

PREREQUISITES FOR HOUSING STOCK REFORM
IN THE CONTEXT OF ENERGY EFFICIENCY

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The article analyzes the fundamental prerequisites for reforming the housing stock to improve its energy efficiency. It examines economic reasons related to high utility costs and the energy intensity of the economy. Technical factors are noted: the physical deterioration of buildings and the inefficiency of engineering systems. The environmental aspect is emphasized, particularly the reduction of carbon dioxide emissions. Social and legislative drivers of the process are highlighted, including the growing demand for a comfortable environment and state programs. The authors conclude that the prerequisites are complex and require the consolidated efforts of the state, businesses, and citizens.

Keywords: *energy efficiency, housing stock, modernization, utility costs, energy intensity, physical deterioration, living standards.*

The housing stock, particularly that built during the Soviet period, now represents one of the most resource-intensive and problematic sectors of the urban economy. A significant proportion of apartment buildings in Belarus and other CIS countries are physically and morally obsolete. This creates an urgent need for their systematic reform. In [1] it is noted that improving the energy efficiency of the housing stock can reduce the energy load on the region. Improving energy efficiency is becoming the key vector of this modernization, driven by a complex set of interrelated prerequisites.

The first group of prerequisites is economic. Economic prerequisites are the most effective at demonstrating the tangible results of energy efficiency improvements in monetary terms. The first and most important aspect is the cost of housing and utility services. Tariffs for energy resources are constantly rising, which inevitably becomes a financial burden for ordinary citizens. Through uninsulated walls, old windows, and worn-out engineering systems, buildings lose up to 40-60% of heat, ultimately requiring a greater volume of thermal energy to heat residential premises. The high energy intensity of the housing stock negatively affects the competitiveness

of the national economy as a whole. Reducing losses in the housing and utilities sector helps lower the overall energy intensity of the GDP, frees up state funds for investment in other sectors, and reduces the financial burden on each individual property owner. According to [2], the reduction of heat loss of enclosing structures (for example, due to thermal modernization) has a direct impact on the energy consumption of residential property. We propose to consider the economic effect of thermal modernization of the city's housing stock in order to reduce the consumption of heat energy. Additionally, management companies that focus on improving the energy efficiency of residential buildings can expect a reduction in costs associated with repairing worn-out networks, preparing for the heating season, and emergency response.

Another group consists of technical and operational factors. Here, the primary and most significant issue is the substantial physical and functional (moral) obsolescence of the residential building stock. Many residential buildings were constructed over 50 years ago as part of mass housing projects, meeting only the minimal thermal protection standards of their time. Their standard service life is coming to an end, and their structures do not comply with modern building codes. These buildings require particular attention, as they are the main major consumers of energy resources, often unjustifiably so. The situation can be changed either by replacing these existing buildings with new, energy-efficient ones or by modernizing the existing stock to meet current energy consumption standards.

Furthermore, inefficient engineering systems have a significant impact on the energy efficiency of residential buildings. Outdated boiler houses, unregulated single-pipe heating systems, and the lack of building-level and apartment-level metering devices lead to irrational resource consumption and an inability to monitor usage. All of the above leads to a decline in the population's quality of life. Drafts, dampness, freezing building structures, and mold are direct consequences of low energy efficiency. This negatively affects the health and comfort of residents.

No less important are the environmental drivers. Due to [1] Within the framework of the system of energy efficiency indicators, the environmental issue of the functioning of the housing stock is also considered. This gives the authors grounds to assert that energy efficiency is the foundation of rational resource use. Improving energy efficiency is a key element of the sustainable development philosophy, aimed at conserving non-renewable natural resources for future generations. Every cubic meter of saved gas or kilogram of saved coal represents not only financial savings but also the preservation of the country's natural capital. Reforming the housing stock reorients energy policy from increasing resource extraction and supply to their intelligent and economical use.

Moreover, improving the energy efficiency of residential buildings contributes to the reduction of greenhouse gas emissions. On one hand, the housing and utilities sector is one of the largest sources of greenhouse gas emissions, primarily carbon dioxide (CO₂), into the atmosphere. This is a direct consequence of outdated boiler houses and thermal power plants burning vast amounts of fossil fuels (gas, coal) to heat inefficient buildings. Enhancing the energy performance of the housing stock leads to a direct reduction in fuel combustion, and consequently, to lower emissions. This is not only a contribution to fulfilling international commitments under the Paris Agreement but also a tangible step towards mitigating climate change impacts—reducing the frequency and intensity of extreme weather events. Besides CO₂, the combustion of fuel releases substances harmful to health: sulfur oxides (SO_x) and nitrogen oxides (NO_x), soot (particulate matter), and carcinogens. These emissions form smog and are responsible for respiratory, cardiovascular, and oncological diseases. Modernizing the heat supply system together with building insulation allows not only for a reduction in the overall volume of emissions but also for an improvement in urban air quality, which directly affects the health and life expectancy of city residents.

