

**THE ROLE OF MODERNIZATION RESIDENTIAL BUILDINGS IN ACHIEVING  
SUSTAINABLE DEVELOPMENT GOALS:  
THEORETICAL SOLUTIONS AND IMPLEMENTATION**

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**Abstract.** Modernization of residential buildings is a significant contribution to achieving sustainable development goals and solving its tasks. The housing stock of Ukraine is predominantly composed of panel housing projects and construction of the years of the Soviet Union. According to statistics, old panel residential buildings makes up more than 85% of the entire housing stock of Ukraine. Such buildings do not meet modern requirements and standards. A similar situation exists with the social housing stock in other countries, especially in countries with a heritage of Soviet panel buildings. Renovation of the old housing stock and bringing it to modern needs, requirements and standards will significantly affect the reduction of primary energy consumption and carbon emissions. Its solving sustainable development tasks in terms of inclusiveness and creating attractive living conditions in accordance with modern standards. The issue of modernization of panel residential buildings heritage of Soviet times – is considered. Gaps in this issue are identified and analyzed. The arguments for the necessity and importance of sustainable comprehensive modernization are presented using a descriptive-explanatory method. Theoretical solutions and opportunities for the implementation of complex modernization projects are presented. The importance and advantages of such a principle are noted. At the same time, a positive contribution to urban development is noted. However, obstacles and the need to overcome them are noted.

The topic of a complex approach to the modernization of the residential buildings should be given more attention. After all, partial solutions do not solve all the problems of the house and the surround space. Also its don't allow to fully achieve the goals of sustainable development, which can be provided by the complex modernization of residential buildings.

A complex approach to the modernization of residential buildings allows to create competitive conditions for new construction, prevents the degradation of old residential neighborhoods. As a result – economic and social well-being of residents; economic growth of the city. Solving a number of tasks of sustainable urban development and achieving other Goals of Sustainable Development.

**Keywords:** sustainable comprehensive modernization, residential neighborhoods, housing stock, mass panel residential buildings, Sustainable development, Sustainable urban development, renovation.

**Introduction.** Panel residential buildings designed during the Soviet period, which make up the main part of Ukraine's housing stock, were built in blocks and neighborhoods. The situation with social housing is similar in other countries, especially in countries with a heritage of Soviet housing development. These include not only post-Soviet countries, but also some of the countries that are currently part of the European Union. Therefore, the renovation of the old housing stock is a relevant topic not only for Ukraine, but also for many other countries. Discussions of the renovation and regeneration of the housing stock in Ukraine and other countries of the world are predominantly viewed in terms of energy efficiency, in order to reduce carbon emissions into the atmosphere, and the repair of worn-out engineering parts of the building, in order to increase the value of square meters and prevent the degradation of old residential areas. The topic of sustainable comprehensive modernization is almost never considered in practice.

**Analysis of Recent Research and Publications.** With the adoption of the sustainable development agenda [1], views on the tasks and ways of implementing urban development have changed somewhat. In accordance with sustainable urban development, certain tasks have been set. One of them is decarbonization.

There are energy efficiency funds at the state level, the task of which is aimed at saving primary energy and reducing carbon emissions in Ukraine and some other countries [2-4]. The funds provide financial support to households, but part of the costs still fall on the co-owners of the housing.

In relation to residential buildings, this is modernization aimed at energy efficiency. According to many studies, this issue is controversial. Researchers determine not only economic disadvantage, but also raises many controversial issues regarding the reluctance of co-owners to co-finance programs, despite the significant contribution of funds, which is mostly 70% of the total cost. At the same time, the inexpediency of the programs from the point of view of investment and savings is noted. Using the example of Ukraine, this issue was considered in research, which noted the inexpediency of modernization only for energy efficiency in the presence of other technical problems, such as engineering and technical parts and components of the building [5]. Despite certain privileges for co-owners of energy-renovated buildings in Germany, researchers also note the reluctance of co-owners to co-finance energy efficiency projects. For example, this issue is considered in the work of scientists who note that the marginal costs significantly exceed the marginal benefits [6]. However, it is still necessary to accelerate the pace of regeneration of buildings with low energy efficiency in order to achieve the European Union (EU) climate change policy by 2050 [7].

A case in point is the study by Lithuanian researchers Dalia Streimikiene and Tomas Balezentis, as Lithuania, so as Ukraine, has a significant heritage of old panel houses. The study notes that although policies and measures exist to promote large-scale energy renovation, many obstacles still exist and the pace of energy renovation is still very slow, especially in new EU member states and former Soviet Union members [8].

