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INDICATORS OF MODERNIZATION OF APARTMENT BUILDINGS ON THE BASIS OF SUSTAINABLE DEVELOPMENT

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Abstract. Modernization of residential buildings on the basis of sustainable development should consider not only energy efficiency. After all, the tasks of sustainable urban development are inclusiveness and safety. All the goals of sustainable development are interconnected. The construction industry has a critical role in achieving almost all the goals. Given that old houses usually require modernization, projects should take into account inclusive planning solutions, repair work of outdated parts and engineering systems of the building, energy efficiency, as well as safety and attractiveness to increase the market value. This approach is considered due to the fact that almost all modernization programs offer only energy efficiency. Energy efficiency does not cover the necessary repairs to the building, nor does it solve other sustainable development tasks. Residential buildings and adjacent territory are the essence of cities. Without sustainable modernization of residential buildings, the goal of sustainable cities will not be achieved.

In this regard, the concept of modernization of housing buildings on the basis of sustainable development is proposed. Indicators and criteria that should be taken into account when developing projects for the modernization of residential buildings are determined. That is complete renovation of the building and the surrounding area as modernization and repair work taking into account inclusiveness and regeneration of the technical condition. Architectural and planning decisions, engineering and construction works should be considered as one set of works for complete renovation and regeneration for creation of comfortable and safe living conditions in order to achieve the goals of sustainable development.

Keywords: indicators of modernization, residential buildings, modernization, sustainable development, sustainable modernization

Introduction. Modernization of residential buildings on the basis of sustainable development must meet certain indicators. Modernization can be called sustainable only if all indicators are present in the regeneration process. Partial modernization processes such as energy efficiency cannot correspond to complex sustainable modernization. Energy efficiency, which is currently receiving the most attention, is only part of sustainable modernization. Buildings which need energy efficiency are mainly very old ones that have expired.

Repair work to restore outdated parts and elements of the house is not always carried out according to plan. This is especially the case in post-Soviet countries and East Europe with a heritage of panel residential buildings of mass residential construction. But others countries are not exclusion.

At the time of construction, the houses met building regulations and norms, but the architectural and planning solutions were not oriented towards inclusiveness. Today there are such houses, most of which were built in the 70s and 90s of the 20th century. Such a residential building requires not only modernization and inclusive architectural planning solutions on the basis of sustainable development, but also repair work to bring the building up to the appropriate technical standards and living conditions.

If only energy efficiency works are carried out, there will remain the issue of worn-out communication systems and nodes, such as water supply and sewage systems. The issue of indoor common areas also remains

open. The unresolved issue of inclusivity. The general technical condition of the building and the architectural and planning decision will remain the same. The task of sustainable development of cities will not be achieved only in terms of energy efficiency. The task of environmental protection will be partially solved, and all other issues, including improving the quality of life and inclusiveness, will remain an unresolved issue. The increase in the cost of housing, as an economic development, has not been resolved. Preventing the degradation of areas with old, unattractive residential buildings will also remain in question.

Analysis of recent research and publications. The UNCTAD, as a body of the UN General Assembly, whose resolutions are of a recommendatory nature, developed manuals marking indicators for achieving the goals of sustainable development in the main directions in the economic, environmental, social and institutional spheres [1]. As the scientists note in the research, the key indicators of sustainability regarding the modernization of an individual building and the revival of cities depend on three aspects: environmental, economic and social sustainability [2]. Considering that all UN member states have supported the Sustainable Development Agenda until 2030, old residential buildings in all countries need to be modernized in accordance with the principles of sustainable development [3]. The housing stock of the post-Soviet countries, where the majority of residential buildings are dominated by the Soviet heritage of panel, old and non energy efficient residential buildings, needs the most attention. But other countries are no exception, such as Finland [4].

The authors note the importance of modernization of residential buildings in their articles. It is like a necessity for energy efficiency [5]. Improving living conditions and increasing the cost of housing also [6]. Prevent the degradation of areas with old residential buildings [7]. The need for the regeneration of social housing development is considered in the example of France, Belgium and Italy [8]. Economic and social aspects are noted. The need for modernization of residential buildings is considered on the example of Kazakhstan, a post-Soviet country [9].

