVAH), vary significantly from year to year, suggesting changes in energy prices and potentially shifting consumption patterns. The highest per unit charge of 11.17 Rs/KVAH was recorded in June 2023. This might be the result of higher charges or increased demand in the summer. In July and August of 2023, the fees decreased dramatically to 7.88 and 7.48 rupees per KVAH, respectively. This decline was likely caused by lower energy rates or lower consumption. The charges in September 2023 increased significantly to 10.99 Rs/KVAH, and in October 2023 they remained at 9.49 Rs/KVAH. This increase was probably caused by the return to regular academic activities and higher energy consumption. Due to increased energy use near the end of the semester, the per unit charge increased to 10.88 Rs/KVAH in November 2023. December 2023 had the lowest charge of 7.09 Rs/KVAH, presumably as a result of lower activity during the holiday season. The increase to 10.86 Rs/KVAH in January 2024 suggests that regular usage has resumed following the holidays. While charges in March and April 2024 were relatively stable at 9.46 and 9.59 Rs/KVAH, respectively, February 2024's charges were slightly lower at 9.25 Rs/KVAH. The per unit charge dropped to 9.22 Rs/KVAH in May 2024, showing a steady trend with small variations. These variations show how dynamic pricing and consumption of electricity are, impacted by factors such as academic schedules, seasonal variations, and potentially varying tariff rates from the electricity supplier.

3.1.7 Energy consumption by major instruments:

Table no.3.4 Energy consumed per annum by major instruments in all the departments and administrative room of college

Sr. No.	Equipment	Number	kWh/Annum
1	Moter	2	2312
2	Fridge	1	693.6
3	CCTV	12	1528
4	Vending machine & Incinerator	2	1523.2
5	Water purifier	1	664.7
6	Mixer	2	462.4
7	Oven	1	1734



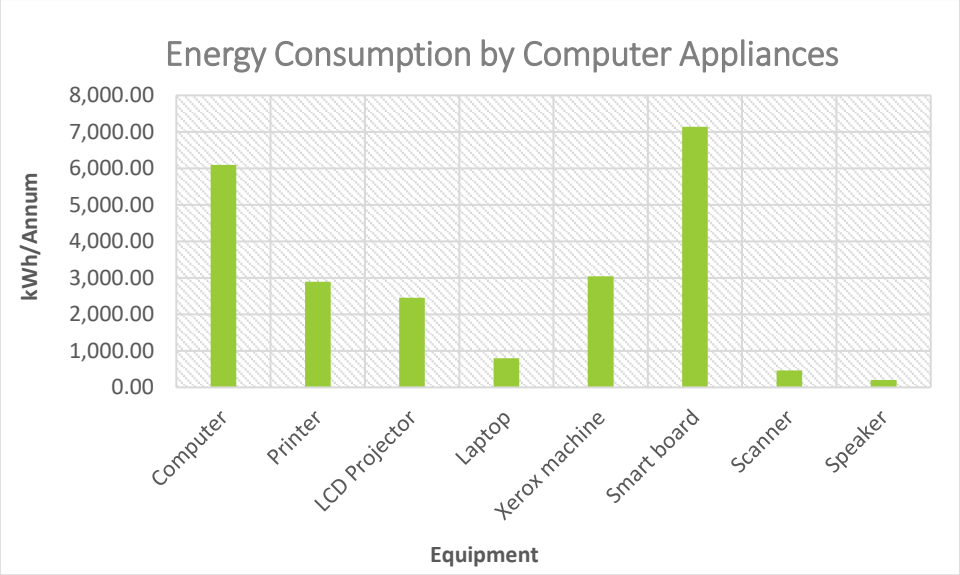
Graph No.3.4: Energy consumed per annum by major instruments at all departments and administrative room in the college

The New Miraj Education Society's Kanya Mahavidyalaya in Miraj has had its major instrument energy consumption for a full year, as well as the energy consumption of the administrative room, examined. Two motors make up a substantial portion of several operations, as evidenced by the data, which shows that their combined yearly consumption comes to 2,312 kWh. In use, the one refrigerator uses 693.6 kWh annually, which is a moderate but necessary amount of energy. At 6,528 kWh annually, the security system which

consists of 12 CCTV units is a significant energy user. The necessity of operating efficiently and possible areas for energy-saving upgrades are highlighted by this high usage. Together, the two incinerators and vending machines consume 1,523.2 kWh of energy annually, which is a significant amount of energy for these commonplace appliances. The water purifier uses 664.7 kWh a year to guarantee that clean drinking water is available. Mixers are another significant energy consumer; two units, used in canteens or laboratories, use 462.4 kWh annually. Last but not least, the college's oven, which uses 1,734 kWh a year, is a major energy consumer, probably in the areas used for food preparation. These important instruments use 13,917.9 kWh a year in total. This thorough examination of equipment usage identifies important areas for possible gains in energy efficiency and emphasises the significance of routinely assessing and optimising energy use within the organisation.

