

## **Habilitation thesis**

# **Research on the integration of renewable energy sources and the recovery of lost energy for the improvement of energy efficiency in buildings**

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### **Abstract**

The habilitation thesis is structured in two main parts. In the first part regards the most important achievements (obtained after being awarded the title of doctor in engineering sciences, on November 27, 2009) are presented from a professional, academic, and scientific point of view. The second part describes the teaching and research career development plan in the Faculty of Construction within the Politehnica University of Timisoara.

Due to the energy and climate change issues that humanity faced in the last 10 years, the scientific and research activity has been focused around the concept of energy efficiency of the facilities that serve and equip buildings, and respectively the reduction of energy consumption and pollutant emissions.

This concept is viewed with real interest by all structures of society and from this point of view, at the level of the European Union (EU), energy efficiency is a strategic priority, with objectives for reducing consumption and energy waste and implicitly of pollutant emissions with clear targets and deadlines.

Therefore, the directions of scientific research addressed have, in recent years, gravitated around this topic. The choice of this field of interest is not a coincidence, but is due to a number of factors, the main ones being related to the graduation of the "Building Services" majored and the "Energy-Ecology in the field of thermal and transport vehicles" master's program, as well as the involvement in several technical projects for the integration of renewable energy sources (RES) in installations serving buildings concretized in scientific articles and respectively in research contracts in which we developed topics and pilot installations aimed at the recovery of lost energy, the reduction of energy consumption primary and green energy production or that resulted in studies on optimizing the operation of systems installations for buildings.

The results obtained in the scientific research activity were published in journals and at national/international conferences totaling 167 scientific articles, 95 of which are indexed in international databases such as ISI, SCOPUS, PROQUEST or EBSCO.

Simultaneously with the research activities, since 2003, I started my university career at the Politehnica University of Timisoara, Faculty of Mechanics, Department of Mechanical Machines and Transport Equipment, that continued from 2010, at the Faculty of Construction within the same university, at the Department of Building Services where I initially held the position of Lecturer, and from the academic year 2016-2017, I hold the position of Associated Professor. In the teaching activity from 2010 until now, I have been teaching courses/applications in 13 subjects from the Bachelor's field of Building Services Engineering, one subject from the Bachelor's field of Architecture and Urban Planning, one subject from the Bachelor's field of Furniture and Interior Design, one subject in the Bachelor's field of Civil Engineering in German, six subjects in the Master's programs Optimizing and Modernizing Installation Systems and respectively one subject in the Sustainable Development and Energy Audit program. I also coordinate the practice activity (Professional Practice 1,2 and 3) at the Master's program Optimizing and Modernizing Installation Systems and respectively speciality practice 2 at the Bachelor's cycle, specializing in Building Services.

During this entire period, I developed as a sole author or in collaboration with others, three books, 2 laboratory/design guides and course support materials and applications, in electronic format, for all subjects taught during this period.

I was constantly preoccupied with modernizing the laboratories, actively participating in the equipping of the Hydraulics and Plumbing Installations (HPI) laboratory, the Electrical Installations (EI) laboratory, the Thermal Installations (TI) laboratory, the Ventilation and Air-conditioning Installations (HVAC) laboratory, of the IT Systems Laboratory (ITS), the Technology and Installation Mounting Laboratory (TIM) and the Building Automation and Control Systems Laboratory (BACS), the last two of which are currently being set up.

The continuation of research directions and career development, from a scientific, professional and academic point of view, will follow the current energy situation with an emphasis on the integration of RSE and their efficient use, the reduction of energy consumption and energy waste, as well as the increase of responsibility towards the environment by reducing emissions pollutants and the recovery, recycling and reuse of waste resulting from the operation of facilities or the decommissioning of components of facility systems. In this sense, I will apply to the international and national competitions within the National Plan for Research, Development, Innovation as a project director or in

research teams to attract funds necessary for the development of the research infrastructure of the research laboratory " Research Centre for Building Services - CCIC", but also of didactic laboratories.

The results that I will obtain will be, first of all, the subject of scientific articles that I propose either to publish in national and international journals relevant to the field of building services engineering, or to present them at national/international conferences/congresses in which I will participate, and on the other hand these results will improve the didactic materials of the courses I teach and will constitute a research base for future research topics for young PhD students.

At the same time, I will continue to collaborate with national and international economic agents that are active in the field of building services engineering, participating in exchange programs and workshops for results' dissemination.

A main objective proposed for future research activity is to attract PhD students in research grants with themes in their research directions so as to ensure the necessary infrastructure for the completion of their PhD theses.

The research topics will address subjects regarding energy efficiency of buildings through installation systems, the integration of renewable energy sources in installation systems, the reduction of energy consumption in the built areas, the production and storage of energy from renewable energy sources, studies on the optimization of the water supply systems, district heating or electrical energy supply networks, protecting natural resources and generally protecting the environment.

In conclusion, the priority direction for the development of scientific and research activity is to form an interdisciplinary and multidisciplinary research team in the complex field of constructions that will allow participation in research, development and innovation programs that will take place at European level. Thus, new directions of current research can be opened, which address hybrid systems of production of useful energy from the combination of renewable resources (by mixing renewable sources), namely: electrical and thermal energy, mechanical energy from steam, chemical energy under the form of hydrogen, etc.

The habilitation thesis ends with a bibliography that summarizes both bibliographic references from the specialized literature and my own publications that were the basis of this paper.