Analytics of electrical system to improve its efficiency with the help of energy audit

Swaraj Ambekar, Yash Daimiwal, Pratik Yadav, Prof. Mrs. Madhura Tuljapurkar
PES Modern College of Engineering

***Abstract*-An essential tool for assessing patterns of energy use and finding areas for cost and energy savings is an energy audit. This study presents the findings of an energy audit conducted at [insert name/type of facility] with the aim of assessing the effectiveness of energy use and suggesting enhancements to overall energy performance. Extensive data collection, fuel and power consumption analysis, equipment performance evaluation, and identification of the primary energy-consuming systems were all part of the audit process. The areas with excessive energy waste, inefficient equipment, and unsafe operating procedures were highlighted in the main results. A list of suggestions, spanning from capital-intensive retrofits to low-cost behavior change, was derived from the investigation. By following these measures, energy consumption may be reduced by an estimated [insert percentage]% and significant cost savings can be realized, all while supporting environmental initiatives. The importance of energy management in reducing environmental impacts and enhancing operational efficiency is emphasized by this audit.**

***Keywords*- energy, audit, saving, consumption, cost**

I. INTRODUCTION

The globe is currently plagued by a multitude of issues that do significant harm to all people. Climate change and pollution are the major issues. Humans engage in these actions in order to generate energy from fossil fuels.[1]Energy conservation is vital since energy generation is highly expensive. A variety of safety devices are placed within the electrical system, which has a lengthy connected networking system, and a variable load is hooked into the system. This results in a loss of electrical energy that is transferred as heat energy, which lowers the system efficiency and power consumption. This can be minimized by using the modus operandi energy auditing, which guarantees the identification of the entire electrical system's performance; if there are leaks, these will be found and fixed, extending the lifespan of the electrical and electronic equipment [2]. Depending on the type of energy audit and the reason for the energy audit facility, the energy audit may start with looking at the electricity bill, which shows energy usage. The energy audit has been conducted by various researchers in different ways for the energy consumption has been presented in [3], and it states that energy audit in the residential house and the given advice on how to utilize the energy efficiently, which can help lower the rate on their power bill. The programs on energy auditing procedures and Ecuadorian policies are examined in Reference [4]. To clarify, an energy audit is an examination of the energy usage of a specific space or facility. The first step in effective energy management is energy conservation, which may be achieved by employing equipment with the proper rating, high-efficiency devices, and a shift in habits that result in significant energy audit waste [5]. Regular energy auditing will show the electrical energy consumption and wastage of electrical energy, it also helps in suggesting the new energy-saving opportunities and it is reviewed in reference [6].

Need for energy audit

1 an energy audit can reduce energy consumption.
2 an energy audit can reduce the energy bill and save the money.
3 an energy audit can improve the comfort level.
4 an energy audit can reduce the carbon footprints.
5 an energy audit can reduce unnecessary waste and pollution.

II. METHODOLOGY

The Preliminary Assessment Methodology-systematic process that evaluates the possible effects of a project in its first phase. It starts with establishing the project's goals and scope, then it collects existing data and identifies important stakeholders, visits the site to observe current conditions, analyzes potential environmental and social impacts, suggests initial mitigation measures, and concludes with a report that makes recommendations about whether a full evaluation is

necessary.

Data Collection-The process of methodically gathering relevant data to support analysis and decision-making is known as the data collection methodology. Selecting the appropriate instruments, such as surveys, interviews, observations, or records, comes after identifying the data requirements and sources. To guarantee accuracy and consistency, data is gathered in a methodical manner. To allow insightful conclusions and additional action, the data is verified, sorted, and readied for analysis after collection.

Energy Monitoring & Measurements- In order to identify inefficiencies and improve efficiency, the Energy Monitoring & Measurements Methodology comprises tracking and evaluating energy usage. Establishing baseline energy consumption levels and selecting appropriate monitoring equipment are the first steps. At regular intervals, sensors and meters are used to collect data. Patterns, periods of peak demand, and locations of energy waste are found by analyzing the collected data. Making well-informed judgments on energy-saving projects, efficiency improvements, and sustainable energy management techniques is made easier by this procedure.

Data Analysis- To obtain useful information, the Data Analysis Approach comprises evaluating and interpreting collected data. To make the data reliable and consistent, the first step is to organize and clean it. Depending on the study's objectives, particular analytical techniques are then used, such as statistical analysis or comparative analysis.

Identification of Energy Saving Opportunities- In order to find areas where energy consumption can be reduced without sacrificing performance, it is necessary to analyze patterns of energy utilization. To find waste or inefficiency, this involves analyzing the effectiveness of the equipment, procedures, and system configurations.

Recommendations and Implementation- In order to improve performance and efficiency, recommendations and implementation involve making practical suggestions based on data analysis and issues found. A clear action plan is then created after the proposals are rated according to their effect and viability.

