# DETAILED ENERGY AUDIT REPORT

# E&TC DEPARTMENT

**A REPORT ON ENERGY AUDIT & CONSERVATION MEASURES (SEMESTER - III)**

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# Society for Computer Technology and Research’s

# PUNE INSTITUTE OF COMPUTER TECHNOLOGY

# DHANKAWADI, PUNE – 43

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**- CERTIFICATE-**

This is to certify that the work incorporated in the report entitled “ENERGY AUDIT & CONSERVATION MEASURES ()) (SEMESTER - III)” is carried out by a group of students with Project Id under the subject (COMMUNITY ENGAGEMENT PROJECT) during A.Y. 2025-2026 .

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**Date:**

**Place:** PUNE

**Abstract**

This report presents the results of a **Primary (Walk-through) Energy Audit** conducted at the **Electronics and Telecommunication (E&TC) Department, Pune Institute of Computer Technology (PICT)**. The audit aimed to assess the department’s current energy consumption patterns, identify **Significant Energy Users (SEUs)**, and recommend **cost-effective Energy Conservation Measures (ECMs)** to enhance energy efficiency.

The total annual energy consumption of the department was found to be **137,349.5 kWh**, with **personal computers (PCs)** identified as the dominant energy consumers, accounting for approximately **74%** of the total usage. Based on the analysis, three major ECMs were proposed — **PC Power Management Policy**, **Choke Tube Light Replacement**, and **Ceiling Fan Replacement**. Implementation of these measures can yield an estimated annual saving of **30,319.2 kWh**, representing a **22.07% reduction** in total energy use, with a **simple payback period of 1.80 years**.

The findings and recommendations in this report support the principles of **ISO 50001:2018** for establishing an effective **Energy Management System (EnMS)** through operational control, performance monitoring, and continual improvement

**ACKNOWLEDGEMENT**

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**Chapter 1**

**INTRODUCTION**

Energy is one of the most vital resources for any educational institution, as it supports classrooms, laboratories, computer centers, and administrative facilities. The rising cost of electricity and the growing emphasis on sustainability have made energy conservation an essential aspect of campus management. Conducting an **Energy Audit** helps in assessing the energy flow within a system and identifying potential areas where energy losses can be minimized without affecting productivity or comfort.

The **Electronics and Telecommunication (E&TC) Department of Pune Institute of Computer Technology (PICT)** consumes a significant portion of the institute’s total electrical energy due to its use of computers, laboratory instruments, lighting, and ventilation systems. Therefore, an energy audit of this department provides valuable insights into current energy usage patterns and opportunities for energy savings.

**1.1 Objective of the Audit**

The primary objectives of this walk-through (primary) energy audit are as follows:

* To quantify the current energy consumption of the E&TC Department.
* To identify **Significant Energy Users (SEUs)** and analyze their contribution to total power usage.
* To propose practical and cost-effective **Energy Conservation Measures (ECMs)** to reduce electricity consumption.
* To estimate potential savings, investment requirements, and simple payback periods for the suggested ECMs.
* To align the audit recommendations with **the ISO 50001:2018 Energy Management System framework,** promoting continual improvement and sustainable energy management practices.

**1.2 Scope of Work**

The scope of this audit covers all major electrical and electronic systems within the E&TC Department at PICT, including:

* Lighting systems (LED and fluorescent tube lights).
* Ceiling and table fans.
* Personal computers and IT peripherals.
* Miscellaneous electrical loads such as laboratory equipment and office appliances.

The audit focuses **on measuring energy consumption, analyzing usage hours, identifying inefficiencies,** and **recommending improvements** through equipment replacement, policy changes, and efficient operational practices.

**1.3 Significance of the Study**

This project contributes to the college’s sustainability goals by promoting energy efficiency and awareness among students and staff. The findings demonstrate how small behavioral and technical changes can lead to significant power and cost savings. Additionally, the project provides a framework for establishing a **department-level Energy Management System (EnMS)** under **ISO 50001:2018** guidelines.

Through this study, students gain hands-on experience in real-world energy auditing, measurement, and analysis — key skills for engineers in the modern energy-conscious world.

