iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 Issue: IX Month of publication: September 2025

DOI: https://doi.org/10.22214/ijraset.2025.74003

Energy Audit of Engineering Ladies Hostel

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Abstract: This paper presents a energy audit of the Ladies Hostel at Proudadevaraya Institute of Technology (PDIT), focusing on energy consumption patterns and opportunities for improving efficiency and sustainability. The audit evaluates major energy-consuming systems, including lighting, heating, ventilation, air conditioning (HVAC), and electrical appliances, based on data collected through site inspections, utility bill analysis. Findings reveal high energy usage due to outdated lighting and inefficient appliances; transitioning to LED fixtures and optimizing natural lighting can yield substantial savings. The HVAC systems, identified as significant energy loads, are recommended for replacement with energy-efficient models and routine maintenance. Common-use appliances such as refrigerators and microwaves are outdated, prompting appliance for upgrades and energy-conscious behavior initiatives among residents. Overall, the proposed measures offer both economic and environmental benefits, aligning with broader sustainability goals, and conclude with practical recommendations for operational upgrades and awareness initiatives to foster long-term energy conservation in campus.
Keywords: Energy audit, Campus sustainability, HVAC systems, LED retrofitting.

I. INTRODUCTION

Energy audits are systematic evaluations of energy consumption patterns conducted within facilities, buildings, or organizations to identify opportunities for conservation, efficiency improvements, and cost savings. By analyzing how energy is used and where it is potentially wasted, these audits help optimize performance and reduce environmental impact.

In the context of campus housing, hostels represent a significant portion of institutional energy use due to the continuous operation of lighting, HVAC systems, and electrical appliances. This study focuses on the Ladies Hostel of Proudadevaraya Institute of Technology (PDIT), aiming to assess current consumption patterns, identify inefficiencies, and propose actionable measures for improved sustainability.

The audit evaluates outdated lighting infrastructure, energy-intensive appliances, and usage behaviors among residents. It emphasizes upgrades such as LED retrofitting, BLDC fan installations, solar water heating, and the integration of renewable energy through solar photovoltaic panels. The findings are grounded in site inspections, data analysis, and stakeholder interviews, offering both short-term savings and long-term operational benefits.

This work contributes to institutional sustainability by fostering environmental stewardship and offering practical guidelines that can be replicated across similar residential facilities.

II. LITERATURE REVIEW

Energy audits in hostel buildings reveal high energy consumption from lighting, cooking systems, and electronic devices. Studies across educational institutions emphasize the impact of structured audits— ranging from basic walk-throughs to detailed metering analyses—with recommendations like LED retrofits, steam cooking solutions, and building envelope improvements. Sameeullah [1] and Madhusudan et al. [2] demonstrate how targeted audits can uncover hidden inefficiencies and provide realistic savings with clear payback periods.

Lonare et al. [3] and Li [4] explore the value of resident engagement, daylight usage, and thermal comfort adjustments to lower consumption sustainably. Despite hurdles such as budget constraints, lack of awareness, and limited technical expertise, emerging technologies like IoT-based monitoring systems [5] and BEE policy frameworks pave the way for real-time energy tracking and strategic implementation. These audits not only reduce costs but also foster a culture of environmental responsibility among hostel residents.

III. METHODOLOGY AND DATA COLLECTION

The energy audit at PDIT Ladies Hostel was conducted through a structured multi-phase approach comprising pre-audit preparation, site-level data collection, analytical assessment, recommendation planning, and reporting.

Figure.1.PDIT Ladies hostel

A. Pre-Audit Phase

The audit scope was defined to include lighting systems, HVAC units, kitchen equipment, and general electrical loads. Initial data such as monthly energy bills, room occupancy levels, and historical consumption trends were collected. Audit planning encompassed resource allocation, timeline scheduling, and stakeholder engagement.

Figure.2. Transformer

B. Site Inspection and Data Collection

A comprehensive walk-through of the facility was performed, covering 55 rooms and shared spaces such as kitchen and mess hall. Real-time measurements were recorded using data loggers and meter readings. Visual inspection was complemented by staff interviews to identify usage behaviors. An inventory of energy- consuming appliances—including fans, fluorescent tubes, LED lights, refrigerators, pumps, and sockets— was compiled.