An analysis of the ecological and economic development of the country is considered on the example of Lithuania [10]. Modernization of residential buildings is one of the factors in achieving ecological and economic sustainability of cities.

In the context of consideration of indicators of sustainable modernization, it is not an exception to consider the construction and use of a global indicator of sustainability [11]. Many researchers note the need for responsible energy consumption and environmental protection. In accordance with the principles of sustainable development, responsible production and consumption of primary energy resources will provide the opportunity for economic prosperity and a healthy life for future generations. The system of indicators of the modernization of the world is studied [12]. Sustainable urban development should focus not only on modern construction, but also on original natural ecosystems and traditional cultural protection [13]. The measurement of sustainability is not only a controversial issue, but also attracts the attention of both scientists and politicians since the late 1980s [14]. International indicators of sustainable development were considered even before adopted agenda in the 2015 for Transforming our world: the 2030 Agenda for Sustainable Development [15]. The study is based on certain goals of sustainable development, declared by the adopted agenda in 2015 and predominantly focused on the issue of solving environmental problems. [16,17]. Indicators are mostly defined specifically for sustainable development in general [18]. Models and strategies for the regeneration of residential buildings are determined on the basis of sustainable development, as the achievement of the 11th goal — sustainable development of cities [19]. Of course, the success of any transformation depends on the ways of its implementation. The difference between regeneration and sustainable modernization remains an open question.

Objectives and tasks. The aim and task of this work is to identify exactly the indicators of sustainable modernization of multi-apartment residential buildings. Predominantly, the issue of modernization is considered as ecological modernization, including the energy efficiency of buildings. The issue of improving the quality of living conditions, such as preventing the degradation of neighborhoods with outdated residential buildings and increasing the value of square meters of housing, is considered separately. Taking into account the instructions and recommendations of the UN departments, which determine the general goals and strategies of sustainable development, including the sustainable development of cities, there is a need to define indicators of sustainable modernization of residential buildings. After all, in accordance with the principles of sustainable

development, in order to achieve all the goals of urbanization, it is necessary to have a general concept of sustainable modernization of multi-story residential buildings as an integral part of cities.

Materials and Methodology. A qualitative analysis of publications and their research revealed gaps in the identification of sustainable modernization of residential building. The analysis of state and non-state studies, recommendations, reports and conclusions of UN departments, which focus on global indicators of sustainable development, provided the basis for determining indicators specifically for the modernization of multi-apartment residential buildings on the basis of sustainable development. In this work, descriptive and explanatory methods provide information on the identified indicators of sustainable modernization of residential buildings.

Results. Analysis of information on sustainable development, including the UN System-Wide Strategy on Sustainable Urban Development, defines certain parameters of sustainable development in relation to construction. The interrelationship of the goal of sustainable cities and communities with other goals of sustainable development is noted [20]. Construction covers most goals [21].

Modernization of multi-apartment residential buildings is one of the goals of achieving sustainable urban development. Sustainable development of cities and communities is one of the parts of achieving the goals of sustainable development.

The main parameters of the new course of modernization of cities and residential development are:
1. Restoration and development based on the best international experience using modern solutions and "green" technologies.
2. Regeneration on the basis of sustainable development.
3. Energy independence – decarbonization of buildings and systems due to a significant increase in their energy efficiency.
4. Inclusiveness – creation of a favorable environment for equal access and opportunities for all citizens and fair distribution material and social benefits.
5. Civil protection – creation of space to ensure maximum safety for the population.