**Chapter 2**

**METHODOLOGY**

**2.1 Pre-Audit Preparation**

* Collected historical electricity consumption data from departmental bills and sub-meters.
* Studied department layouts, equipment inventory, and operating schedules.
* Identified potential Significant Energy Users (SEUs) for detailed monitoring.
* Prepared audit checklists to systematically record data.

**2.2 On-Site Data Collection**

* Measured actual energy usage of lighting, ceiling fans, computers, and lab equipment using power meters.
* Observed operational patterns and equipment usage during peak and off-peak hours.
* Recorded equipment conditions, occupancy, and behavioral factors affecting energy consumption.
* Collected supplementary electrical parameters: voltage, current, and power factor for precise calculations.

**2.3 Data Analysis and Calculations**

* Calculated energy consumption per equipment using:
* Aggregated consumption for the department to identify high-energy loads.
* Ranked SEUs based on contribution to total energy consumption.
* Estimated potential savings and payback periods for recommended Energy Conservation Measures (ECMs) such as LED lighting and BLDC fan replacement.

**2.4 Recommendations and Reporting**

* Established an energy baseline for the department.
* Proposed practical ECMs including equipment upgrades and operational improvements.
* Designed a preliminary IoT-based energy monitoring system for continuous tracking and alignment with **ISO 50001:2018.**
* Compiled all findings, calculations, charts, and recommendations into a structured report.

**Chapter 3**

**CALCULATIONS AND RESULT**

**Energy Consumption Calculation**

• **Formula we’ll use for Calculations :**

Total Load (in watts or kW):

Total Load=∑ (Number of units × Power rating)

Total Energy Consumption (in kWh):

Energy Consumption per day = ∑ (Number of units × Power rating in kW × Usage hours)

* **Calculation Table :**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Equipment | Quantity | Power  (in W) | Usage  (Hrs/day) | Total  Load (in  W) | Total  Load  (in  kW) | Energy  Consumption(kW/Day) |
| LED Tube  lights | 104 | 20 | 8 | 2080 | 2.08 | 16.64 |
| Choke  tube lights | 27 | 60 | 8 | 1680 | 1.68 | 12.96 |
| Ceiling Fans | 136 | 60 | 8 | 8160 | 8.16 | 65.28 |
| Bulbs | 22 | 9 | 8 | 198 | 0.19 | 1.58 |
| Table fans | 3 | 60 | 8 | 180 | 0.18 | 1.44 |
| PCs | 232 | 150 | 8 | 34,800 | 34.80 | 278.40 |
| Total | 524 | - | - | 47,038 | 47.04 | 376.30 |

**Total Calculation for Daily Consumption:**

Total Connected Load = 47.04 kW

Total Daily Energy Consumption = 376.30 kWh/day

• Equipment-wise Energy Consumption:

**LED Tube Lights (104 units)**

1. Daily: 16.64 kWh
2. Monthly (30 days): 499.2 kWh
3. Yearly (365 days): 6,073.6 kWh

**Choke Tube Lights (27 units)**

1. Daily: 12.96 kWh
2. Monthly: 388.8 kWh
3. Yearly: 4,730.4 kWh

**Ceiling Fans (136 units)**

1. Daily: 65.28 kWh
2. Monthly: 1,958.4 kWh
3. Yearly: 23,827.2 kWh

**Bulbs (22 units)**

1. Daily: 1.58 kWh
2. Monthly: 47.4 kWh
3. Yearly: 576.7 kWh

**Table Fans (3 units)**

1. Daily: 1.44 kWh
2. Monthly: 43.2 kWh
3. Yearly: 525.6 kWh

**PCs (232 units):**

1. Daily: 278.40 kWh
2. Monthly: 8,352 kWh
3. Yearly: 101,616 kWh

**Totals:**

1. Daily Consumption: 376.30 kWh
2. Monthly Consumption (30 days): 11,289 kWh
3. Yearly Consumption (365 days): 137,349.5 kWh

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**Chapter 5**

**ENERGY CONSERVATION MEASURES**

**5.1Overview**Energy Conservation Measures (ECMs) are practical steps to reduce energy consumption, improve efficiency, and lower operational costs. Based on the energy audit and equipment analysis, ECMs have been proposed for significant energy users (SEUs) like PCs, fans, and lighting systems. The measures include both technical upgrades and operational improvements.

