

**THE IMPACT OF SUSTAINABLE DEVELOPMENT ON NEW CONCEPT OF  
MODERNISATION OF RESIDENTIAL BUILDINGS**

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**Abstract.** Modernization of multi-apartment buildings is one of the steps towards achieving the goals of Sustainable Development of cities and communities. It is not only energy efficient, but also inclusive and spatial solutions. New concept has been introduced such as "Sustainable modernization" is a harmonious and balanced process that combines coordinated changes in today's and future needs, and "Sustainable modernization of residential buildings" is a complete set of actions for the regeneration of buildings and residential areas, including the regeneration of communal communications and nodes. Because only energy efficiency of buildings is not enough for the achievement of the goals of sustainable cities and communities, considering the fulfillment of all the tasks set. The goal is to make cities and human settlements inclusive, safe, resilient and sustainable. Regeneration today is the modernization of multi-apartment buildings to achieve energy efficiency to conserve and reduce the use of energy resources, which helps reduce utility costs and carbon emissions. But it does not satisfy the task of inclusive and planning decisions as Sustainable Urban Development. Panel mass housing construction heritage makes up a significant part of the country's housing stock in post-Soviet countries. These buildings were built according to standards that do not meet modern requirements and energy inefficient. New concept of regeneration on the basis of sustainable development is proposed as the modernization of residential buildings considering the wishes and needs of co-owners, inclusive and sustainable planning. That is, the architectural and planning decision includes the need for the house and the surrounding area for inclusive and reconstruction taking into account the social needs of the residential quarter.

**Keywords:** regeneration, modernization, Sustainable modernization, Sustainable Development, Sustainable Urban Development, multi-apartment building, residential building

**Introduction.** Modernization of residential buildings is an important topic especially regarding sustainable development cities and communities. The goal of Sustainable Urban Development is to make cities and human settlements inclusive, safe, resilient and sustainable [1, 2]. When it comes to regeneration or modernization, it is usually energy efficiency. Energy efficiency of buildings is not enough for the achievement of the goals of sustainable cities and communities, considering the fulfillment of all the tasks set. It is not only energy efficient, but also inclusive and planning solutions. New concept has been introduced such as "Sustainable modernization" is a harmonious and balanced process that combines coordinated changes in today's and future needs, and "Sustainable modernization of residential buildings" is a complete set of actions for the regeneration of buildings and residential areas, including inclusive and social architectural planning solution and the regeneration of communal communications and nodes. Regeneration today is the modernization of multi-apartment buildings to achieve energy efficiency to conserve and reduce the use of energy resources, which helps reduce utility costs and carbon emissions. But it does not satisfy the task of inclusive and planning decisions as Sustainable Urban Development. New concept of regeneration on the basis of sustainable development is proposed as the modernization of residential buildings considering the wishes and needs of co-owners, inclusive and sustainable planning. That is, the architectural and planning decision includes the need for the house and the surrounding area for inclusive and reconstruction taking into account the social needs of the residential quarter and neighborhoods.

Modernization should be considered a complete set of actions for the regeneration of residential buildings and neighborhoods, taking into account the regeneration of communal nodes, which are on the balance sheet of the state and other organizations and enterprises. In other words, the modernization of the housing stock of sustainable cities is the regeneration of the building stock and urban communications and technical and engineering communication nodes such as boiler houses, transformer substations, the sewage system of the city, taking into account the current needs and with a focus on future generations with the preservation of natural resources and the environment and inclusive.

Considering that the goal of modernization is sustainable inclusive cities and sustainable communities, the task of the countries is the comprehensive achievement and solution of economic, social, legislative and political tasks of Sustainable Development.

This is no longer just an engineering construction decision for multi-apartment building, but the architectural planning of the surrounding area, neighborhoods and the city as a whole. This is no longer an architectural decision from the point of view of appearance and construction norms and energy efficiency, as in the construction of a new residential complex, and as in the case of reconstruction taking into account the possible re-planning and completion of socially significant elements of the house and outbuildings in residential neighborhoods.