Based on the analysis and collected foreign experience, it is necessary to achieve the following goals of sustainable modernization of housing development:
1. Bringing all buildings into compliance with local and state laws, rules and regulations.
2. Involvement of residents and condominiums and other interested parties even before the development and financing of the project.
3. Promoting interest and interaction and meeting the needs of residents in the development of the project.
4. Taking into account the needs of residents in the architectural and planning decision, priorities and requirements of the scope of modernization, advantages of construction and planning.
5. Assistance to co-owners in consultations and social support.
6. Facilitation of cooperation and analysis for the improvement of construction systems of further maintenance.
7. Taking inclusiveness into account when developing architectural and planning solutions for the house and the surrounding area to ensure access for all segments of the population.
8. Control of the penetration of air and moisture into the premises to prevent a change in the healthy microclimate and mold.
9. Improving the attractiveness, durability and functionality of apartments and common areas.
10. Use of materials and products that are durable and safe for the environment and people.
11. Modernization of independent year-round microclimate systems of a residential building with a focus on local regulation in each apartment.
12. Autonomy of all possible building systems.
13. Decarbonization and reduction and savings on energy carriers.
14. Electro Modernization.
15. Use of effective methods of planning modernization projects, such as improving the quality of work and reducing costs, reliable phased design for preparatory and construction works in order to reduce the risk of disruptions in the lives of residents during modernization and for the effective realization of the project.

In order to declare a sustainable complete modernization, and not a partial one, which in a certain way

satisfies the conditions of sustainable development, such as energy efficiency, it is necessary to define indicators. The general set of such indicators can confirm the sustainable modernization of residential buildings. The indicators are shown in Figure 1.

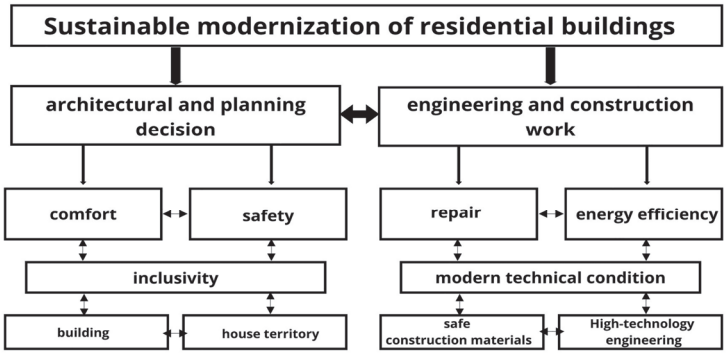

Figure 1. *Indicators of sustainable modernization of residential buildings.*

In order to determine the sustainable modernization of residential buildings, it is necessary to be guided by the specified indicators, as a set of parameters of the new concept. Sustainable modernization means meeting today's housing needs with future generations in mind. Sustainability can be achieved only with a comprehensive approach to modernization works: an inclusive architectural and planning solution and restorative engineering and construction works. At the same time, the architectural and planning solution should ensure comfortable and safe living conditions and inclusiveness of the house and the surrounding area. Regeneration works should ensure restoration of the technical condition of the building and energy efficiency due to the use of safe building materials and the latest engineering technologies. This set of works should provide a solution to the modernization of residential buildings for many years to come. This will be achieved by bringing the building to an engineering and technical condition that meets modern needs and norms, and an inclusive planning decision.

I would like to highlight a study that confirms that the regeneration of old buildings is not a utopia. The study was conducted even before the approval of the agenda of sustainable development until 2030. But even then, the need to modernize residential buildings was noted, taking into account today's needs and thinking about the future. The research concerned the concept of sustainable development and consideration of the regeneration of the housing stock without resorting to demolition [22]. For many years, researchers have been determining the problems of old residential buildings, especially the period of mass residential construction after the Second World War. There are not only the post-Soviet countries or Eastern Europe. The housing stock of this period is energy inefficient and needs repair work, at least to restore the technical condition.

All programs and projects are aimed at energy efficiency. Funds for energy efficiency [23] and modernization [24] are being created; green bonds to finance energy efficiency, as an example [25]. But proposals for complete modernization are isolated cases, such as the example of the USA in the city of New York [26].

Today, the goals of sustainable development are increasingly discussed. The issues of energy efficiency and restorative repair work of old residential buildings have not become less relevant. Therefore, the regeneration of residential buildings should be considered on the basis of sustainable development. In this regard, there is a need to determine indicators of sustainable modernization of residential buildings in order to understand the importance of regeneration processes in accordance with the sustainable urban development.