**5.2 Lighting Systems**

**5.2.1 LED Tube Lights & Choke Tube Lights Replacement**

* Replace old choke tube lights with LED tubes to reduce energy consumption.
* Estimated Savings:
  + Current consumption: 12.96 kWh/day (choke tube lights)
  + After LED replacement: ~6 kWh/day
* Payback Period: 1–2 years depending on investment cost.

**5.2.2 Bulbs Replacement**

* Replace incandescent or CFL bulbs with LED bulbs.
* Energy savings: 30–40% per bulb.

**5.3 Ceiling and Table Fans**

**5.3.1 Ceiling Fans Replacement with BLDC (Atomberg) Fans**

* Replace conventional 60 W ceiling fans with BLDC fans (28–30 W).
* Daily Energy Savings per Fan: 32 W × 8 h = 0.256 kWh
* For 136 fans: 34.8 kWh/day → Potential savings: ~50%

**5.3.2 Table Fans**

* Similarly, replace high-power table fans with energy-efficient alternatives.

**5.4 PC Power Management**

* Implement power management policies for all 232 PCs:
  + Enable sleep/hibernate during inactivity.
  + Schedule shutdown after work hours.
* Estimated savings: 15–20% of PC energy (~15–20 kWh/day).

**5.5 Summary of Energy Savings**

| ECM | Current Daily Consumption (kWh) | After ECM (kWh) | Daily Savings (kWh) | Annual Savings (kWh) |
| --- | --- | --- | --- | --- |
| LED Replacement | 16.64 + 12.96 | 6 + 16.64 | 7.32 | 2,670 |
| Ceiling Fan BLDC | 65.28 | 32.64 | 32.64 | 11,913 |
| Table Fans | 1.44 | 0.72 | 0.72 | 262.8 |
| PC Power Mgmt | 278.40 | 236.64 | 41.76 | 15,242 |
| Total Savings | 376.30 | 276 | 82.44 | 30,087.8 |

**5.6 Advantages of ECM Implementation**

* Reduced electricity bills and operational costs.
* Extended life of equipment due to efficient usage.
* Supports sustainability initiatives and ISO 50001 compliance.
* Creates awareness among students and staff regarding energy conservation.

**Chapter 6**

**Technical Solution: IoT-Based Energy Monitoring System**

**6.1Overview**

Energy Conservation Measures (ECMs) are practical steps to reduce energy consumption, improve efficiency, and lower operational costs. Based on the energy audit and equipment analysis, ECMs have been proposed for significant energy users (SEUs) such as PCs, fans, and lighting systems. The chapter also includes a **technical solution** for continuous monitoring using an IoT-based energy management system.

**6.2 Lighting Systems**

**6.2.1 LED Tube Lights & Choke Tube Lights Replacement**

* Replace old choke tube lights with **LED tubes** to reduce energy consumption.
* **Estimated Savings:**
  + Current consumption: 12.96 kWh/day (choke tube lights)
  + After LED replacement: ~6 kWh/day
* **Payback Period:** 1–2 years depending on investment cost.

**6.2.2 Bulbs Replacement**

* Replace incandescent or CFL bulbs with LED bulbs.
* Energy savings: 30–40% per bulb.

**6.3 Ceiling and Table Fans**

**6.3.1 Ceiling Fans Replacement with BLDC (Atomberg) Fans**

* Replace conventional 60 W ceiling fans with **BLDC fans (28–30 W)**.
* **Daily Energy Savings per Fan:** 32 W × 8 h = 0.256 kWh
* For 136 fans: 34.8 kWh/day → Potential savings: ~50%

**6.3.2 Table Fans**

* Replace high-power table fans with energy-efficient alternatives.

**6.4 PC Power Management**

* Implement **power management policies** for all 232 PCs:
  + Enable sleep/hibernate during inactivity.
  + Schedule shutdown after work hours.
* Estimated savings: 15–20% of PC energy (~41.76 kWh/day).

