REPORT ON COMMUNITY ENGAGEMENT PROJECT

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

**SECOND YEAR B.TECH.**

In

Electronics and Telecommunication Department


By

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**DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION**

**PUNE INSTITUTE OF COMPUTER TECHNOLOGY**

**PUNE – 43**


**OCTOBER 2025**

Department of Electronics and Telecommunication Engineering
Pune Institute of Computer Technology, Pune – 43

# CERTIFICATE

This is to certify that Mr. Rohan Sakhare with roll number 22265 & Exam seat number - S240502257 respectively from **SCTR's Pune Institute of Computer Technology (PICT)**, **Class SY B. Tech.** has successfully completed the **COMMUNITY ENGAGEMENT PROJECT** activity titled "Energy Audit and Conservation Measures" for the duration 14/07/2025 to 06/07/2025, number of hours 30 in our Institute Pune Institute of Computer Technology, Pune at E&TC Department as a part of SY B. Tech curriculum. We are pleased to offer this certificate for active participation and contribution to our institute for valuable information and knowledge sharing.

**Sign**_____

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# CERTIFICATE

This is to certify that Mr. Satyam Sonawane with roll number 22267 & Exam seat number – S240502303 respectively from **SCTR's Pune Institute of Computer Technology (PICT)**, **Class SY B. Tech.** has successfully completed the **COMMUNITY ENGAGEMENT PROJECT** activity titled "Energy Audit and Conservation Measures" for the duration 14/07/2025 to 06/07/2025, number of hours 30 in our Institute Pune Institute of Computer Technology, Pune at E&TC Department as a part of SY B. Tech curriculum. We are pleased to offer this certificate for active participation and contribution to our institute for valuable information and knowledge sharing.

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# CERTIFICATE

This is to certify that Mr. Rudraksh Samundre with roll number 22264 & Exam seat number-S2405052259 respectively from **SCTR's Pune Institute of Computer Technology (PICT)**, **Class SY B. Tech.** has successfully completed the **COMMUNITY ENGAGEMENT PROJECT** activity titled "Energy Audit and Conservation Measures" for the duration 14/07/2025 to 06/07/2025, number of hours 30 in our Institute Pune Institute of Computer Technology, Pune at E&TC Department as a part of SY B. Tech curriculum. We are pleased to offer this certificate for active participation and contribution to our institute for valuable information and knowledge sharing.

**Sign**_____

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# ACKNOWLEDGEMENTS

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Name of Student & Sign

ROHAN SAKHARE

SATYAM SONAWANE

RUDRAKSH SAMUNDRE

# 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

- **Assess current energy usage** of the E&TC Department and identify major energy-consuming systems (SEUs).
- **Recommend practical and cost-effective Energy Conservation Measures (ECMs)** with estimated savings and payback periods.
- **Align findings with ISO 50001:2018** to support continual improvement and sustainable energy management.

### 1.2 Scope of Work

The audit covers all major electrical and electronic systems in the E&TC Department at PICT, including lighting, fans, computers,and laboratory equipment.It focuses on measuring energy consumption, analyzing usage patterns , identifying inefficiencies, and recommending improvements through equipment upgrades 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:

  **Energy (kWh) = Power (kW) × Operating Hours (h)**
  (Reference : ISO 50001:2018)

- 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.** .

# Chapter 3

## CALCULATIONS AND RESULT

**Energy Consumption Calculation**

**Formula used 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)

| ECM | Current Daily Consumption | After ECM (kWh) | Daily Savings (kWh) | Annual Savings (kWh) |
|---|---|---|---|---|
| LED Replacement | 16.64 | 6 | 7.32 | 2,670 |
| Ceiling Fan | 12.96 | 16.64 | 0 | 11,913 |
| Table Fans | 65.28 | 32.64 | 0.72 | 262.8 |
| PC Power | 278.40 | 236.6 | 41.76 | 30,087.8 |
| Savings | 376.30 | 276 | 82.44 | 44.93 |

**Fig -3.1- Tabular representation of equipments and comparative savings**

**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

This graph analyzes the **376.30 kWh Daily Energy Consumption**, clearly showing that **PCs** and **Ceiling Fans** are the dominant consumers. These two categories alone account for over **91%** of the total load, highlighting them as the primary targets for energy efficiency improvements. This sharp imbalance demonstrates the need to focus conservation efforts on a few key high-usage equipment types for maximum impact.