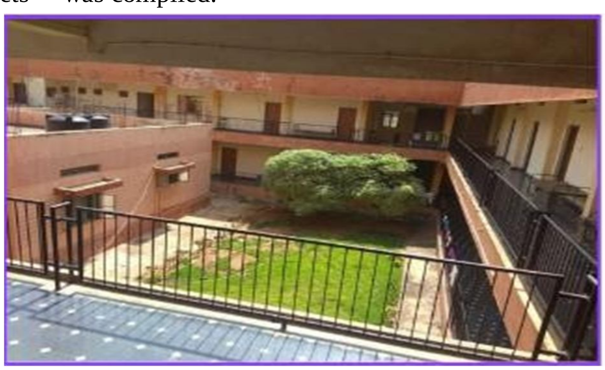

Figure .3. PDIT Ladies hostel Floors

C. Data Analysis

Energy usage data were analyzed to identify daily and annual consumption patterns. Benchmarking with similar institutions was performed to gauge efficiency gaps. Equipment with excessive energy loads, such as 75 W fans and 36 W tube lights, were flagged for replacement.

Figure.4.PDIT Hostel Water Pump

Figure.5.PDIT Hostel DG Set

D. Recommendation Development

Based on load profiling, recommendations included replacing AC induction fans with BLDC fans, tube lights with LED T-bulbs, and conventional appliances with energy-efficient models. Cost-benefit analysis revealed estimated savings of ₹5469/month.

E. Implementation Plan

An implementation roadmap was designed, including equipment procurement, stakeholder coordination, and installation sequencing. Considerations were made for future solar integration via rooftop PV systems.

IV. ENERGY CONSUMPTION ANALYSIS

The case study considered here is an engineering college boarding for ladies. Totally there are 55 rooms available for accommodation. In addition to this we have kitchen, and mess hall. These rooms have a total of 62 fans, 77 fluorescent lights, 40 zero watts bulb, 1refrigerator, 1 Grinder, 9 power sockets, 2 water pumps, 2 exhaust fans, 65 LED lights, 61sockets, 2 water purifier with cooler.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IX Sep 2025- Available at www.ijraset.com

Figure.6.Electrical Control Panel

Table.1.Energy Consumption In Hostel Rooms

Electric load	Quantity	wattage (W)	Daily hours of usage	Kwh used in a day	Kwh used in a year
Fan	55	75W	10h	41.25	12,375
Tube light	75	36W	8h	21.62	6480
LED light	57	22W	4h	10.032	3009.6
Sockets	55	65W	3h	14.3	4890
Water pump	1	5HP	2h	7.46	2238
Water pump	1	1HP	2h	1.49	447.6
Zero bulbs	40	12W	7h	3.36	1530
Power sockets	9	1500W	2h	27	4860

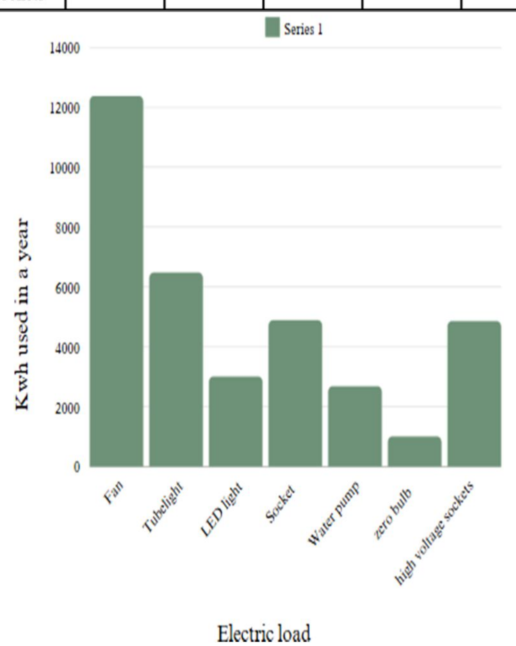

Figure.7. Energy Consumption In Hostel Rooms

The energy distribution in the over all hostel rooms is observed and tabulated under Table.1.energy consumption in the hostel rooms and graphical represented in the figure 7 given above.

