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ENERGY EFFICIENCY IN THE RECONSTRUCTION OF HOUSING STOCK: IMPLEMENTING EUROPEAN STANDARDS IN UKRAINE[19]

The restoration of Ukraine's housing stock after significant destruction requires the application of modern energy-efficient technologies that meet European standards [1]. The main aspects include improving thermal insulation, implementing smart energy systems, and transitioning to alternative energy sources [2]. European practices in post-crisis reconstruction highlight the need to integrate energy-efficient strategies at the design and construction stages [3].

An essential element of the reconstruction of damaged buildings is the use of high-efficiency thermal insulation materials (aerogels, vacuum panels, energy-efficient glass), which significantly reduce heat losses [4]. In EU countries, particularly in Germany and Sweden, passive house technologies are actively used to minimize energy consumption for heating and air conditioning [5].

Intelligent energy management systems in residential areas are being implemented not only in Denmark and the Netherlands but also in many other countries, contributing to improved energy consumption efficiency and reduced environmental impact. For

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example, through the "Smart Grid" programs and the development of smart meters, Germany is actively integrating renewable energy sources into the energy system. This reduces dependence on traditional energy sources and allows for better balancing of supply and demand. Sweden uses smart grids to manage energy consumption in residential complexes, combining "smart home" systems with centralized energy networks. This reduces energy costs and ensures stable supply under changing solar radiation or wind conditions [6, 7].

One of the key aspects of implementing energy-efficient technologies is reducing CO_2 emissions and lowering the overall environmental burden [8]. The use of solar panels, heat pumps, and heat recovery technologies significantly reduces the consumption of traditional energy resources [9]. In Finland and Austria, a significant portion of the housing stock uses combined heat and power (CHP) systems, which provide high energy efficiency with low environmental impact [10].

European countries that have undergone post-conflict and post-disaster reconstruction demonstrate successful examples of applying energy-efficient strategies. For instance, after the 2009 earthquake in Italy, the government introduced a comprehensive reconstruction program incorporating modern insulation technologies and solar energy [1]. Similarly, Norway and Switzerland actively use financial mechanisms to support green building, which reduces energy costs for the population [2].

Ukraine has significant potential to integrate similar approaches, especially considering the requirements of European legislation on building energy efficiency [3]. The creation of government programs to support energy-efficient construction, attracting international investments, and implementing European standards in design will be key factors in developing a sustainable housing infrastructure in Ukraine [4].

Energy efficiency in the reconstruction of Ukraine's housing stock is not only an economic necessity but also a strategic direction for environmental development [5]. The use of European standards will significantly reduce energy costs, improve living comfort, and reduce greenhouse gas emissions [6]. International experience demonstrates that

integrating innovative technologies, government support for energy-efficient solutions, and active public involvement are crucial to successful reconstruction [7].

Further research should focus on adapting European methodologies to the Ukrainian context, including creating a stimulating legislative framework, developing the energy-efficient materials market, and raising public awareness about energy-saving opportunities [8].

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