In the USA, the approach to the renovation of residential buildings was reviewed using the example of New York City. According to the project, the need to pay attention not only to parts that require immediate or current repairs, but to comprehensive renovation when modernizing residential buildings is noted [9]. The need for the renovation of social housing is noted in a study commissioned by the European Union. The study was conducted on the example of several agglomerations in different countries, taking into account retrospective analysis. The analysis showed the need to involve residents in order to take into account the individual needs of housing being considered for modernization. Also, Aernouts. N. and colleagues note a great need for the renovation of old social housing on the example of several European countries [10].

The renovation of residential buildings should be considered on the basis of sustainable development, according all goals and the implementation of their tasks. As noted by researchers, the construction industry plays a significant role in achieving almost all sustainable development goals [11]. Therefore, sustainable modernization should solve not only the task of energy efficiency, but also bring the building to an appropriate technical condition, taking into account the tasks of sustainable development in terms of inclusiveness and sustainable urban development. Therefore, as noted in the study, the involvement of all stakeholders in the process is necessary [12].

The importance of the condition of the surround area is noted. Studies note the positive impact of landscaping when choosing a place to live and the importance of close access to green spaces [13, 14]. Environmental factors affect psychological well-being. It is necessary to design spaces that support mental and physical health. Sustainable and attractive urban environment should to meets the needs of the community [15].

**Objective and Tasks.** Illumination of the problems of modernization panel residential buildings in terms of achieving the goals of sustainable development. Identification of theoretical solutions and possibilities for the implementation of the tasks of sustainable urban development and the achievement of other Goals of the Sustainable development by the way of modernization of the old mass panel residential buildings.

**Materials and Research Methodology.** There were analyses of the current research and implemented projects that may be relevant to the modernization of the housing stock. Identified the main trends and gaps in this issue. Through a qualitative analysis of modern trends, the role of complex modernization of the mass panel residential buildings in the final goal of sustainable development is determined. Using a descriptive method, theoretical solutions and possible ways of implementing the modernization of residential buildings are presented to achieve the Sustainable urban development.

**Results.** Energy-efficient modernization of the housing stock is widely discussed in almost all countries of the world. A common problem exists in countries with a heritage of mass panel residential buildings from the Soviet era.

Despite significant progress in terms of creating funds to finance energy efficient modernization, obstacles remain on the way to the pace of such modernization. The main obstacle is co-financing. And this problem is not only in Ukraine with its low income and high annual credit rates, but also in other European countries.

The larger the modernization project, the greater the costs, but also the greater the benefits in the future.

Sustainable modernization should be a comprehensive project that will cover the issues of energy efficiency, renovation work, inclusive architectural and planning solutions for the house and the surrounding area. No less important in planning is the landscaping of the territory and accessibility. Today, the issue of landscaping, green construction and the "15-minute city" concept is widely considered. The "15-minute city" concept, according the existing planning of residential neighborhoods and areas, can be easily implemented. During the Soviet Union, residential neighborhoods were planned with developed social infrastructure, such as a school, kindergarten, medical facility and areas for sports and recreation. Therefore, the modernization of residential buildings together with the surrounding area will be able to cover the tasks of sustainable development in decarbonization through close accessibility on foot, or by bicycle, to daily necessary facilities. Residential buildings in Ukraine have mostly already reached the end of their operational life or will do so in the near future. Therefore, the issue of the appropriate condition of the building is no less important than achieving sustainable development goals in terms of sustainable urban planning. Unfortunately, comprehensive modernization in Ukraine, and in many other countries, is not considered at the legislative level. Sustainable modernization that will be able, thanks to architectural and engineering solutions, to ensure the implementation of sustainable development tasks and achieve sustainable development goals, which are covered by architecture, construction and urban planning. These are not only attractive buildings and preventing the degradation of old residential areas, but also the economic growth of cities and the country as a whole. Projects of sustainable modernization of panel housing projects of the 70-90s, which still have an unfinished service life, are most appropriate to consider. But without appropriate encouragement from the government, unfortunately, such projects cannot be implemented. The interest of the construction industry in such projects should be no less than the building of new houses. Therefore, the economic benefit for the developers and the development companies should be no less than when building a new house.

Panel residential buildings were built in the same way and have a relatively similar architectural planing solutions. Therefore, an architectural and engineering project can be used for a certain group of houses and modified for another similar development. And this applies not only to the cities of Ukraine, but can also be used in other post-Soviet countries, including some countries of the European Union.

