Optimal ways to develop ecological and energy-efficient construction

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Abstract. The construction industry has a significant impact on our environment. When erecting buildings and structures, building materials, energy, water and other resources, the production of which violates the ecological balance, are used. The construction process itself has also negative effect on environment and the nearby objects with noise, vibration exposure, waste incineration, groundwater and soil pollution in general. However, the time period required for the construction of the building is insignificant compared to the period of operation. Experts estimate the service life of modern monolithic buildings at 125 - 150 years, and in some cases this index reaches 300 years. During this time, a new problem arises - the ecological balance violation: insufficient insolation, changes in natural wind flows, hydrogeology, vegetation reduction, soil and vegetation layer pollution, air masses stagnation, etc. All this creates the prerequisites for the creation of special environmental protection measures aimed at maintaining ecological balance. Thus, at each stage of the life cycle of a building, it is necessary to carry out the measures to protect the environment and minimize harmful effects on the environment. Today the prerequisites for the green building development are being laid in Russia. The main idea is to reduce energy intensity and increase energy efficiency in construction.

Introduction
Currently, the environmental issue is acute. The industrial development of countries has led to a large-scale depletion of limited natural resources. Society was faced with the choice of finding more alternative energy sources [1-2].

Cities are the centers of economic development in Russia, more than 70% of the country’s population is concentrated in them, therefore, the question of the need to preserve a favorable living environment arises most acutely in cities [3-5]. The high density of population, transport and industrial enterprises in limited areas is the main reason for the environmental problems of the cities, the main ones of which are:
- air pollution;
- surface water sources pollution;
- groundwater pollution;
- disturbance and destruction of the fertile soil layer, salinization, waterlogging and lands desertification;
- increase in the area occupied by landfills with solid domestic waste;
- lack of green space [6-8].

As a result, about 40 percent of the territory in the Russian Federation is experiencing environmental problems, ranging from water pollution to radioactive emissions into the atmosphere [9-10]. This, in turn, affects the life quality of the population and is health dangerous [11].

The most popular standards are: BREEAM (Building Research Establishment Environmental Assessment Method, Great Britain), LEED (Leadership in Energy and Environmental Design, USA), DGNB (Deutsche Gesellschaft fur Nachhaltiges Bauen Germany). Russia has recently introduced its own certification system “Green Standards”.

**Main part**

“Green Standard” is effective in solving the following tasks:
- reducing the consumption level of energy and material resources by the building;
- reducing the adverse impact on natural ecosystems;
- ensuring a guaranteed level of comfort for the human environment;
- creation of new energy-efficient and energy-saving products, new jobs in the manufacturing and operating sectors.

In the countries where Green Building is developing, national standards that take into account the socio-economic and natural conditions of the country are being created: for example, it is inappropriate to introduce such recommendations in the northern regions of Russia as autonomous power generation by wind generators and solar panels, but in the south, this will give great savings energy resources.

Construction in accordance with international environmental standards makes it possible to minimize the consumption of natural resources, improve the energy efficiency of the system and improve comfort for the consumers. Figure 1 shows the percentage by the type of real estate properties in the world.

**Figure 1.** Percentage by the type of real estate commissioned “green” objects in the world: offices – 50%, hotels – 3%, production warehouse space -11%, production warehouse space –4%, retail real estate –11%

In the Russian market, most of the buildings that have any of the environmental certificates belong to the office segment - 59% of the total number of “green” buildings. Warehouse and industrial facilities are in second place in Russia - 23%. Hotels are in third place - 5% respectively (Figure 2).