This is creating inclusive cities and overcoming social exclusion, including in the development of modernization projects. When it comes to sustainable modernization, it is necessary to engage in explanatory work for co-owners of multi-apartment buildings and take into account their wishes and needs. Analyzing the current situation and focusing on future needs is important not only from the point of view of the operation of the house or residential neighborhoods, but also the current and future needs of inclusive urban planning. Architects and researchers of social issues need to take a direct part in the development of state or other programs, as well as in the planning of projects for each separate group of residential buildings or even a separate residential neighborhood, depending on the design and financial capabilities.

There are very important participation of the builder, developer, condominiums, local government and social authorities' protection for obtaining consent from the co-owners for temporary or permanent eviction, consent to dismantling and receiving compensation in monetary equivalent or for the cost of a new apartment in a new building which will build on the same place or elsewhere. Work on clarification and initiating programs both at the state, local and commercial and at the level of non-governmental organizations is important. That is, the initiation of the modernization programs with the involvement of all stakeholders for the preparation, analysis and planning of the project. So there are no controversial issues at the stage of development and implementation. Achieving the goals of sustainable development is a global socio-political trend.

If previously the concept of sustainable development was adopted by the General Assembly in the 1987 year report of Brundtland Commission [3], then with the adoption of goals until 2030 [2], any issues related to the achievement of these goals and the implementation of tasks must be considered comprehensively. Achievement is not possible if the execution works partially. World is changing and we should follow new trends. Any country can't exist without people. The government, architectures, constructors companies and Organization when talking about modernization and regeneration should to involve in inclusive, planning decision of housing buildings and neighborhoods at first have thinking about social needs and well-being people and about energy efficient, how saving energy resources for world and saving money for people in utility costs, and their safe and comfort future also. Regeneration of multi-apartment building shows how sustainable modernization is a very complex and expensive program. Given that large-scale Social Housing estates are predominantly inhabited by low-income people, financing is more complicated because it is difficult to obtain consent on co-financing from co-owners of old multi-apartment buildings. All current modernization programs are energy efficient only and require co-financing by co-owners. Co-financing is very complicated for low-income citizens especially in Post-Soviet countries because the credit rate is so high. Large-scale Social Housing estates in the European Union are widely, especially how "panel houses" Soviet heritage in Post-Soviet countries such as Lithuania, Estonia, Slovenia etc. Large-scale multi-apartment "panel houses"

building until the 90s of the 20th century constitutes the main part of the housing stock in Post-Soviet countries like Ukraine, Kazakhstan and others. Some of them are old and emergency. The housing stock of Ukraine built before the 90s is more than 85%. Many houses built in the 90s aren't to meet requirements, current building codes and energy efficiency also, not to mention the inclusive of neighborhoods. More than 60% of multi-apartment buildings have reached the end of their service life and didn't regenerate at all. It is inappropriate to carry out only energy modernization in houses with a completed service life and in which no repairs have been made to other communication and engineering parts and components.

**Analysis of Recent Research and Publications.** N. Aernouts with other researchers in their report note that joint approaches to residential regeneration focused on sustainable development and redesign of public space in social housing have rarely been seen in the past [4]. It refers to the consideration of the modernization project both the involvement of social housing residents in the regeneration of their living environment and the study of local living conditions to promote construction with a mutually beneficial approach to planning solutions.

Joining the efforts of co-owners, condominiums, housing and utility organizations, architects as spatial practitioners, and social organizations around the theme of regeneration are very necessary.

Modernization issues are widely discussed and researched, especially about "panel houses" post-Soviet heritage. The problem of old residential buildings in Slovenia is described in comparison to mass housing after the Second World War and the post-socialist era. It is proposed to introduce an appropriate policy for the regeneration of housing in order to create an attractive living environment and prevent the degradation of these neighborhoods [5]. Possibilities of modernization of mass series Soviet residential building construction of the 1960s in Almaty city were explored. The purpose of the research is to find an opportunity to transform the housing stock through modernization and achieve comfortable living conditions [6]. Energy efficiency issues of old buildings of Soviet heritage in Lithuania are raised. It is noted that many multi-apartment buildings are in a particularly bad heat-technical condition and energy costs for heating are significant. Heat supply infrastructure is morally and physically outdated. Obstacles to modernization are highlighted such as not only legal and technical factors, but also financial and social aspects regarding possibilities of co-owners [7]. The problem of residential housing built in the 1950s in Poland is considered. Low comfort and attractiveness of such buildings and poor technical condition are noted. Considering the modern requirements for housing and the goals of sustainable development, possible directions of modernization are proposed by M. Piekarski with colleagues [8]. The proposal is considered in terms of a technically similar residential development of the 1950s, as a unified concept for modernization projects of a certain group of buildings. The issue of the necessity of housing regeneration for more comfortable and attractive living as well as due to poor technical condition and energy inefficiency is considered by many authors.