Table No. 3.5: Electronic Appliances and their energy consumption (kWh/Annum) at all departments, Computer Laboratories and Administrative room in the college

Sr. No.	Equipment	Number	kWh/Annum
1	Computer	41	6,098.75
2	Printer	10	2,890
3	LCD Projector	5	2,456.50
4	Laptop	12	799.68
5	Xerox machine	2	3,046.40
6	Smart board	3	7,140
7	Scanner	2	462.4
8	Speaker	16	198.01



Graph No. 3.5: Electronic Appliances and their energy consumption (kWh/Annum) at all departments, Computer Laboratories and Administrative room in the college.

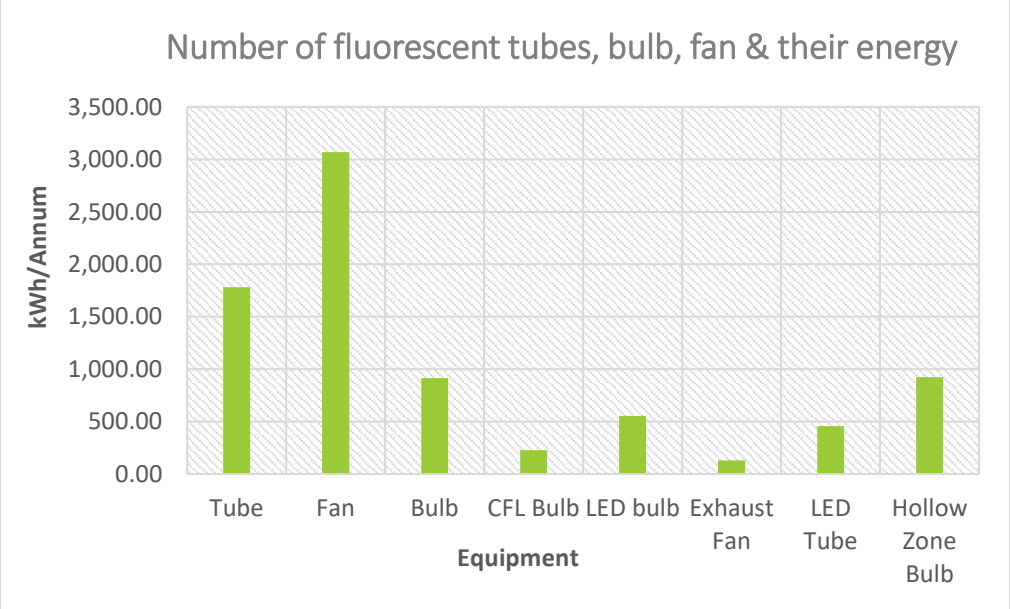
At The New Miraj Education Society's Kanya Mahavidyalaya, Miraj, the energy consumption of electronic appliances in all departments, computer labs, and administrative rooms has been thoroughly examined. The results have provided important new information about the total amount of energy used. The 41 computers that are in use at the college use 6,098.75 kWh a year, which is indicative of their vital role in both administrative and academic operations. The 10 printers that are in use also use 2,890 kWh annually, which emphasises how important they are for academic assignments and documentation. In addition, the college uses five LCD projectors, which use 2,456.5 kWh a year and are necessary for lectures and presentations. In addition, 12 laptops add 799.68 kWh to the annual energy usage, demonstrating their importance even though they use less energy than desktop computers. The fact that two Xerox machines use 3,046.4 kWh annually highlights how important they are for copying materials and documents. With three units consuming 7,140 kWh annually, smart boards are significant energy consumers that play a significant part in contemporary educational activities. In addition, the college runs two scanners that use 462.4 kWh annually and are necessary for scanning papers and course materials. Finally, the combined yearly consumption of 16 speakers, despite their small individual consumption, adds up to 198.01 kWh across departments.