TABLE.2. Energy Consumption In Hostel Mess

Electric load	Quantity	wattage (W)	Daily hours of usage	Kwh used in a day	Kwh used in a year
Fan	7	75W	6h	3.15	945
Tube light	2	36W	8h	0.576	172.8
LED light	8	22W	8h	1.408	422.4
Sockets	6	65W	4h	1.408	468
Water purifier	2	300W	15h	9	2700
Refrigerat-or	1	450W	24h	10.8	3942
Grinder	1	1500W	2h	3	600
Exhaust fans	2	65W	8h	0.52	156

The energy consumption in the hostel mess is been tabulated under the Table.2.Energy consumption in the hostel mess and also graphically represented in the above figure.9.

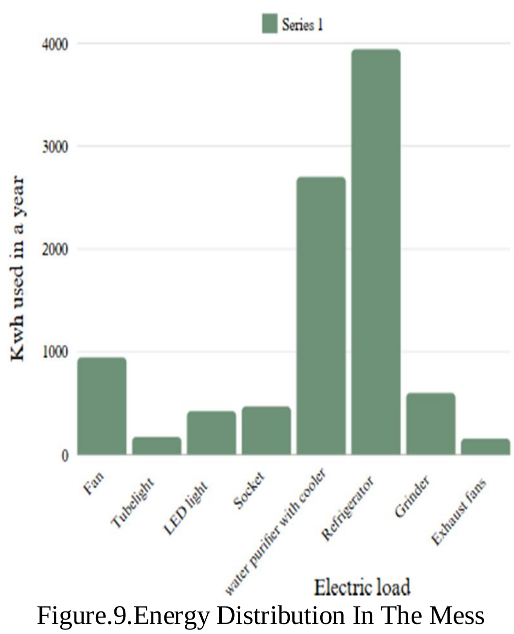

Figure.9.Energy Distribution In The Mess

As per the Audit performed it has found that the over all energy consumed in a year is 45,235.8 Kwh it is also found that the peak month where the energy is consumed at the peak point is in April and base load where the yearly consumption is very low that is on December month. It is also found that these variations is due to the seasonal effects as well as the academic year effect in the summer it is the highest consumption and during winters it has the least consumption

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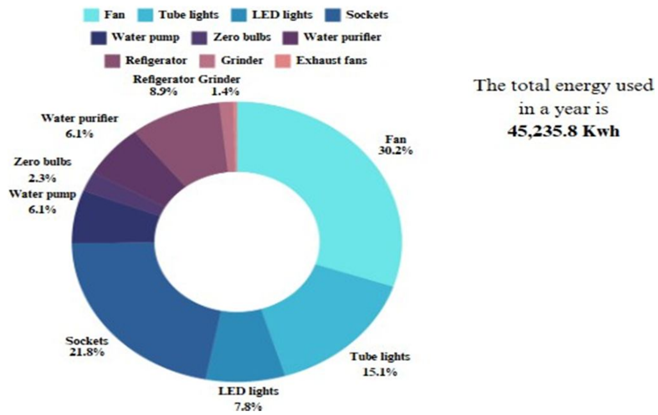