Improving the energy efficiency of residential properties can also work in synergy with other environmental initiatives. An energy-efficient building serves as an ideal platform for implementing other "green" technologies, such as utilizing renewable energy sources, installing heat recovery systems in ventilation, or implementing water recycling and rainwater harvesting.

Thus, the environmental rationale demonstrates that housing stock reform is not merely about "thermal insulating of buildings," but rather a comprehensive environmental modernization. It contributes to solving global problems while simultaneously creating a healthier and more comfortable living environment for people here and now.

A particularly important aspect of improving the energy efficiency of the housing stock is the enhancement of the population's quality of life. Comfortable and warm housing is a fundamental social need. This is not merely a technical or economic task but also a direct tool for improving citizens' quality of life, which manifests on several levels.

Primarily, it involves the improvement of physical comfort and health. The low energy efficiency of buildings is directly linked to unfavorable living conditions that negatively impact health. However, a range of technical measures can eliminate these problems. The thermal insulation of building envelopes (walls, windows, roofs) creates a uniform and stable thermal regime within apartments. Reducing the level of wall freezing is one of the key steps in combating dampness and mold. Sealed and

warm walls prevent condensation, which eliminates the conditions for mold growth—a potent allergen that provokes respiratory diseases. Furthermore, modern energy-efficient windows and insulated facades act as high-quality sound barriers, creating a quieter and more peaceful environment inside the apartment, which is especially important in noisy urban areas.

It is also crucial to highlight the increase in economic well-being and the reduction of citizen stress. As noted earlier, reducing the financial burden through enhanced energy efficiency is a key economic incentive. A substantial reduction in heating and electricity bills frees up the family budget for other purposes, such as recreation, education, and healthy nutrition, which directly raises the standard of living. Moreover, after modernization, residents no longer fear significant annual increases in utility tariffs because the actual resource consumption becomes substantially lower. This reduces stress levels and enhances the financial stability of households.

Furthermore, in the context of improving quality of life, the creation of a modern and safe living environment is of no small importance. The renewal of infrastructure and the aesthetic upgrades that come with energy efficiency programs transform the external appearance of buildings and adjacent territories. This has a positive impact on the perception of one's living environment and contributes to overall psychological comfort.

Consequently, a rise in the population's environmental literacy occurs spontaneously. Residents are increasingly recognizing the advantages of energy-efficient homes and are starting to initiate their own projects for thermal modernization and utility system upgrades.

The implementation of all the aforementioned measures would be difficult without a state-level policy on energy efficiency. In the Republic of Belarus, this policy is enshrined in the National Strategy for Sustainable Development, the Law "On Energy Saving," state programs for major overhaul, preferential loans for the modernization of residential buildings, etc. The state is interested in a stable and energy-independent housing stock and is actively facilitating the process of its achievement.

Thus, reforming the housing stock towards improved energy efficiency emerges not as an isolated technical task, but as a comprehensive national strategy. It is driven by interconnected prerequisites: from the economic necessity of reducing the financial burden on citizens and the state, to the environmental imperative and the social demand for a comfortable and healthy living environment. The success of this transformation is only possible through consolidated efforts, where state policy creates the framework, businesses provide effective solutions, and a knowledgeable, active citizenry becomes the main driver of positive change. Only such an approach will

enable the creation of a sustainable, economical, and comfortable housing stock that meets the challenges of our time.

References

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ПРЕДПОСЫЛКИ РЕФОРМИРОВАНИЯ ЖИЛИЩНОГО ФОНДА В КОНТЕКСТЕ ПОВЫШЕНИЯ ЕГО ЭНЕРГОЭФФЕКТИВНОСТИ

Статья посвящена анализу ключевых предпосылок реформирования жилищного фонда для повышения его энергоэффективности. Рассматриваются экономические причины, связанные с высокими затратами на ЖКУ и энергоёмкостью экономики. Отмечаются технические факторы: физический износ зданий и неэффективность инженерных систем. Подчерчивается экологическая составляющая, в частности снижение выбросов углекислого газа. Выделяются социальные и законодательные драйверы процесса, включающие рост запроса на комфортную среду и государственные программы. Авторы делают выводы о комплексном характере предпосылок, требующих консолидированных усилий государства, бизнеса и граждан.