Unfortunately, today there are no financial mechanisms for the implementation of projects that would cover the complete renovation of the building to modern requirements and needs, as well as ensuring the solution of all sustainable development tasks in terms of sustainable urban development and related goals. There is global experience in the renovation of residential buildings. The example of Israel, Singapore and the USA highlights practical promising mechanisms for encouraging the construction sector, co-owners and management companies, such as the

condominiums. Depending on the country, the state has introduced various mechanisms for encouraging developers to modernization.

The main principles are to create economically advantageous conditions for modernization compared to new construction, where not only the developer (investor, developer) but also the co-owners (residents) and the State are in a favorable position. Among such mechanisms are the transfer of modernized housing into partial ownership of the developer; transfer of land into ownership; maintenance of residential development. The construction industry is responsible for the issue of resettlement, provision of temporary or permanent housing at its own expense, or other mechanisms for ensuring the implementation of the project. At the same time, co-owners receive housing that meets modern requirements and needs; the construction industry receives income from the sale of completed residential or commercial space; the State - improvement of the surround area and attractive and nice city. In general, this is an increase in the price of square meters, which has a positive effect on the economic condition of the city and the state as a whole; development and improvement of cities; income from additional square meters; improvement of neighborhoods and prevention of its degradation; improving conditions for residents; achieving the goals of sustainable urban development.

A comprehensive approach should be based on the basic principles depicted in Figure 1.

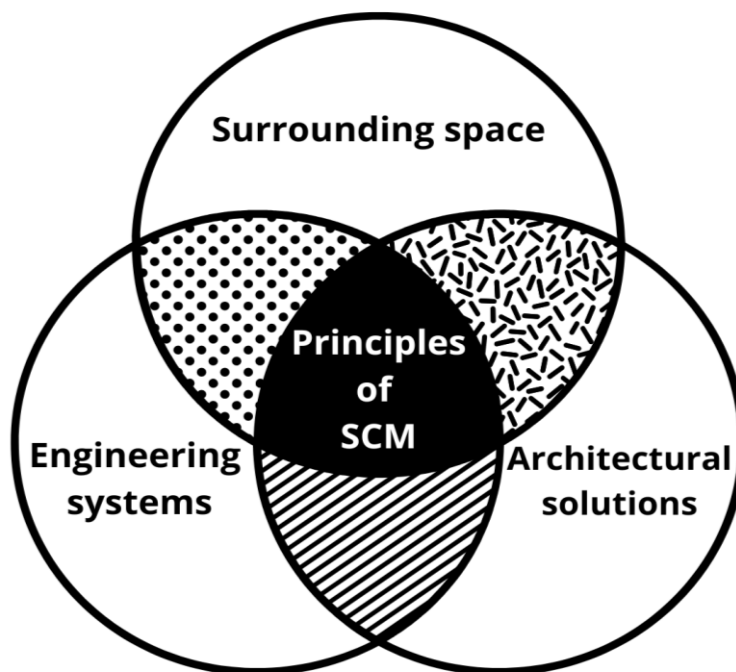


Fig. 1. Principles of sustainable comprehensive modernization of residential buildings  
(Principles of SCM)

This is a simultaneous comprehensive approach and the creation of a project that ensures the modernization of the engineering structures of the building, the architectural and planning solution of the house and the surround area to improve the quality of living conditions and operational characteristics of the house and the environment.

With a comprehensive approach, using the existing housing stock base: houses built in blocks with wide open surrounding space, it is possible to renovate existing panel housing to a competitive regarding new construction. This does not require the use of new plots and densification of residential space. This approach allows solving a range of tasks of sustainable urban development, which is schematically depicted in Figure 2.

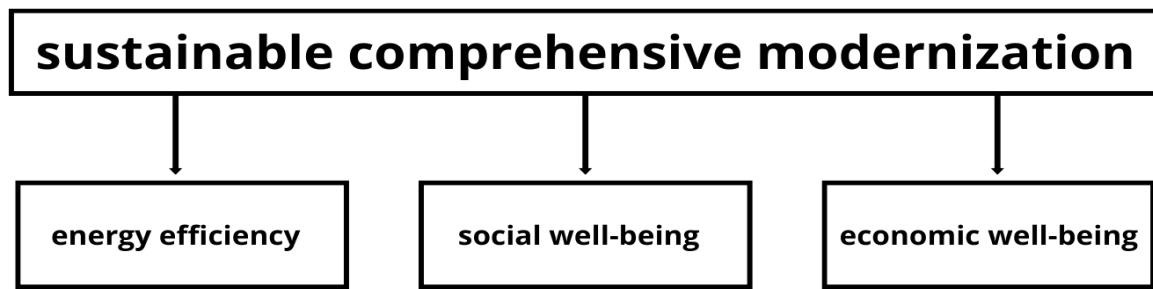


Fig 2. Advantages of the Sustainable comprehensive modernization of the housing stock

This approach prevails in the current situation:

- new, modern, comfortable buildings;
- attractive surrounding area.

