REDUCING ENERGY CONSUMPTION IN THE BSC.CSIT BUILDING AT BHAKTAPUR MULTIPLE CAMPUS

1. Introduction

Background:
Energy efficiency is increasingly important for educational institutions, both for reducing costs and minimizing environmental impact. The BSc.CSIT Building at Bhaktapur Multiple Campus is a modern educational facility that presents opportunities for improving energy efficiency explained through simulation and modeling.

Objective:
This case study aims to explore potential energy savings in the BSc.CSIT Building using simulation tools to analyze current energy consumption and identify effective interventions.

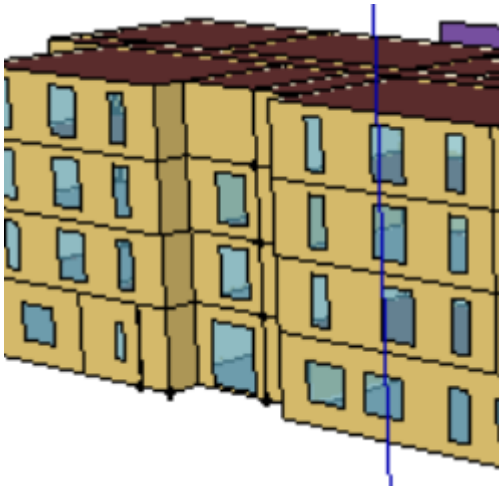
2. Methodology

Simulation Tools:
The simulation was conducted using OpenStudio, an open-source building energy modeling software that integrates with EnergyPlus. EnergyPlus was chosen for its ability to accurately model complex building systems and energy flows.

Data Collection:
Data collection involved gathering information on the building's architecture, materials, and systems. Key data included:

- **Building Specifications**: Total floor area of 3,000 square meters, with four stories.
- **Occupancy Patterns**: Approximately 300 students and staff use the building during peak hours.
- **Systems**: HVAC, lighting, and electrical systems.

Model Setup:
The simulation model was constructed using the collected data, with careful calibration to ensure accuracy. Parameters included schedules for lighting, equipment, and HVAC operation based on observed usage patterns as shown below:



3. Case Study: Building Overview

Profile:
The BSc.CSIT Building is located on the Bhaktapur Multiple Campus in Nepal. It serves as a hub for computer science education and is equipped with modern facilities, including computer labs, classrooms, and faculty offices.

Baseline Consumption:
Initial energy consumption data was obtained from utility bills and building management records. The building's annual energy use was 800 MWh, with HVAC systems accounting for 50% of this total.

4. Charts and Analysis of Building

- **Building Floor Plan**

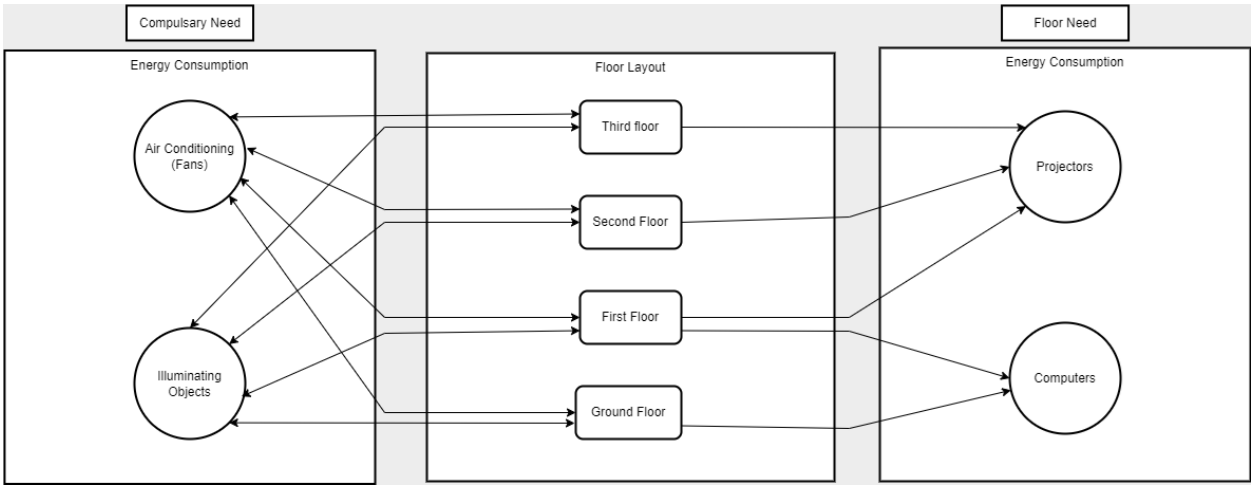
  Chart Description:

  The floor plan chart provides a detailed layout of each floor in the BSc.CSIT Building, illustrating the arrangement of classrooms, labs, offices, and common areas. The chart is divided into four sections, corresponding to each floor of the building.

  Explanation:

  - **Ground Floor**: Includes the main entrance, lobby, administrative offices, and a few classrooms.
  - **First Floor**: Primarily dedicated to computer labs and additional classrooms.
  - **Second Floor**: Features faculty offices, meeting rooms, and a library.
  - **Third Floor**: Houses lecture halls and seminar rooms for larger gatherings and events.

This floor plan was used to define the building's geometry in the simulation model, ensuring accurate representation of space usage and occupancy patterns.



- **All Floors Layout**

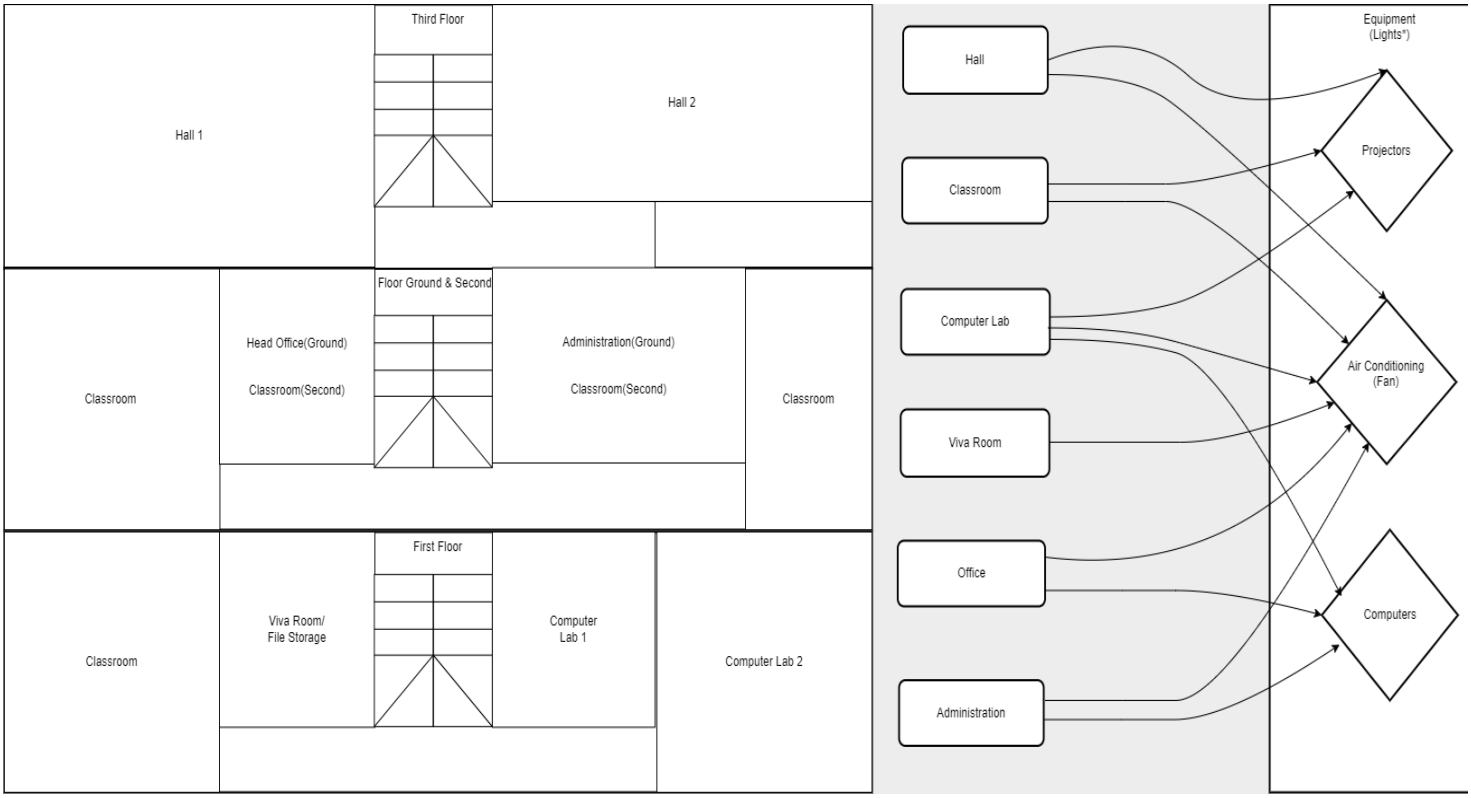
  Chart Description:

  The all-floors layout chart presents an overview of the entire building, showing the vertical distribution of spaces and their functions across different levels. This comprehensive view helps in understanding the building's spatial organization.

Explanation:

- **Zoning**: Each floor is divided into zones based on function and occupancy, which informed the thermal zone definitions in the simulation.
- **Connectivity**: The chart highlights staircases and corridors, crucial for modeling airflow and occupant movement.

The all-floors layout chart was instrumental in defining the building's overall structure for the energy simulation.



- **Energy Consumption by Floor**

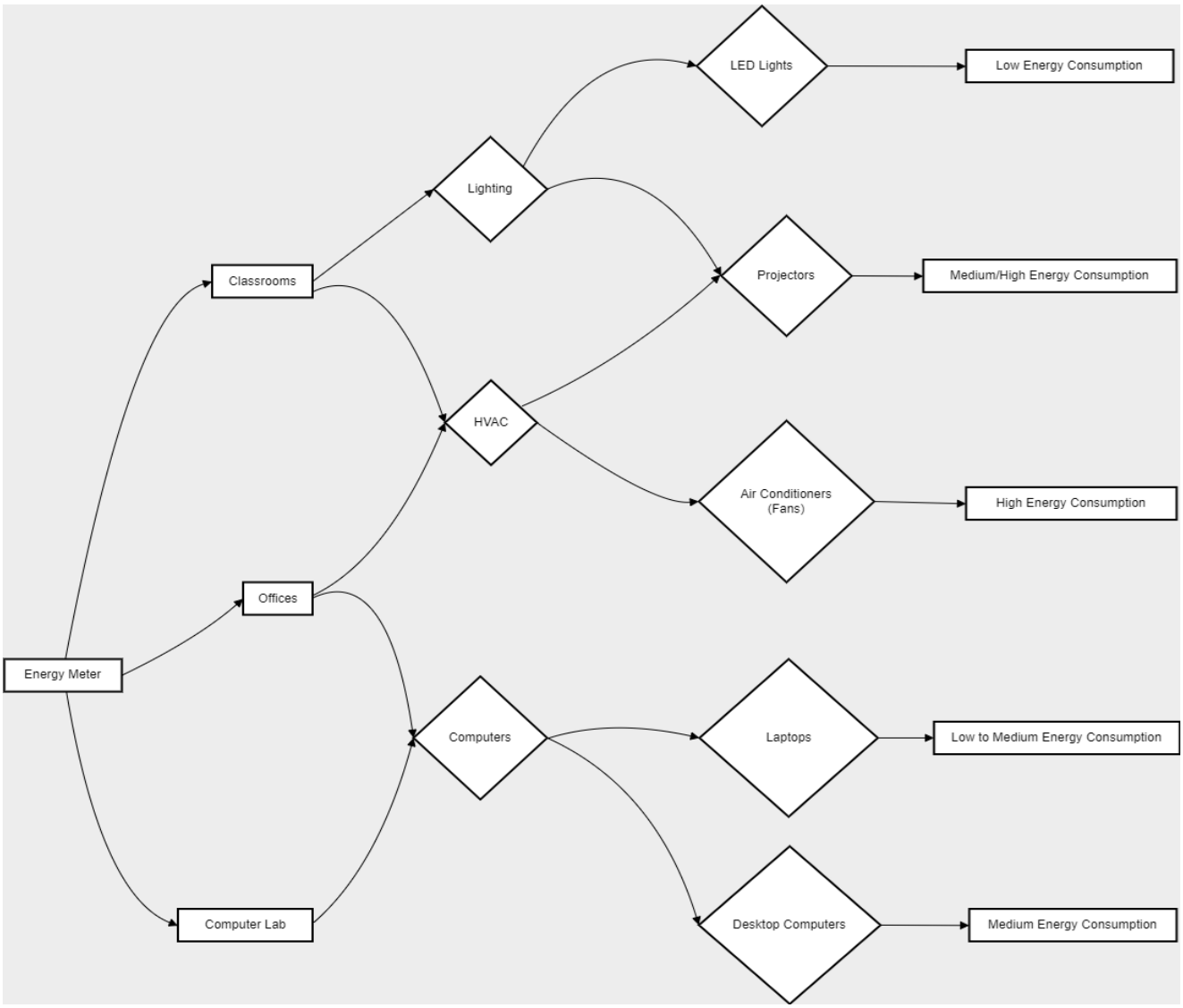
  Chart Description:

  The energy consumption chart displays the energy use for each floor of the BSc.CSIT Building, broken down by HVAC, lighting, and equipment. This data provides insights into the building's energy demands and potential areas for efficiency improvements.

Explanation:

- **Ground Floor**: Higher energy use is observed due to HVAC systems maintaining comfortable temperatures in administrative areas.
- **First Floor**: Computer labs contribute to significant energy consumption, primarily due to equipment use.
- **Second Floor**: Faculty offices and the library show moderate energy use, with opportunities for lighting and HVAC efficiency.
- **Third Floor**: Lecture halls demand high energy use during peak hours, emphasizing the need for optimized HVAC scheduling.

This chart guided the identification of key interventions to reduce energy consumption, focusing on HVAC and lighting improvements.



5. Simulation Results and Interventions

Results:
The simulation identified several key areas for improvement:

- **HVAC Efficiency**: The system was found to operate beyond necessary hours, especially in unoccupied spaces.
- **Lighting Optimization**: Lighting was frequently used when natural daylight was sufficient.

Proposed Interventions:
Based on the simulation results, the following interventions were suggested:

- **HVAC Scheduling**: Implementing a smarter scheduling system to reduce unnecessary operation during off-peak times.
- **Lighting Upgrades**: Installing LED lights with daylight sensors to minimize electricity use during daylight hours.
- **Insulation Enhancements**: Improving the building's insulation to reduce heating and cooling loads.

6. Analysis

Energy Savings:
The proposed interventions are expected to reduce energy consumption by 25%, equivalent to an annual saving of 200 MWh. HVAC adjustments are anticipated to contribute significantly to these savings.

Cost-Benefit Analysis:
The estimated cost of implementing these changes is Rs.1500,000, with a payback period of approximately three years. The financial benefits, coupled with environmental advantages, support the feasibility of the interventions.

7. Conclusion

Summary of Findings:
The case study demonstrates the effectiveness of simulation and modeling in identifying and implementing energy-saving measures in the BSc.CSIT Building. The proposed interventions offer significant energy and cost savings.

Recommendations:
It is recommended that the campus administration proceed with the proposed changes and continue monitoring energy use through simulation tools. Future studies could explore additional energy-saving technologies, such as solar panels and smart building systems.

7. References

1. OpenStudio. (2024). OpenStudio Documentation. Retrieved from https://openstudio.net.
2. Nepal Electricity Authority. (2024). Energy Efficiency in Educational Buildings. Retrieved from https://nea.org.np/energy-efficiency.
3. Bhaktapur Multiple Campus Informative Research and Analysis