Voltage Measurement

Sr. No	Parameter	Voltage
1	R-Y	410 V
2	Y-B	410 V
3	B-R	413 V
4	R-N	233.1 V
5	Y-N	235.3 V
6	B-N	233.4 V

Current measurement

Sr. No	Parameter	Current
1	R	93.5 A
2	Y	74.9 A
3	B	65.6 A
4	N	45.4 A

No Cost Recommendations

1 Maximize daylight by keeping windows and glass areas clear.

2 Turn off lights and fans when areas are unoccupied

3 Use fans with AC to circulate cool air and allow higher AC setpoints

4 Clean fan blades and motors regularly to improve efficiency

5 Increase thermostat setpoint to 24–26°C.

6 Enable sleep mode or set to hibernate after 10–15 mins of inactivity.

7 Turn off monitors and desktops at the end of the day.

Low Cost Recommendations

1 Install motion sensors in low-use areas like washrooms, corridors, staircases.

2 Use task lighting instead of brightly lighting the whole space unnecessarily.

3 Seal gaps around windows and doors to reduce cooling losses.

4 USE occupancy sensors for fans.

5 Install programmable thermostats to automate temperature settings.

Equipment Replacement Recommendations

Sr. No	Present Equipment	Present Equipment Cost (per unit)	Recommended Replacement Equipment	Recommended Equipment Cost (per unit)
1	Fluorescent Tubes	2381	LED Square light	1650
2	Mercury vapor lamp	8500	LED Street Light	2250

3	Ceiling fan (60)	1529	Ceiling fan BLDC (28)	2800
4	Ceiling fan (53)	2200	Ceiling fan BLDC (31)	3299
5	Wall fan (60)	2200	Wall fan BLDC (35)	2300
6	Air Conditioner (1.5 Ton)	-	Airtron energy saver device	10500
7	Air Conditioner (2 Ton)	-	Airtron energy saver device	10500
8	Air Conditioner (2.5 Ton)	-	Airtron energy saver device	10500
9	Computer	32690	Laptop (Lenovo)	39980

Reduced carbon Emission

Sr. No	Equipment	Energy saving (Annua)	Per Unit Carbon Emission (kg)	Reduced Carbon Emission (kg)
1	Fluorescent Tubes	13975	0.8	11180
2	Mercury vapor lamp	1410	0.8	1128
3	Ceiling fan (60)	4158	0.8	3326.4
4	Ceiling fan (53)	8577.03	0.8	6861.62
5	Wall fan (60)	1069.25	0.8	855.4
6	Air Conditioner (1.5 Ton)	6468.75	0.8	5175
7	Air Conditioner (2 Ton)	65290.05	0.8	52232.04
8	Air Conditioner (2.5 Ton)	13818	0.8	11054.4
9	Computer	268128.42	0.8	214502.73

III. CONCLUTION

We performed an energy audit at the Corporate Government Office in Rastapeth, where we examined the office's twelve-month energy bill and measured the voltage and current. The voltage was consistent, but the current was out of balance. Additionally, we inspect each office space to ascertain the total load linked in each space and group them into several equipment-based groups. We have provided suggestions with payback periods for a number of energy-intensive gadgets that are used. They may prevent needless energy use by following these suggestions.

REFERENCES

[1] Ganapathy, G. Soman, V. M. G. Manoj, R. Lekshamana, "Online energy audit and renewable energy management system," *International Conference on Computing Communication Control and automation*, Aug. 2016, pp. 1–6, doi: 10.1109/ICCUBEA.2016.7860035.

[2] P. S. Aithal, P. Sridhar Acharya, "Techniques for electric energy auditing in education system," *Int. J. Manag. IT Eng.*, vol. 5, no. 7, pp. 318-325, Jul. 2015.

[3] Kumar, S. Ranjan, M. B. K. Singh, P. Kumari, L. Ramesh, "Electrical energy audit in residential house," *Procedia Technol.*, vol. 21, pp. 625-630, 2015, doi: 10.1016/j.protcy.2015.10.074.

[4] D. Moya, R. Torres, S. Stegen, "Analysis of the ecuadorian energy audit practices: a review of energy efficiency promotion," *Renew. Sustain. Energy Rev.*, vol. 62, pp. 289-296, Sep. 2016, doi: 10.1016/j.rser.2016.04.052.

[5] A. Chakraborty, D. Dey, P. Das, "Investigation of energy consumption and reservation scheme using energy auditing techniques," *International Conference on Smart Systems and Inventive Technology*, Dec. 2018, pp. 34-38.

[6] A. M. J. Mahdi, "Energy audit a step to effective energy management," *Int. J. Trend Res. Dev.*, vol. 5, no. 2, pp. 521-525, 2018.