Financing issues and possibilities of co-owners are also not ignored [9]. Many countries have inherited a lot of energy-inefficient buildings from the time of the Soviet Union. Analysis of the issues of willingness to co-finance the energy reconstruction of residential buildings on the example of Lithuania showed problems. The results showed that there are organizational and economic barriers and current policies and support schemes do not adequately address them. Insufficient government support and reluctance to take loans, as well as the inability to make collective decisions and lack of cooperation is a major obstacle to the implementation of modernization projects in the field of energy efficiency [10]. The question was raised whether modernization pays off. The research is based on the analysis of German apartment buildings. As it turned out, the significant environmental premium and the costs of the tax on carbon emissions do not adequately compensate for the costs of energy-efficient modernization. A. Groh with other researchers had been highlighted that marginal costs far exceed marginal benefits [11]. In connection with the relatively low level of construction and the insufficient level of reconstruction of the existing one, the question arises of quickly achieving the goals of sustainable development in terms of energy efficiency. But despite all efforts, the rates of regeneration are low. Such a problem is proposed to be solved comprehensively – improving energy efficiency through deep renovation. The discussion

focuses on technical, financial and social aspects and barriers in the context of building renovation [12]. The issue of implementing energy efficiency in multi-apartment buildings in Ukraine is also being considered. Insufficient state support and funding, as well as the financial incapacity of co-owners of the house are noted [13].

The problems of energy efficiency modernization and the need to regenerate buildings due to unsatisfactory conditions are considered and obstacles and barriers are discussed. The need for a comprehensive approach and deep regeneration is also noted.

Topics of sustainable modernization of multi-apartment buildings such as ways to reach the goals of sustainable development including inclusiveness and regeneration housing stock and sustainable urbanization of comfortable living today and in future don't usually be considered such as government programs. All government programs concentrated energy efficient as usual.

**Objective and Tasks.** The objective of research is to identify impact sustainable development on modernization of multi-apartment residential buildings. Transforming our world: the 2030 Agenda for Sustainable Development [1] has made adjustments to views and perceptions on urban development. In this connection, the task became the development of a new approach for the modernization of residential buildings. New approaches require new concepts. Modernizations of multi-apartment residential buildings needs to take into account the goals and objectives of sustainable development. The task is to identify gaps in the existing approach to the modernization of residential buildings and find ways to solve them.

**Materials and methods.** The research is built on empirical methods such as descriptive and observation based on the theoretical method quantitative and qualitative analysis data and legislation. Using the method of quantitative and qualitative analysis the issue of regeneration of large-scale social housing in some cities of the European Union is analyzed as examples of France, Belgium and Italy. The analysis used report Socholab [4] at the request of the European Union and other available information. Socholab report with retrospective analysis of existing projects in the suburbs Paris, municipalities and communes; action research ongoing experience in Milan and Brussels gave an introduction about regeneration large-scale social housing estates in Europe. Policy objectives given in Programming Manual (2021-2027) Interreg Europe co-funded European Union [14]. Using the method of generalization and qualitative analysis, the situation in the modernization of old residential buildings in European countries with the post-Soviet heritage of "panel houses" was determined. The emphasis is on describing programs, the legislative and financing way in Lithuania example [15-20]. Programs and plans, legislation and government and bank are given information about modernization. Using the method of quantitative and qualitative analysis of existing modernization programs in Post-Soviet countries, using the example of Kazakhstan [21] and Ukraine, current trends in the regeneration of the housing stock were determined [22, 23]. Modernization programs introduce information about regeneration structure. Quantitative and qualitative analysis of the Ukrainian legislation provided an opportunity to determine future prospects. Using the method of generalization and analysis of statistical data on the housing stock of Ukraine, current and future opportunities for the modernization of the multi-apartment buildings, as well as possible obstacles in the implementation of projects are identified. Using the method of observation and anonymous survey by condominium representatives and co-owners of multi-apartment buildings, problems associated with sustainable modernization in Ukraine were identified. Descriptive and explanatory method, based on the obtained analyzed data, the current situation was determined, which was compared with the tasks of urban development, as well as the achievement of the goals of sustainable development until 2030. A quantitative and qualitative analysis of the involvement of all stakeholders such as Organizations, Founds, construction companies and others identified possible ways and incentives for sustainable modernization using the example of Ukraine. A comparative analysis led to the conclusion that it is necessary to change approaches and emphasis in implementing the tasks of sustainable cities.