Overall, this analysis shows the important areas of energy use, with smart boards and computers being the biggest users. This data is essential for formulating plans to improve

energy efficiency, like switching to newer, more energy-efficient equipment, streamlining usage patterns, and encouraging staff and students to practice energy conservation. The college may significantly decrease its overall energy use and operating expenses by concentrating on these areas.

Table No. 3.6: Number of fluorescent tubes, bulbs and fans and their energy consumption (kWh/ Annum) at all departments in the college

Sr. No.	Equipment	Number	kWh/Annum
1	Tube	77	1,780.24
2	Fan	43	3,070.20
3	Bulb	60	913.92
4	CFL Bulb	15	228.48
5	LED bulb	16	554.88
6	Exhaust Fan	2	129.47
7	LED Tube	30	456.96
8	Hollow Zone Bulb	8	924.8



Graph No.3.6: Number of fluorescent Tubes, bulbs and fans and their energy Consumption (kWh/ Annum) at all departments in the college

The Kanya Mahavidyalaya, Miraj, of the New Miraj Education Society has comprehensive data on the energy usage of different lighting and cooling devices throughout its departments. The college runs 43 fans that use 3,070.2 kWh annually and 77 fluorescent tubes that use 1,780.24 kWh annually. In addition, 15 CFL bulbs and 60 conventional bulbs use 228.48 and 913.92 kWh of energy each year, respectively. An increase in energy-efficient lighting is evident in the usage of 30 LED tubes, which use 456.96 kWh, and 16 LED bulbs, which use 554.88 kWh. Additionally, the college uses 129.47 kWh for 2 exhaust fans and 924.8 kWh for 8 hollow zone bulbs per year. The annual energy consumption of these fixtures comes to 8,058.95 kWh. The significance of lighting and cooling in the college's energy profile is emphasised by this data, which also points to additional opportunities for energy savings through sustained adoption of energy-efficient practices and technologies.

Key Observations:

1. Monthly Energy Use and Costs: The monthly energy consumption ranges from 1,177 kWh to 1,676 kWh, and the associated bills are between ₹10,820 and ₹15,720.

2.Variable Per Unit Charges: The monthly bill amounts are impacted by the variable per unit electricity cost, which varies from ₹7.09 to ₹11.17.

3.Major Instrument Energy Consumption: Every year, 13,917.9 kWh are consumed by major instruments like motors and CCTV systems, with the latter being the most significant consumer.

4.Electronic Appliances in Departments and Laboratories: With an annual energy consumption of 23,091.74 kWh, computers, Xerox machines, and smart boards are major energy consumers.

5.Lighting and Cooling Equipment: The annual energy consumption of fans, fluorescent tubes, and hollow zone bulbs is 8,058.95 kWh.

6.Aggregate Annual Consumption: 45,068.59 kWh is the total yearly energy consumption of all significant instruments, appliances, and lighting equipment.

7.Potential for Energy Savings: LED lighting can replace conventional lighting and high-energy-consuming equipment can minimise energy use.

8.Impact of Seasonal Variations: Higher cooling requirements during the warmer months lead to a peak in energy usage, which emphasises the need for effective cooling solutions.

9.Overall Energy Efficiency: The college's energy footprint is being reduced by the transition to energy-efficient technologies like LED lighting and energy-efficient appliances.

10.Strategic Recommendations: Carry out routine energy audits, swap out energy-intensive equipment for more energy-efficient models, encourage energy-saving behaviours, and put in place intelligent energy management systems for real-time monitoring and optimisation.

Chapter IV

Summary and Conclusion

Summary:

Energy Audit is one of the important tools to check the balance of natural resources and its judicial use. Energy auditing is the process of identifying and determining whether institutional practices which are eco-friendly and sustainable. It is a process of regular identification, quantification, documenting, reporting and monitoring of environmentally important components in a specified area. The Department of Environmental Science, Shivaji University, Kolhapur has conducted an "Energy Audit" of The New Miraj Education Society's Kanya Mahavidyalaya, Miraj in the academic year 2023-24. The main objective to carry out energy audit is to check the Energy Audit practices followed by college and to conduct a well-defined audit report to understand whether the college is on the track of sustainable development. After completing the audit procedure of college for Energy Audit practices, there are following conclusions, recommendations and Energy Management Plan (EMP) which can be followed by college in future for keeping campus environment friendly.

