

Evaluating Energy Transition of a complex of buildings in a historic site of Rome toward Zero-Emissions for a Sustainable Future

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Abstract : Recent European policies have been set ambitious targets aimed at significantly reducing CO₂ emissions by 2030, with a long-term vision of transforming existing buildings into Zero-Emissions Buildings (ZEmB) by 2050. This vision represents a key point for the energy transition as the whole building stock currently accounts for 36% of total energy consumption across the Europe, mainly due to their poor energy performance. The challenge towards Zero-Emissions Buildings is particularly felt in Italy, where a significant number of buildings with historical significance or situated within protected/constrained areas can be found. Furthermore, an estimated 70% of the national building stock are built before 1976, indicating a widespread issue of poor energy performance. Addressing the energy inefficiency of these buildings is crucial to refining a comprehensive energy renovation approach aimed at facilitating their energy transition. In this framework the current study focuses on analysing a challenging complex of buildings to be totally restored through significant energy renovation interventions. The goal is to recover these disused buildings situated in a significant archaeological zone of Rome, contributing to the restoration and reintegration of this historically valuable site, while also offering insights useful for achieving zeroemission requirements for buildings within such contexts. In pursuit of meeting the stringent zero-emission requirements, a comprehensive study was carried out to assess the complex of buildings, envisioning substantial renovation measures on building envelope and plant systems and incorporating renewable energy system solutions, always respecting and preserving the historic site. An energy audit of the complex of buildings was performed to define the actual energy consumption for each energy service by adopting the hourly calculation methods. Subsequently, significant energy renovation interventions on both building envelope and mechanical systems have been examined respecting the historical value and preservation of site. These retrofit strategies have been investigated with threefold aims: 1) to recover the existing buildings ensuring the energy efficiency of the whole complex of buildings, 2) to explore which solutions have allowed achieving and facilitating the ZEmB status, 3) to balance the energy transition requirements with the sustainable aspect in order to preserve the historic value of the buildings and site. This study has pointed out the potentiality and the technical challenges associated with implementing renovation solutions for such buildings, representing one of the first attempt towards realizing this ambitious target for this type of building.

Keywords : energy conservation and transition, complex of buildings in historic site, zero-emission buildings, energy efficiency recovery

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