FIGURE.10. Over all Energy Distribution in Hostel

Table.3. Existing energy bill of hostel calculations performed

AREA	EQUIPMENT USED	NUMBER OF EQUIPMENTS	TOTAL ENERGY CONSUMPTIO N OF AN EQUIPMENT (PER MONTH)	TOTAL ENERGY COST PER MONTH
Accomada-tion of total rooms=55	Fan	55	990 KWH	Rs.6930.00
	Tubelights	75	518.4 KWH	Rs.3628.800
	LED bulbs	57	240.76 KWH	Rs.1685.32
	zero bulbs	40	80.64 KWH	Rs.564.48
	sockets	55	343.2 KWH	Rs.2402.40
	power sockets	9	648 KWH	Rs.4536.00
Mess	Fan	7	94.5 KWH	Rs.661.00
	Tubelights	2	17.28 KWH	Rs.120.00
	LED bulbs	8	42.24 KWH	Rs.295.00
	sockets	6	46.8 KWH	Rs.327.00
	water purifier	2	270 KWH	Rs.1890.00
	Refrigerator	1	324 KWH	Rs.2268.00
	Grinder	1	90 KWH	Rs.630.00
	Exhaust fans	1	15.6 KWH	Rs.109.00
exterior	Water pump 1	1	223.8KWH	Rs.1566.60
	Water pump 2	1	44.76KWH	Rs.313.32
TOTAL COST PER MONTH= Rs.28,217.32				

Total Daily Energy Consumption (kWh) = ∑ (Number of Devices×Power per Device (kW)×Daily .
Annual Energy Consumption=Total Daily Energy Consumption (kWh)×No. of Days in a Year

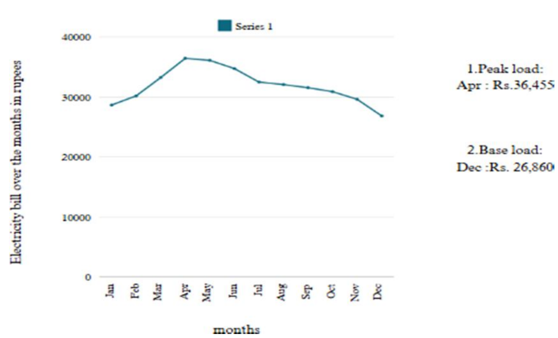

Figure.11. Energy Consumption Annually

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V. ENERGY CONSERVATION MEASURES

A. Previous Energy Consumption and Costs

Total Electricity Bill: ₹28,217 per month High-Energy consumption Appliances: Tubelights: 36W each
Fans: 75W each Refrigerator: 450W

B. Energy Efficiency Measures Implemented

Lighting Upgrades:
Old Tubelights (36W each): Replaced with 20W T-bulbs Energy Savings: 36W - 20W = 16W per bulb saved
Fan Upgrades:
Old Fans (75W each): Replaced with 40W fans Energy Savings: 75W - 40W = 35W per fan saved

C. Refrigerator Upgrade

Old Refrigerator (450W): Replaced with a 300W refrigerator
Energy Savings: 450W - 300W = 150W saved

D. New Energy Consumption and Costs

Reduced Electricity Bill: ₹22,784 per month
Total Savings: ₹28,217 - ₹22,784 = ₹5,469 saved per month
Impact Analysis Financial Benefits:
Monthly Savings: ₹5,469
Annual Savings: ₹5,467 x 12 = ₹65,628

VI. SUGESSTIONS AND RECOMMENDATION

1) Replace all fluorescent and zero watt bulbs with LED T-bulbs (20W)
2) Swap existing AC induction ceiling fans (75W) with BLDC fans (35W), which cut power consumption by ~50%.
3) Upgrade old refrigerators and grinders to energy- efficient, star-rated models.
4) Suggest using solar water heaters for long-term savings despite initial costs.
5) Schedule regular maintenance for HVAC, pumps, and other heavy-duty systems
6) Include a feasibility analysis with projected ROI for the institution
7) Install solar PV panels on rooftops to offset grid dependency and reduce carbon emissions.

VII. CONCLUSION

The energy audit conducted at PDIT Ladies Hostel has unveiled significant inefficiencies in power usage due to outdated appliances, poor lighting systems, and lack of energy-conscious behaviors. By identifying critical load contributors—such as conventional fans, tubelights, and high-power appliances—the audit outlined targeted upgrades that not only cut monthly energy costs from ₹28,217 to ₹22,784 but also projected annual savings of ₹65,628.

This initiative doesn't just reflect financial optimization; it signals a shift toward environmental stewardship through suggestions like BLDC fan installations, solar water heating, and LED lighting. Moreover, fostering resident awareness and establishing routine maintenance ensures the longevity of these improvements.

