

Transformation to Sustainable Building Energy Systems: A Decision Support System

Completed Research Paper

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Abstract

The sustainable transformation of the building sector is one of the biggest levers to achieve global climate protection agreements. Therefore, individual decisions regarding building energy systems (BESs) become more important and building stakeholders require tangible options to create an energy-efficient and renewable-energy-based building stock. Our research aims to address this problem and presents a decision support system based on a software engineering approach that follows the guidelines of the design science research methodology and seeks to provide guidance for investment decisions in BESs by highlighting technical, economical, and ecological performance indicators. The computational study evaluates the performance of various scenarios regarding costs and CO₂ emissions for different buildings. Our results contribute insights for the design of future BESs and provide building stakeholders with a holistic view to tackle conflicting objectives and to follow a sustainable transformation path.

Keywords: Transformation of Building Energy Systems, Decision Support System, Design Science, Green IS, Energy Informatics

Introduction

The United Nations (UN) lists 17 sustainability development goals that should be pursued globally at political, economic, and social levels. Among these goals are calls for increased awareness of climate change mitigation, the use of affordable and clean energy resources, and sustainable urban and community development. Furthermore, the achievement of sustainability development goals is linked to a time horizon. The share of renewable energy in the global energy mix should be drastically increased, and investments in energy infrastructure and clean energy technology are to be stimulated until 2030. Adherence to these targets represents a demanding challenge. To this end, the goals formulated by the UN go conjointly with the Paris Agreement of 2015 (United Nations, 2020; European Commission, 2020). As climate change still represents one of the most significant challenges that society must face, it is essential to address the sectors that potentially have the greatest leverage for CO₂ mitigation. According to the International Energy Agency (IEA), the building and construction sector accounted for 36% of global final energy use and emitted 39% of energy and process-related CO₂ emissions in 2018 (International Energy Agency, 2020). Thus, the