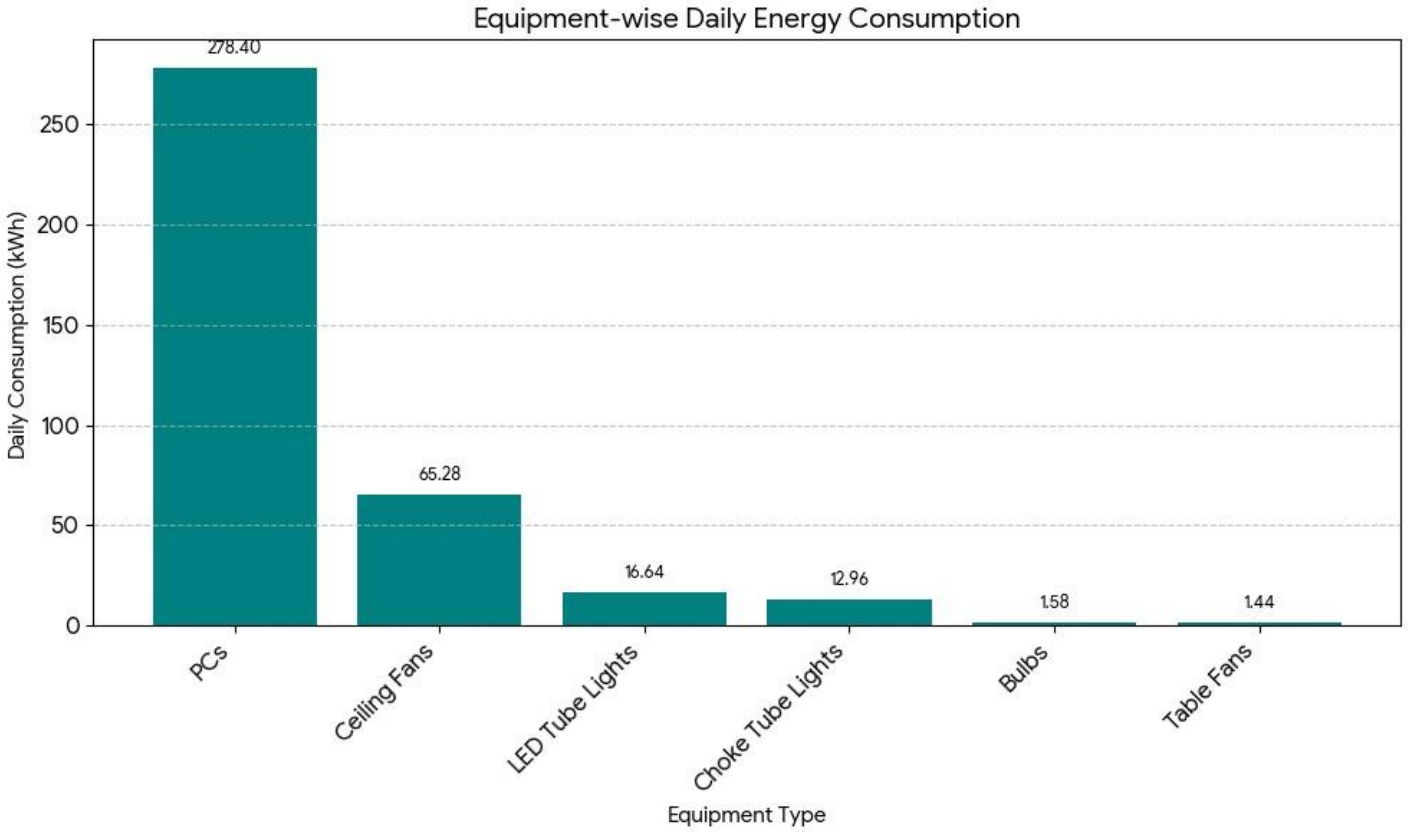


Fig 3.2 -Graph represents energy consumption equipment wise

# Chapter 4

## ENERGY CONSERVATION MEASURES (ECMs)

### Overview

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.

#### 4.1 Lighting Systems

##### 4.1.1 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.

##### 4.1.2 Bulbs Replacement

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

#### 4.2 Ceiling and Table Fans

##### 4.2.1 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%

##### 4.2.2 Table Fans

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

### 4.3 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).

### 4.5 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 5

## Technical Solution: IoT-Based Energy Monitoring System

### 5.1 Overview

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.

### 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

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- Replace conventional 60 W ceiling fans with **BLDC fans (28–30 W)**.
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- For 136 fans: 34.8 kWh/day → Potential savings: ~50%

#### 5.3.2 Table Fans

- 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 (~41.76 kWh/day).

### 5.5 IoT-Based Energy Monitoring System (Technical Solution)

#### 5.5.1 Problem Statement

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

#### 5.5.2 Objectives

- Real-time tracking of departmental energy usage.
- Identify high-energy loads and inefficiencies.
- Enable data-driven decision-making for future energy-saving measures.
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#### 5.5.3 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.

#### 5.5.4 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.

#### 5.5.5 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.

# Chapter 6

## 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 7

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