**Results.** Agglomeration has great political significance. There is a desire and foundation aimed at creating an alternative point of view on neighborhoods and directing the actions of local authorities to promote local regenerative changes in the housing stock. Large-scale social housing

estates are characterized by important socio-spatial problems. These emphasize the need for extremely innovative and integrated programs through the territorial determinations of planning and interconnection of the city with districts and neighborhoods. The Soholab project is based to develop an integrated approach to the regeneration of social housing in Europe [4].

Housing stock analysis of multi-apartment buildings which were built before the 1990s, especially in countries with a Soviet heritage, such as "panel houses" determined the real situation and their needs. All buildings more or less, depending on countries' construction standards, do not meet the building regulations. These include: energy efficiency and general condition of house. Housing stock has completed service life in most cases. Better situations with buildings which were partially renovated or regenerated parts of buildings such as roof, walls, electricity, plumbing system, canalization communications and others.

The example of the countries of the European Union demonstrates the fact that the situation is not so deplorable as the houses are periodically repaired and meet operational requirements. Modernization requires a new approach such as to involve co-owners into process for understanding their and their houses' needs. Creating new programs that will include inclusive planning solutions is preferable. Innovation programs means projects which include whole buildings and residential neighborhoods' needs. Modernization today is considered as energy efficient. Regeneration and repair of parts of the building is as a separate periodic process. This process allows repair of old elements of the buildings and makes the house suitable for operation. Without a new planning solution it is difficult to make regeneration of the building which responds to modern construction standards considering changes in current building regulations because majority houses were built until the 1990s. This also does not include spatial re-planning and inclusiveness of buildings and neighborhoods.

The housing stock of post-Soviet countries is distinguished by the fact that planned periodic repair works are rarely carried out. The situation is that almost all houses need regeneration and repair of nodes and engineering parts. That is, it is impractical to improve the heating system and to insulate the walls and roof without repairing these elements.

Energy efficient modernization is only suitable for buildings that meet operational requirements and don't have a completed service life. When it comes to sustainable development, it is advisable to create programs that will comprehensively cover all problematic aspects: energy efficiency, regeneration of all worn-out nodes, and inclusive re-planning. This applies to both of the buildings and residential neighborhoods.

The strategy of all modernization programs is aimed at reducing primary energy consumption and carbon emissions. The comparative characteristics of the modernization program considering average statistical analysis are presented in Table 1.

Table 1 – Comparative characteristics of modernization programs (statistical average)

Countries	Initiator	Cover	Financing	Co-financing
EU	Government Organization Nongovernmental Organization	up to 70%	funds	co-owners*
Post-Soviet		up to 70%	funds	co-owners*

\*– Self-financing or bank credit financing

Cost of work and materials does not differ significantly. Average monthly incomes are much lower in post-Soviet countries. Average credit rate in many post-Soviet countries is much higher than in EU countries. Therefore co-financing by co-owners in post-Soviet countries is a controversial issue. A survey in Ukraine showed a significant percentage of reluctance to participate in modernization projects precisely because of the financial burden.

Sometimes it is possible to find additional financing for low-income families or postponement of payments for the post-modernization period, when savings on utility services are already significantly noticeable.

Modernization Fund covers up to 70% priority investments including modernization of energy networks [24].

The Energy Modernization Program and "Green Country" were initiated with the participation of the President of Ukraine. Accordingly, changes were made to the legislation and a decarbonization and energy-efficient modernization fund was created as a permanent source of financing for many energy efficiency projects and programs in various sectors of the economy [25]. Changes in legislation can provide a basis for 100% financing of energy efficiency modernization.