The New Miraj Education Society's Kanya Mahavidyalaya in Miraj has conducted an energy audit that has revealed the college's usage patterns and highlighted important areas where savings could be made. The range of monthly energy usage, which varies from 1,177 kWh to 1,676 kWh, is caused by variations in the per unit charges, which vary from ₹7.09 to ₹11.17. Large-scale devices like motors and CCTV systems use 13,917.9 kWh yearly, whereas electronic devices like computers, Xerox machines, and smart boards use 23,091.74 kWh. Fans, fluorescent tubes, and hollow zone bulbs are among the lighting and cooling devices that consume 8,058.95 kWh a year. 45,068.59 kWh of energy are consumed annually across all of these categories combined.

Conclusion:

The Kanya Mahavidyalaya, Miraj, of The New Miraj Education Society has a lot of potential to improve energy efficiency and cut expenses, according to the energy audit. The total amount of energy used is significantly increased by high-energy devices like smart boards, CCTV systems, and conventional lighting fixtures. During the warmer months, the need for efficient cooling solutions is highlighted by seasonal variations in energy consumption. The college is making progress in lowering its energy footprint by switching to

more energy-efficient technologies, like LED lighting. Even so, there is still a good chance that additional savings can be achieved by replacing outdated equipment and optimizing usage.

From the Energy Audit, following are some of the conclusions which can be taken for improvement in the campus.

1.Installation of solar panels provides ample amount of electricity. Such solar modules should be installed wherever possible in the campus.

2.Use of LED lamps and Tube Lights is minimum and is to be encouraged.

3. Computer and office equipment consuming more energy in the college. The replacement of old equipment can be beneficial for solving this issue.

4. The replacement of florescent tube by LED can be beneficial for solving electricity consumption issue.

Recommendations:

Following is some of the key recommendations for improving campus environment:

1.Conduct Regular Energy Audits: To track and examine patterns of energy consumption and pinpoint new areas in need of improvement, conduct regular energy audits.

2. Replace High-Energy Devices: Give priority to swapping out old electronic appliances and conventional lightbulbs for more energy-efficient models, such as LED lighting and ENERGY STAR appliances.

3. Optimise Usage Schedules: Create and carry out high-energy equipment usage schedules that make sure the equipment is only used when required and turned off when not in use.

4. Promote Energy-Saving Practices: Inform employees and students about energy-saving techniques and encourage actions that improve energy efficiency as a whole, like shutting off lights and appliances when not in use.

5. Implement Smart Energy Management Systems: Make an investment in intelligent energy management systems to track and manage energy consumption in real time, allowing for quick corrections and enhancements.

6. Upgrade Cooling Solutions: Use energy-efficient fans and air conditioners, as well as better insulation, to increase the effectiveness of cooling solutions, especially during times of high usage.

7. Pay Attention to Major Instruments and Appliances: Make sure major instruments and appliances are regularly serviced and maintained to ensure optimal performance. Upgrades should be taken into consideration when significant energy savings can be realised.

The New Miraj Education Society's Kanya Mahavidyalaya, Miraj, can save a significant amount of energy, cut expenses associated with running the facility, and help create a more sustainable future by implementing these suggestions.

Chapter V

Energy Management Plan (EMP):

By understanding the dynamics of present situation of resource utilization and current Energy Audit practices, the Department of Environmental Science has prepared an "Energy Management Plan" for the New Miraj Education Society's Kanya Mahavidyalaya, Miraj. This plan will reveal the strengths and weaknesses and suggests remedies to develop Energy Audit campus. The EMP also gives suggestion for the priority of work to carry out.

Energy Management Plan

Sector	Strengths	Weakness	Suggestions	Priority
Electricity	The dedication to energy-efficient technologies like LED lighting and the support provided by contemporary electronic appliances for efficient operations.	Consist of large seasonal variations in energy consumption, high energy consumption from outdated, inefficient lighting and cooling equipment, and a reliance on conventional, less energy-efficient appliances.	1. Install energy-efficient LED lighting and ENERGY STAR-rated appliances in place of outdated cooling and lighting systems. 2. To improve efficiency, use smart systems to track and manage energy usage in real time. 3. Inform employees and students about energy-saving techniques, such as shutting off lights and appliances when not in use. 4. Installation of sensor-based electrification for fans, lights, etc. Useof solar pumps for water tanks. 5. Installation of solar panels on the top of building can reducethe use of conventional energy.	Medium