In Russia, the construction of Olympic facilities in Sochi has become unprecedented in terms of energy efficiency. In addition to efficient energy saving thanks to new thermal protection materials, environmentally friendly production of electricity using solar panels was launched. In addition, rainwater was used in technical processes to preserve the hydraulic system of the Imeretinskaya Lowland. And the points for processing construction and wood waste made it possible to use about 90% of construction waste in the construction of highways, sidewalks, land reclamation on the Sochi Park territory.
Figure 2. Percentage by the type of real estate put into operation “green” objects in Russia: offices - 59%, hotels - 5%, industrial and warehouse space - 23%, residential real estate - 2%, retail real estate - 2%

Today the prerequisites for the development of green building are being laid in Russia. The main idea is to reduce the energy intensity of the gross domestic product of the Russian Federation by at least 40%. The lack of energy resources slows down economy development, therefore this law should push the real estate market towards energy conservation, which in turn will entail the economy development of the Russian Federation. According to the law, the reduction in energy intensity will be carried out mainly by replacing the incandescent lamps, installing electricity consumption meters and reducing the cost of heating premises. However, the law is still not supported by the normative acts and real mechanisms of its implementation and incentives to use.

Green certification is voluntary. The certified property becomes more attractive and competitive in the real estate market, because guaranteed to have a high quality of construction and excellent performance of the facility, its energy efficiency and environmental friendliness. The development and implementation of environmental construction standards will intensify business expansion, the development of innovative technologies and the economy. We get the environmentally friendly and energy efficient buildings that comply with the following principles:
- quality improvement of real estate objects;
- reducing the cost of building the facility and its subsequent operation;
- caring for residents and creating comfortable conditions for them to be in buildings both within the framework of work and in ordinary life;
- creation of conditions for the minimum impact of facilities under construction on the environment.

The economic benefits of green building:
1. The energy consumption of the building is reduced by 25%, therefore the energy costs are reduced.
2. Water consumption is reduced by 30%, thus reducing the cost of water supply.
3. “Smart” controls and controls save on building maintenance.
4. Increased tenant satisfaction as well as reduced rental refusals, which in turn minimizes costs.
5. Green construction is an excellent marketing ploy to attract potential tenants and owners, increases the rate of return on leased space.
6. The characteristics of “green” buildings already meet the requirements of the law on energy efficiency and the expected tightening thereof, which will save on refurbishment and reconstruction of these facilities.
7. Environmental technologies will soon become an effective method of reducing the cost of a building.

At the moment, the rise in the cost of construction of “green” buildings is 4-8%, in cases of particularly complex design solutions this index reaches 18%, however, the costs of construction of many “green” buildings do not exceed the cost of their “non-green” counterparts. In any case, a quick payback over several years by reducing the operating costs should not interfere with the introduction of eco-technologies into the real estate market.

Therefore, green building is undeniably more cost effective when considering the full life cycle of a building.
Today, Russia has all the necessary prerequisites for the green building market development:
- the global economic crisis has significantly slowed down the construction pace. It is necessary to introduce innovative technologies, reduce costs and improve the quality of facilities under construction to gain competitive advantages in the construction market;
- Russia has announced its commitments to improve energy efficiency in construction in accordance with the Kyoto Protocol;
- Russia plans to improve energy efficiency by 40% by 2022;
- in the long-term plans, Russia will introduce free pricing on the domestic energy market, which will soon lead to a sharp rise in prices for connecting and using electricity;
- the growth of social, environmental and economic problems in Russia is largely due to the ineffective use of outdated technologies and low-quality materials. Unreasonably large waste of natural resources is also detrimental

The growth in demand for green buildings is confirmed by the dynamics of the number of certified facilities in recent years.

![Figure 3. Dynamics of the number of certified objects according to BREEAM, LEED and DGNB standards: number of new certified facilities, total number of certified facilities](image)

Figure 3 shows the growth dynamics of “green” objects in the Russian real estate market for 2010-2019.

On the part of the state at the legislative level, a number of changes are already being made to spread the energy-efficient construction methods in the territory of the Russian Federation.

**Summary**

Green technologies are the most promising solution to the environmental and economic problems Russia is facing now. A large number of conferences are being held on the topic of “green” construction, scientific papers are published, projects of energy-efficient buildings are being developed. A legal framework is being prepared and introduced to help introduce green technologies to the Russian real estate market. The construction pace of energy efficient facilities is increasing every year, which shows great interest in this area of construction. Today Russia is at the beginning of a long way leading to sustainable development, both in economy and in social and environmental aspects of life.

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