The initiators of modernization projects in Ukraine are condominiums, as representatives of co-owners. Therefore, responsible for all issues of coordination and dispute resolution are condominiums. Any regeneration or modernization project requires the consent of co-owners. Without such agreement in participation and co-financing, the modernization project, including the achievement of the goals of sustainable development of cities and communities, is impossible. The dispute resolution causes the reluctance of condominiums to participate in regeneration.

The dispute resolution, including between condominiums and co-owners, is a separate topic for discussion. This is especially relevant for Ukraine because alternative dispute resolution is not widespread in Ukraine compared to the countries of the European Union. Modernization is only co-owners' expression of will, not an obligation, therefore solving such issues in court is impractical and in general is not their competence.

In order to achieve the goals of sustainable development of cities and communities, it is necessary to consider rehabilitation of residential buildings and residential neighborhoods. Rehabilitation such as regeneration multi-apartment building, re-organization and planning solutions which include inclusive cities is very important for achieving the goals of sustainable development. Therefore, when we talk about sustainable urbanization, we must talk about sustainable modernization.

Sustainable modernization is the new concept. Because full modernization which covers all construction elements and inclusive solutions it does not apply at this moment.

Rehabilitation is a set of measures to economic, technical and social factors of a residential building with the aim of regenerating engineering condition or achieving modern standards of new construction in relation to individual structural elements, as well as extending the life of the building.

Inclusiveness is very important for sustainable cities. Especially the cities of the post-Soviet countries and their residential neighborhoods are not equipped for people with disabilities. Planning solutions of "Panel houses" and similar ones mostly do not have suitable conditions for mothers with children and disabled people. Access to parks, driveways, underpasses is difficult for people with disabilities and even for pensioners and mothers with baby carriages – too high steps make passage impossible. Pharmacies should be inclusive, but they are usually located in violation of today's building regulations, for example. They need a re-planning solution regarding new construction regulation and sustainable modernization. Inclusive urban reconstruction is a new opportunity to make the country accessible to all its inhabitants. Inclusiveness is the access of all categories of citizens to spaces of the city. It is part of the achievement of goals of sustainable urbanization.

The innovative concept is the integration of both modernization and regeneration including inclusiveness planning solutions for multi-apartment building and residential neighborhoods.

Developing programs and their projects is appropriate for separate groups of houses which depend on construction year building. As a rule, large-scale residential buildings of different years of construction differ in engineering and architectural solutions: the number of floors, amount of elevators, and floor planning. Therefore, the individual needs of the house must be taken into account when developing projects. Create projects according to groups of houses and residential neighborhoods. As a rule, buildings built before the 1970s differ from the planning solutions of buildings in the 70s-90s 20 centuries.

The combination of all components such as an inclusive planning solution, energy efficiency, regeneration of all need to be repaired elements and engineering units and communications of the building will provide an opportunity to achieve the goals of sustainable urban development and improve housing comfort for present and future generations with the thought of protecting the environment. The components of Sustainable Modernization are shown in Figure 1.

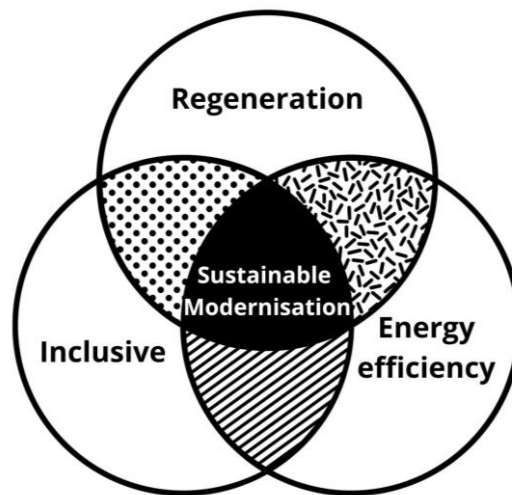


Fig. 1. Sustainable Modernization

Comprehensive modernization of the building with the renewal of city heating communications, electrical substations, sewerage systems, street landscaping will help renew and restore residential neighborhoods and ensure reduction of carbon emissions, the preservation and improvement of the environment also.

