



## Energy efficiency in the Romanian residential building stock: A literature review



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### ABSTRACT

The building sector in Romania is dominated by residential buildings that are old and have poor thermal performance. As a member of the European Union, Romania has to reach the objectives imposed by the Directive 2009/28/EC and to fulfill the requirements of the Energy Performance of Buildings Directive (EPBD) by year 2020. The implementation of these concepts in Romania consists into thermal rehabilitation of the existing buildings, applying the latest thermal performance characteristics in new buildings and establishing the certificate of energy performance. The following paper presents the literature review of the state of building energy performance in Romania. The purpose of the literature review analysis is to provide a snapshot on the existing building energy efficiency and future perspectives on the implementation of high performance buildings in Romania. The implementation of concepts such as the Passive House (PH), nearly Zero Energy Buildings (nZEB) and Net Zero Energy Buildings (NZEB) are discussed in order to help the decision makers to achieve the 2020 objectives. The results of the reviewed publications and case studies are classified under three categories: policy and regulations, technology and feasibility. Finally a holistic perspective on the Strength, Weakness, Opportunities and Threats (SWOTs) of energy efficiency in Romania's residential building sector is presented.

### 1. Introduction

Romania has to reach the objectives imposed by the European Union to reach nearly zero energy buildings by year 2020. The directive mentioned previously states that the share of renewables in the total gross of Romania's energy consumption should be 20%, the emissions of CO<sub>2</sub>, greenhouse gases and the final energy consumption must decrease by 20% and all the new buildings must be passive. The Energy Performance of Buildings Directive (EPBD) requires all European member states, including Romania, to introduce minimum energy performance requirements for all buildings, building elements and technical building systems. The energy performance requirements must be set based on a cost-optimal methodology taking into account life time costs of the building. From 2020 onwards, all European member states will have to construct only nearly Zero Energy Buildings (nZEBs) [1]. In Romania, the implementation of these concepts consists into thermal rehabilitation of the existing buildings, into applying the latest thermal performance requirements for building elements from both new and renovated constructions and into establishing the certificate of energy performance of the building [7].

In Romania about 80% of the buildings need to be renovated in

order to stop the heat losses through the building's envelope and to decrease energy consumption (reference). At the moment, it is difficult to renovate all the buildings to make them performant because of the costs involved. Most of Romania's national building stock have residential function and the costs are supported by the indwellers. Fig. 1 shows the distribution of the residential floor area by building type and urbanization according to the Buildings Performance Institute Europe (BPIE) report [7].

Therefore, the aim of this study is to review literature and to provide a general snapshot about the energy efficiency status in Romania and to document the current state-of-the-art regarding the potential and challenges of implementation of passive house, nZEB and ZEB concepts. This is a fundamental step in order to help decision makers for designing programs to achieve the EU's 2020 objectives. The objectives of this research are to review and analyze publications found in literature related mainly to energy performance in Romanian residential building sector. The work entails the categorization of major publications in sub-topics for a detailed analysis and better understanding of the current Romanian status of buildings and to identify the key findings and the gaps found in literature. The literature review presents the current state-of-the-art of the building energy perfor-

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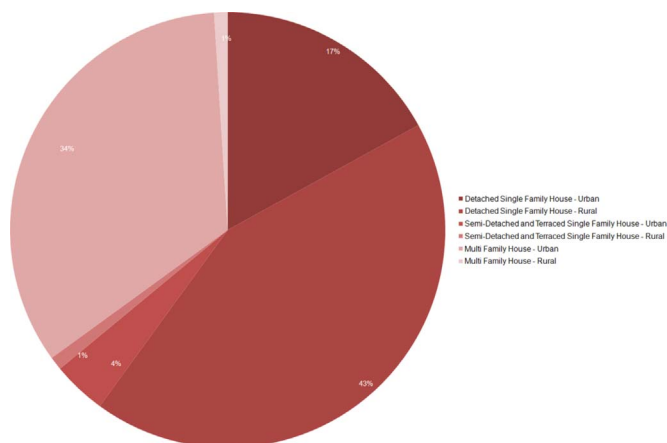


Fig. 1. The distribution of the residential floor area by building type and urbanization according to the Buildings Performance Institute Europe [7].

