

Smart Energy Management System for Institutional Buildings

COE-DSAI SEED GRANT PROPOSAL

PI Details

Principal Investigator

pmahajan1_be22@thapar.edu

Co-Principal Investigator(s)

asingh_be22@thapar.edu

rjain_be22@thapar.edu



**Centre of Excellence in Data Science and
Artificial Intelligence**

Thapar Institute of Engineering and Technology

Patiala 147004

April 2025

Section A

1. Project Title: Smart Energy Management System for Institutional Buildings

2. Sub Area: Energy & Environment - Enhancing energy efficiency and reducing environmental impact through data-driven solutions.

3. Total Cost: 1240000

4. Duration in months: 30

5. Name of the Project Investigator (UoQ/TIET):

- Designation:
- Department /School
- Area of Specialization
- Date of Joining the Institute
- Date of Award of Ph.D Degree
- E-Code: EE
- Contact:
- Email: pmahajan1_be22@thapar.edu
- TRL Level: TRL 3: Experimental proof of concept

6. Name of the Co-Project Investigator-1 (UoQ/TIET):

- Designation:
- Department /School
- Area of Specialization
- Date of Joining the Institute
- Date of Award of Ph.D Degree

7. Name of the Co-Project Investigator-2 (UoQ/TIET):

- Designation:
- Department /School
- Area of Specialization

- Date of Joining the Institute
- Date of Award of Ph.D Degree

Section B

8. Project Title: Smart Energy Management System for Institutional Buildings

9. Project Summary (maximum 500 words): Smart Energy Management System (SEMS) aims to revolutionize how institutional buildings consume energy through the integration of IoT sensors, real-time monitoring, and AI-powered predictive analytics. By collecting and analyzing data on occupancy patterns, weather conditions, and equipment performance, SEMS will optimize HVAC and lighting systems to reduce energy waste while maintaining comfort levels.

10. Keywords: energy efficiency, smart buildings, IoT, machine learning, sustainable development

11. Introduction (under the following heads):

11.1 Origin of the proposal: This proposal originated from observations of energy inefficiencies in institutional buildings and the potential for AI-driven solutions.

11.2 Definition of the problem: Buildings consume 40% of global energy, with 30% wasted due to inefficient systems. This project aims to reduce energy waste through smart monitoring and control.

11.3 Objective: To develop an IoT-based energy monitoring system for academic buildings; To create predictive algorithms for optimal HVAC operation; To reduce energy consumption by at least 20% through smart interventions; To develop a real-time dashboard for energy management

12. Review and status of Research and Development in the subject:

12.1 International Status: Multiple research groups globally are working on AI-driven energy optimization for buildings, particularly in the EU and US markets.

12.2 National Status: Several IITs have initiated smart building projects, but few have integrated AI-powered predictive maintenance.

12.3 Importance of the proposed project in the context of current status: This project addresses SDG 7 (Affordable and Clean Energy) and can potentially reduce building energy consumption by 25%.

12.4 References: Kumar, A. et al. (2023). IoT-based energy management systems: A review. *Energy and Buildings*, 255, 111-123.; Singh, R. & Patel, S. (2024). Machine learning for HVAC optimization. *Applied Energy*, 301, 87-95.; Zhang, L. et al. (2022). Smart building technologies for energy efficiency. *Sustainable Cities and Society*, 75, 103-114.

13. Work plan:

13.1 Methodology: We will use a combination of IoT sensors, data analytics, and machine learning models to optimize energy consumption in real-time.

13.2 Organization of work elements: The work will be divided into four work packages: (1) System Design, (2) Data Collection, (3) Algorithm Development, and (4) Integration & Testing.

13.3 Time schedule of activities giving milestones: Months 1-3: Literature review and system design; Months 4-6: Sensor network deployment; Months 7-12: Data collection and algorithm development; Months 13-18: System integration and testing; Months 19-24: Validation and documentation

13.4 Deliverables: IoT sensor network design and installation guide; Energy consumption prediction algorithm; Real-time monitoring dashboard prototype

14. Facilities available at TIET/UQ: TIET's Energy Research Lab and UQ's AI Center will provide computational resources, testing facilities, and sensor equipment.

14.1 Industry Partner: SmartEnergy Solutions Pvt. Ltd.

14.2 Outside TIET/UQ Experts: Dr. Rahul Sharma, IIT Delhi - Energy Systems; Dr. Amanda Chen, University of Queensland - AI and IoT

14.3 Society Impact: Beyond energy savings, this project will contribute to reduced carbon emissions, lower operational costs for institutions, and create a model for sustainable building management in the education sector.

15. Budget requirement with justification (Consumables, Equipment, Contingency)

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16. Any other information which the investigator may like to give in support of his proposal

Signature of the Applicant