Large-scale projects are expensive of course. But, considering needs for complete regeneration, phased modernization will cost more then. Step-by-step modernization requires development of several projects, coordination, obtaining the approval, coherence, negotiations and search for funding at each stage of the program. Each stage of modernization, as a separate project, will require repetitions of operations. There is a risk that after completing the first stage, engineering changes of the previous phase will be necessary for realization of the next stage, which in turn increases costs also.

The development of universal programs for similar groups of multi-apartment buildings will make it possible to implement successful projects in all cities. Successful implementation depends on commitment and alignment between all stakeholders. Such projects require participation and involvement from Government organizations to each co-owner of the apartment. This is illustrated in Figure 2.



Fig. 2. Stakeholders of Sustainable Modernization of multi-apartment buildings

Cooperation will allow stakeholders to find the optimal solution, to agree on controversial and financing issues.

**Conclusions.** There are prospects for the modernization of residential construction, based on the data on new ideas, parameters and components inherent in the process of urbanization and sustainable modernization of multi-apartment buildings. Interrelationships between different levels of social and political context can combine planning solutions and improvements with socio-political and economic goals. However, construction opportunities within such programs often cannot compensate for structural deficiencies, including lack of co-owners cooperation, public investment, and serious deficiencies in management and maintenance in these areas. In addition, these innovative measures are not well adapted to current modernization programs. Therefore, it is precisely such an imperfection that must be eliminated in current and new modernization projects.

In order to achieve the goals of sustainable development and fulfill the tasks of sustainable cities and communities and sustainable urbanization, it is necessary to develop innovative programs and their projects for the regeneration of buildings and residential neighborhoods.

All current programs as a rule are unified and not adapted to the needs of each home, or similar groups of multi-apartment buildings. The development of programs for similar groups of buildings will provide a comprehensive, innovative and effective approach to the sustainable modernization of residential multi-storey buildings and neighborhoods. The projects will be individual for each group of houses, but universal across the cities or even countries. This will ensure a reliable modernization program that can be implemented over a long period of time with improvements if necessary after monitoring, evaluation and learning of the pilot project.

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## ВПЛИВ СТАЛОГО РОЗВИТКУ НА НОВУ КОНЦЕПЦІЮ МОДЕРНІЗАЦІЇ ЖИТЛОВИХ БУДИНКІВ

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**Анотація.** Модернізація багатоквартирних житлових будинків є одним із кроків до досягнення цілей сталого розвитку міст і громад. Це не лише енергоефективні, але й інклюзивні та просторові рішення. Було введено нову концепцію, таку як «Стала модернізація» – це гармонійний і збалансований процес, який поєднує скоординовані зміни в сьогоdnішніх і майбутніх потребах, та «Стала модернізація житлових будинків» – це повний набір заходів для регенерації будівель і житлових територій, в тому числі реконструкція комунальних комунікацій та вузлів. Лише енергоефективності будівель недостатньо для досягнення цілей сталого розвитку міст і громад, враховуючи виконання всіх поставлених завдань. Мета полягає в тому, щоб зробити міста та населені пункти інклюзивними, безпечними, стійкими та сталими. На сьогоднішній день, регенерація – це модернізація багатоквартирних будинків для досягнення енергоефективності задля збереження та зменшення використання енергетичних ресурсів, що сприяє зменшенню витрат на комунальні послуги та викидів вуглецю. Але, лише енергоефективність не задовольняє завдання інклюзивних планувальних рішень та необхідних ремонтних робіт зношених частин і елементів будинку, як досягнення сталого розвитку міст. Панельна масова житлова забудова часів Радянського Союзу становить значну частину житлового фонду пострадянських країн. Ці будинки побудовані за стандартами, які не відповідають сучасним нормам і вимогам та є енергонеефективними. Пропонується нова концепція регенерації на засадах сталого розвитку, як модернізація житлових будинків, з урахуванням побажань та потреб співвласників, інклюзивного та сталого планування. Модернізація, з точки зору архітектурно-планувальних рішень, має покривати інклюзивність будинку та прилеглої території, а також включати регенерацію житлової забудови з урахуванням соціальних потреб житлового кварталу.

**Ключові слова:** регенерація, модернізація, стійка модернізація, сталий розвиток, сталий міський розвиток, багатоквартирний будинок, житловий будинок.

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