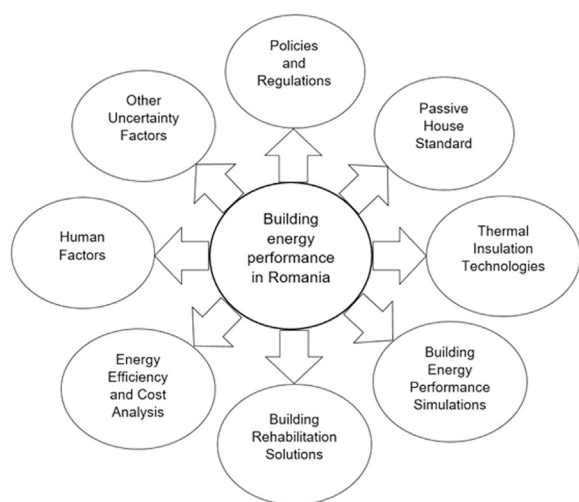


Fig. 2. The key elements that have significant impacts on building energy efficiency, including policies and regulations, technologies, feasibility, human factors and other uncertainty factors.

mance in Romania and the aspects that need to be improved in order to achieve the 2020 objectives. The categorization in sub-topics helps highlighting the levels of building energy performance where Romania has made progress and where it needs to improve. The study reviewed

pilot projects in Romania and compared them with similar projects outside Romania.

The methodology consisted of screening the available resources related to building energy performance in Romania and finding a logical classification. These topics describe Romanian design codes, energy consumption in Romanian buildings, energy prices and climate. The publications related to these topics were arranged in a literature survey list in which the title, authors, publisher and the number of citations of the publication could be traced. Then a SWOT analysis was conducted to have a better understanding of energy efficiency issues and provide perspective on improvements that need to be addressed in the future to dismantle the barriers to the implantation of energy efficiency targets among households in Romania.

This paper is organized into seven sections. In the first section it is identified the research problem, the objective and the significance. The second section describes the methodology of the literature review. The third section describes the findings of the publications related to policies and regulations in energy performance. The fourth section presents the findings about sustainable technologies. The fifth section describes cost analysis in the context of building energy performance. The sixth section presents the human factors and the uncertainty factors that influence the implementation of nZEB in Romania. The seventh section discusses the outcomes of the literature review and presents the conclusions of the study.

## 2. Methodology

The literature review analysis was elaborated by browsing through resources which offer topics related to building energy performance in Romania. These topics include publications related to building energy performance national regulations, to energy consumption of the Romanian building stock and to cost analysis in the context of energy efficiency. The publications gathered in the literature survey list were organized based on their main topic into the following categories: policies and regulations, technology, feasibility and human factors. The publications were sorted into the topics mentioned previously to highlight both the current state-of-the-art and the aspects that need to be improved on different levels of building energy performance in Romania (i.e. policy and regulations, technology and feasibility). The following sections describe the main findings of the reviewed publications from each level of building energy performance in Romania.

The final step of the literature review analysis is the creation of the literature review matrix to summarize the key findings from the previous studies. The paper also includes a SWOT analysis which evaluates the strengths, the weaknesses, the opportunities and the

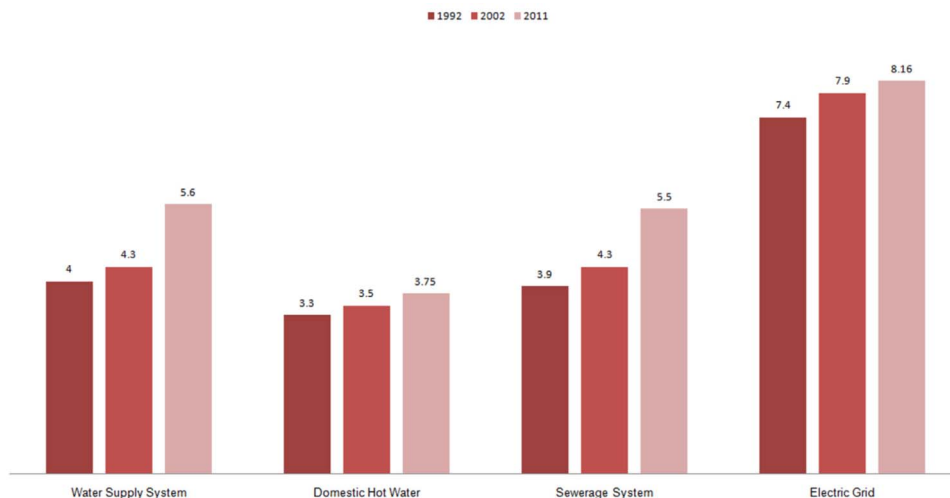


Fig. 3. The number of housing units from Romania based on endowment with the main building services [33,34].

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