**6.5 IoT-Based Energy Monitoring System (Technical Solution)**

**6.5.1 Problem Statement**

* Continuous energy monitoring is required to track savings from ECMs and identify abnormal consumption patterns.

**6.5.2 Objectives**

* Real-time tracking of departmental energy usage.
* Identify high-energy loads and inefficiencies.
* Enable data-driven decision-making for future energy-saving measures.

**6.5.3 System Components**

* Smart energy meters for main panels and individual SEUs.
* IoT gateway for data collection.
* Cloud-based dashboard for visualization and reporting.
* Alerts for excessive consumption or equipment malfunction.

**6.5.4 Working**

* Each energy meter sends real-time data to the IoT gateway.
* The cloud platform aggregates and visualizes data with daily, weekly, and monthly reports.
* Department administrators can monitor consumption remotely and take corrective actions.

**6.5.5 Advantages**

* Enables verification of ECM effectiveness.
* Promotes proactive energy management.
* Aligns with **ISO 50001:2018** energy management requirements.
* Reduces operational costs and improves sustainability awareness.

**6.6 Summary of Energy Savings**

| **ECM / Technical Measure** | **Current Daily Consumption (kWh)** | **After ECM (kWh)** | **Daily Savings (kWh)** | **Annual Savings (kWh)** |
| --- | --- | --- | --- | --- |
| LED Replacement | 16.64 + 12.96 | 16.64 + 6 | 7.32 | 2,670 |
| Ceiling Fan BLDC | 65.28 | 32.64 | 32.64 | 11,913 |
| Table Fans | 1.44 | 0.72 | 0.72 | 263 |
| PC Power Mgmt | 278.40 | 236.64 | 41.76 | 15,242 |
| **Total Savings** | 376.30 | 276 | 82.44 | 30,088 |

**Note:** Figures are approximate and based on rated power and average operating hours

**Chapter 7**

**Conclusion**

The energy audit of the Electronics and Telecommunication (E&TC) Department at PICT provided a detailed assessment of the current energy consumption and identified key areas for improvement. Based on the data collected from lighting, fans, PCs, and laboratory equipment, the total annual energy consumption was found to be **137,349.5 kWh**, with **Desktop PCs and Ceiling Fans** identified as the Significant Energy Users (SEUs).

The proposed **Energy Conservation Measures (ECMs)**, including LED and BLDC fan replacements, PC power management, and operational improvements, are expected to reduce daily energy consumption by **~82.44 kWh**, resulting in annual savings of **~30,088 kWh**. Implementation of these measures will not only reduce electricity costs but also contribute to sustainability and environmental goals.

Furthermore, the **IoT-based energy monitoring system** provides a technical solution for continuous tracking of energy usage, ensuring verification of ECM effectiveness, timely detection of inefficiencies, and alignment with **ISO 50001:2018 Energy Management System** requirements.

In conclusion, this project demonstrates that systematic energy auditing, combined with practical ECMs and monitoring, can significantly improve energy efficiency, reduce operational costs, and foster a culture of energy awareness within the department. The methodology and recommendations outlined in this report provide a replicable framework for other departments and institutions seeking to implement sustainable energy practices.

**Chapter 8**

**REFERENCES**

**1.**)**Internal Data Sources (College / Department Records)**

* PICT E&TC Department Equipment Inventory and Load Data, 2025.
* Calculation Table.xlsx — Energy consumption calculations and equipment details.
* cep[1].docx — Assumptions, alternate solutions (BLDC fans), and monitoring system design.

**2.)** **Standards and Guidelines**

* ISO 50001:2018 — Energy Management Systems — Requirements with Guidance for Use, International Organization for Standardization (ISO).
* Bureau of Energy Efficiency (BEE) Guidelines for Energy Audits in Educational Institutions, 2020.

**3.)Technical References (Optional, if used in ECM calculations)**

* Atomberg BLDC Fan Product Datasheet, Atomberg Innovations, 2024.
* LED Tube and Bulb Product Specifications, Philips / Havells, 2024.

**4.) Software / Tools**

* Microsoft Excel 2019 — Used for energy consumption calculations and charts.
* IoT Energy Monitoring Software Datasheets / User Guides (if referenced).

