LITHUANIAN ENERGY INSTITUTE

ADMISSION TO PHD STUDIES FOR THE YEAR 2026

DOCTORAL RESEARCH TOPIC:

Sustainable and Intelligent Buildings: Interaction Between Humans, Artificial Intelligence, and Thermal Energy Storage Systems

RESEARCH FIELD:

Energetics and Power Engineering (T 006)

BRIEF DESCRIPTION OF RESEARCH TOPIC:

The building sector accounts for a significant share of final energy consumption and greenhouse gas emissions. To achieve the objectives of the European Green Deal, it is essential to transition towards energy-efficient, sustainable, and smart buildings capable of dynamically responding to user needs, environmental conditions, and the interaction of different systems. Traditional building management systems often operate based on fixed algorithms that disregard human behavior and comfort perception, while thermal energy flows within buildings are frequently suboptimal due to limited energy storage solutions. The integration of Artificial Intelligence (AI), Phase Change Materials (PCM), and Digital Twins into building management opens up opportunities to develop a new generation of energy and comfort management systems that dynamically adapt to human needs and environmental changes. Such solutions enable the reduction of energy consumption and CO_2 emissions while improving user comfort and ensuring the sustainability of building operation throughout their life cycle.

Despite the rapid development of building technologies, several challenges remain: the lack of human feedback in building control algorithms (current systems rarely incorporate user perception and behavioral data into decision-making); the limited utilization of thermal energy storage potential in ventilation systems; and the incomplete real-time assessment of building energy performance and intelligence (a lack of methodologies integrating BIM, IoT, and AI data into digital twins capable of accurately predicting energy flows and emissions). Therefore, there is a growing need to develop new scientific methods and experimental tools to address these challenges.

The overall objective of the thematic area is to develop and validate methodologies and technological solutions that integrate human feedback, artificial intelligence, and thermal energy storage principles into building management systems to enhance building energy efficiency, intelligence, and comfort levels while reducing CO_2 emissions.

Sustainable and Intelligent Buildings: Interaction Between Humans, Artificial Intelligence, and Thermal Energy Storage Systems topic consists of three research areas:

- Integration of Human Feedback in Smart Building Management Systems (Motuzienė)

Objective - To develop a methodology/system that integrates human feedback into building management systems using artificial intelligence, aiming to optimize energy demand and ensure a balance between comfort and energy efficiency.

- Application of Phase Change Materials for Energy Storage and Utilization in Building Ventilation Systems (Streckienė)

Objective - To develop and validate a methodology for integrating phase change materials (PCM) into building ventilation systems for energy storage and reuse, aiming to improve thermal efficiency and reduce energy consumption.

- Application of Digital Twin and Real-Time Data for Automatic Determination of Building Energy Performance, Smartness, and Carbon Emission Indicators (Džiugaitė-Tumėnienė)

Objective - To develop and experimentally validate a methodology that enables automatic determination of building energy performance, smartness, and carbon emission indicators by integrating a digital twin with real-time BMS/HVAC and IoT data, combined with AI models.

SCIENTIFIC SUPERVISOR:

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