An important factor is the rethinking of approaches to the definition of modernization. Due to the identified indicators, a new concept of sustainable modernization is emerging. Which reveals the following parameters shown in Figure 2.

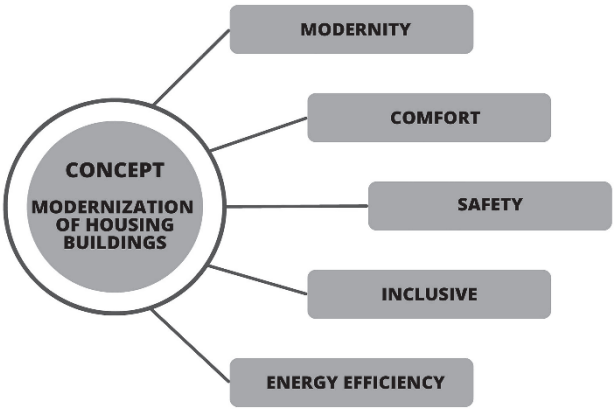

Figure 2. *The concept of sustainable modernization.*

The modernized building and the surrounding area should be inclusive, safe, comfortable and modern. In turn, this leads, in addition to achieving sustainability, such as energy efficiency, inclusiveness and economic growth, to savings on heating and increasing the value of living space.

Conclusions. Due to the proposed model and the indicators that determine it, a new vision of sustainable modernization of housing development is offered. The development of modernization projects taking into account these indicators will help to solve the issue of sustainable cities and communities. Ensuring environmental protection, promoting economic growth, ensuring social development, preventing the degradation of areas with old, unattractive and energy-inefficient residential buildings. For the co-owners of residential buildings, this concept provides savings on the payment of energy carriers and an increase in social and economic well-being due to the increase in the price of square meters of housing and improvement of the quality of housing. For the country, it means improving the image as a modern and stable city that is attractive from the point of view of tourism and investment.

Currently, the focus is on programs and projects related to energy efficiency. Complex regeneration of residential buildings, which achieves the goals of sustainable development, are isolated cases. Such projects involve restoration of the building to the appropriate current state, due to which energy efficiency is achieved. But such projects based on the principles of sustainable development, such as the modernization of residential buildings taking into account inclusive redevelopment and restoration of the technical condition to date, as a concept or an existing project, are not considered.

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ІНДИКАТОРИ МОДЕРНІЗАЦІЇ БАГАТОКВАРТИРНИХ БУДИНКІВ НА ЗАСАДАХ СТАЛОГО РОЗВИТКУ

Анотація. Модернізація житлових будинків на засадах сталого розвитку повинна враховувати не лише енергоефективність. Адже завдання сталого розвитку міст – інклюзивність та безпека. Усі цілі сталого розвитку взаємопов'язані. Будівельна галузь відіграє вирішальну роль у досягненні майже всіх цілей. З огляду на те, що старі будинки зазвичай потребують модернізації, проекти мають враховувати інклюзивні планувальні рішення, ремонт застарілих частин та інженерних систем будинку, енергоефективність, а також безпеку та привабливість для підвищення ринкової вартості. Такий підхід розглядається через те, що практично всі програми модернізації пропонують лише енергоефективність. Енергоефективність не охоплює необхідні ремонти будівлі та не вирішує інші завдання сталого розвитку. Житлові будинки та прибудинкова територія є сутністю міст. Без сталої модернізації житлових будинків мета сталого розвитку міст не буде досягнута.

У зв'язку з цим запропоновано концепцію модернізації житлових будинків на засадах сталого розвитку. Визначено індикатори та критерії, які необхідно враховувати при розробці проектів модернізації житлових будинків. Тобто повний ремонт будівлі та прилеглої території, як модернізація та ремонтні роботи з урахуванням інклюзивності та відновлення технічного стану. Архітектурно-планувальні рішення та інженерно-будівельні роботи слід розглядати як єдиний комплекс робіт з повної реконструкції та відновлення для створення комфортних і безпечних умов проживання з метою досягнення цілей сталого розвитку.

Ключові слова: індикатори модернізації, житлові будинки, модернізація, сталий розвиток, стала модернізація