It's prevents the degradation of old residential areas; extends the operational life of buildings and creates competition for the new construction.

Comprehensive approach to modernization – modernization of engineering structures, modern architectural and planning solutions without violating the integrity of the building and spatial solutions for the surround area. These allow to obtain a modern residential neighborhoods that ensures environmental friendliness, accessibility, energy efficiency and inclusiveness. As a result – a socio-economically attractive residential space; a renewed attractive city, improving the social and economic well-being of residents.

**Conclusions.** Sustainable comprehensive modernization can solve a range of important tasks of sustainable urban development and contribute to the achievement of other Goals. An important aspect today is the search for ways to overcome the financial burden on households and ways to create conditions for stakeholders.

Further research and initiatives in this direction are needed. Detailed attention should be paid to a sustainable integrated approach to the modernization of residential development. The implementation of such projects is of great importance for achieving the Sustainable Development Goals and economic growth of countries. It is the appropriate decisions in this direction that will contribute to the possibility and implementation of such important projects.

The project must be competitive with new construction and interesting from a commercial point of view of the developer. Therefore, it is necessary to use all available tools and create new ones to achieve the goal.

Studies confirm a partial approach. But the scientific community supports the need and importance of modernization and notes the positive impact.

Unfortunately, there are almost no comprehensive approaches and projects. We are only at the beginning of such movements.

At the global level, there are not enough existing large-scale studies. At the same time, scientists from different countries highlight the need and importance of modernization, but also note obstacles.

Ukraine, which has suffered damage to buildings as a result of aggression, should be more interested than others not in repair them to their original condition, but in full, comprehensive modernization.

Sustainable modernization of residential buildings, namely the renovation of panel housing stock, according to solution of necessary tasks, will help achieve sustainable development goals and improve the economic well-being of cities and the country.

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## РОЛЬ МОДЕРНІЗАЦІЇ ЖИТЛОВИХ БУДИНКІВ У ДОСЯГНЕННІ ЦІЛЕЙ СТАЛОГО РОЗВИТКУ: ТЕОРЕТИЧНІ РІШЕННЯ ТА РЕАЛІЗАЦІЯ

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**Анотація.** Модернізація житлової забудови є значним внеском у досягненні цілей сталого розвитку та вирішенні його задач. Житловий фонд України переважним чином складається з панельної житлової забудови проектів і будівництва років Радянського Союзу. За статистичними даними стара житлова забудова загалом становить більше 85% всього житлового фонду України. Такі будинки не відповідають сучасним вимогам і стандартам. Подібна ситуація з соціальним житловим фондом і в інших країнах, особливо в країнах зі спадщиною радянської панельної забудови. Відновлення старого житлового фонду та приведення його до сучасних потреб, вимог та стандартів значним чином вплине на зменшення споживання первинної енергії та зменшення викидів вуглецю, вирішення задач сталого розвитку в частині інклюзивності та створення привабливих житлових умов відповідно до сучасних стандартів.

Розглядається проблематика модернізації панельної житлової забудови – спадщини Радянських часів. Виявляються та аналізуються прогалини в даному питанні. Описово пояснювальним методом наводяться аргументи необхідності та важливості сталої комплексної модернізації. Приводяться теоретичні рішення та можливості для реалізації проектів комплексної модернізації. Зазначається важливість і переваги такого принципу. При цьому відмічається позитивний вклад у розбудову міст. Але зазначаються перешкоди і необхідність їх подолання.

Темі комплексного підходу до модернізації житлового фонду необхідно приділити більше уваги. Адже часткові рішення не вирішують всіх проблем будинку і навколишнього середовища. Також не дозволяють у повному обсязі досягти цілей сталого розвитку, які може забезпечити комплексна модернізація житлової забудови.

Комплексний підхід до модернізації житлової забудови дозволяє створити конкурентні умови новому будівництву, перешкоджає деградації старих житлових кварталів. Як результат – економічний і соціальний добробут мешканців; економічне зростання міста. Вирішення низки завдань сталого міського розвитку та досягнення інших цілей Сталого розвитку.

**Ключові слова:** стійка комплексна модернізація, житлові мікрорайони, житловий фонд, масова панельна житлова забудова, сталий розвиток, сталий розвиток міст, реновація.

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