Ultimately, the audit serves as a replicable model for institutional hostels seeking sustainable energy practices. The recommended measures will transform PDIT Ladies Hostel into an eco-conscious living space, harmonizing technological upgrades with behavioral change for long- term efficiency and responsible energy use

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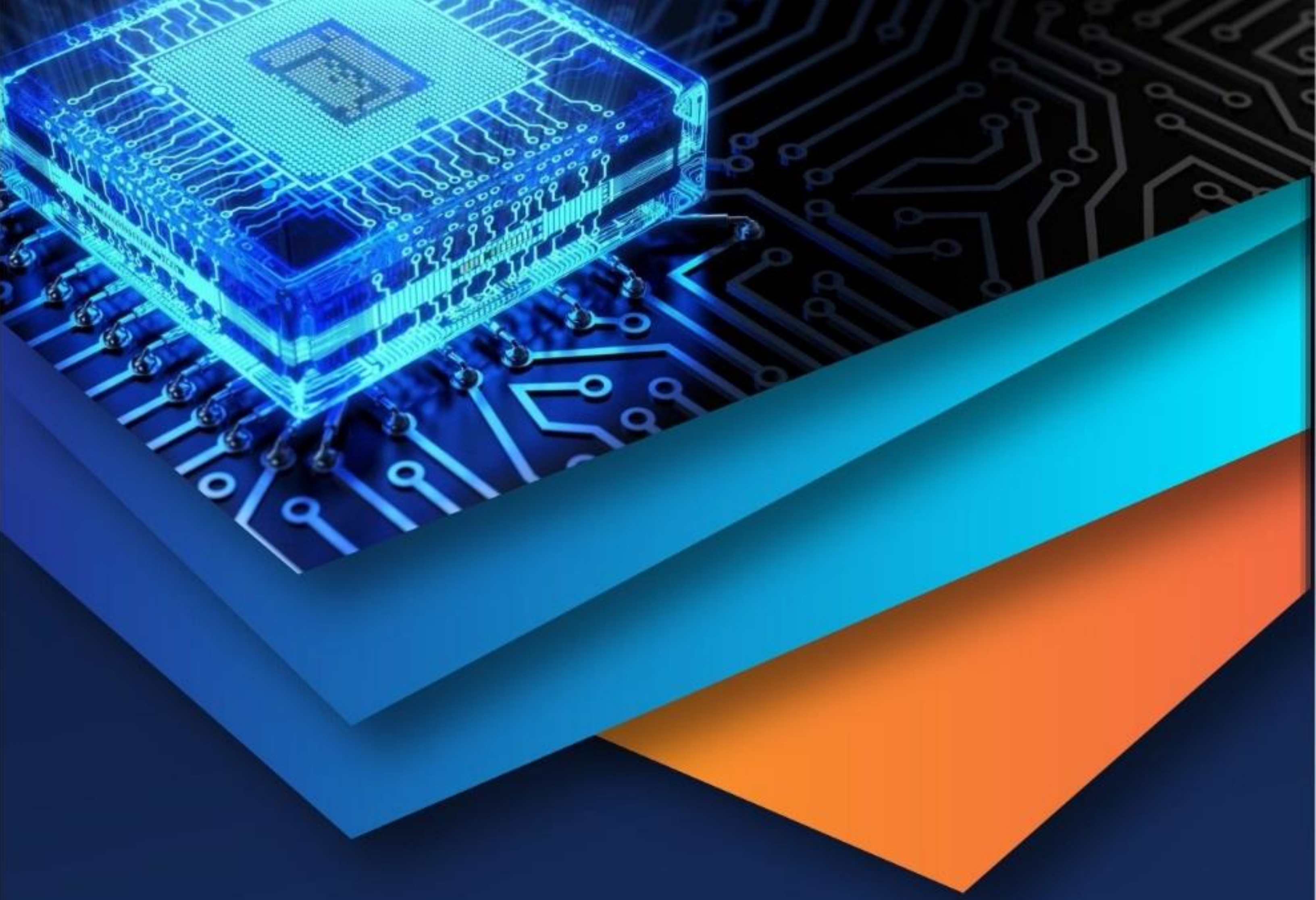

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