On the Question of Low-Energy and Green Housing

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Abstract. People’s mode of life, their professional activity and recreation depend not only on environmental factors including architecture, urban planning of a town or a settlement, but on specific atmosphere formed by the elements that are rather difficult to assess numerically. It also depends on the purity of air, soil and water resources. Generating ever increasing amounts of electrical power is indissolubly related to environmental setting and requires undertaking certain measures. The significant differences between low-energy and green houses have been demonstrated. Construction project should be considered low-energy one if it consumes less energy when in service in comparison with other similar building projects. Correspondingly, green houses are construction projects realized from naturally occurring materials with low conversion rate that could blend in with natural habitat. Every structure with low energy consumption could be considered low-energy house, at the same time, not every low-energy house could be called a green one. When erecting a house, one should take into account not only the benefits of energy saving but also the importance of environmental settings, traditions, customs, and historically developed architectural look of a town or a settlement.

1. Introduction
Throughout the last decades in the Russian Federation, the special attention is given to the issue of preservation of the environment. Human way of life, working and leisure activities are closely related to the environmental factors such as architecture, urban planning, and specific atmosphere conditioned by the elements that could hardly be assessed numerically. They also depend on the purity of air, soil and water.

It’s worth mentioning that the discussions regarding human environmental rights have been initiated in the world community since the 1960s when the largest economies began to experience the negative consequences of ecological crisis caused by pollution of environment and excessive uncontrolled consumption of natural resources. Stockholm Conference of the United Nations Organization held in 1972 has become an important milestone in the process of formation and development of human environmental rights as for the first time in history, the separate issue of a human right to a favourable living environment has been discussed. In particular, the Principle 1 of the Stockholm Declaration stated that everyone has a right to “…favourable living conditions in the environment that allows having good living standards and prosperous life; and primary responsibility for preservation and enhancement of environment rests with everyone…” At the Conference of the United Nations Organization held in June 1992 it was declared that the one and only way for ensuring
long-term economic progress is its integration with environment preservation. The Principle 1 of the Declaration adopted in Rio-De-Janeiro has announced: ‘Everyone has a right to healthy fruitful life in close communion with nature’. The right to a favourable living environment is the fundamental environmental right of every citizen confirmed in the Clause 42 of the Constitution of the Russian Federation and amplified in the Clause 11 of the Federal Law ‘On Protection of Environment’. In compliance with the paragraph 1 of the Clause 11 of the Law, everyone has a right to a favourable living environment, its protection from the negative impact caused by commercial or any other activity, natural and man-made emergencies. According to the Clause 1 of the Federal Law ‘On Protection of Environment’, favourable living environment is the quality environment providing sustainable functioning of natural ecological systems, natural and natural-anthropogenic sites. Actual environmental damage could be manifested in the form of pollution, contamination, damage, destroying, depletion of natural resources, and demise of ecological systems.

Essential ecological damage is characterized by massive bird and animal kill, including aquatic animals kill, on a limited territory when death rate exceeds the statistically average rate threefold and more; by ecological value of a damaged territory or a lost natural site, killed animals and tree and shrubbery vegetation; by the level of land degradation and other negative changes in environment preventing its preservation and further use.

2. Low energy and green houses
Nowadays, one of the most acute issues of environment preservation is an adversarial position of economy and ecology. Thus, overcoming this issue will lead to the progressive development of society. Planning and formulation of activities aimed at preservation of environment should be done factoring in the forecast of social and economic development, scientific research focused on solutions of issues in this sphere. Along with that, forecasting of environmental setting could be seen as a system of evidence-based statements about the changes in environmental conditions with due consideration of economic, social and other factors, as well as the state of scientific and technological potential.

The major natural resources include land plots and other natural objects occupied by transport systems, assets of power, communication, meteorological service, historical and cultural heritage, water and other natural reserves, national parks, sanctuaries, resorts and recreational zones, designated areas of outstanding natural beauty; animal species valuable in respect of business activity and protected animals as wells as species falling within the provisions of international treaties; regularities of mineral deposits and other natural resources. Along with that, legal regulation deals with the following issues: geological study, rational use and preservation of earth resources; utilization, conservation and protection of forest fund, and re-forestation; the use and protection of bodies of water; maintenance of storage lakes and multi-purpose water resources utilization systems, protective and other types of hydraulic facilities (apart from navigational hydraulic structures) and provision of their safety; protection, usage and restoration of wildlife objects and their natural habitat; specially protected nature conservation areas; environment protection and ensuring ecological safety; outdoor air protection, waste processing and consumption (excluding radioactive waste); improvement of economic mechanism for regulation of environmental resources management. The areas subject to control include: geological study, rational usage and preservation of earth resources; utilization, conservation and protection of forest fund, and re-forestation; the use and protection of bodies of water; protection, usage and restoration of wildlife objects and their natural habitat; supervision in the area of wildlife objects related to game; and water biological resources in specially protected nature conservation areas, in the sphere of organization and functioning of specially protected nature conservation areas; activity in the field of industrial waste processing and consumption, waste movement; control over outdoor air protection, production and consumption of ozone depleting substances; supervision in the area of technical state and service of hydraulic structures; licensing of hazardous waste treatment; polluting emission and discharge as well as hazardous physical actions on environment; control over placement, landfill, movement, storage, disposal and utilization of industrial and other hazardous waste.
In the process of commercial activities, human being has a dramatic impact on environment, mostly a negative one that leads to the serious environmental issues for both environment and humans. Moreover, such an impact is expressed not only in pollution of environment with hazardous substances but also in depletion of natural resources (woods, water, and mineral deposits) in enormous amounts.

Determining reasonable limits of the impact on environment is seen as an acute problem while the solution of this problem is essential for sustainable development. Ecological regulation is carried out with the purpose of the government control over the impact of commercial and other activities on environment ensuring preservation of habitat and provision of ecological safety.

2.1. Legal framework of ecological law

Two main groups of ecological regulations could be distinguished (regulation in the sphere of environment protection): regulations and standards in terms of environmental quality; regulations and standards in terms of admissible impact on environment when carrying out commercial or other activity. Regulations in terms of environmental quality are those that are set in compliance with physical, chemical, biological, and other factors evaluating the state of environment, and favourable environment is ensured provided those regulations and standards are met. This group includes the regulations set in compliance with chemical parameters of environment, including permissible exposure limits of chemical substances, e.g. radioactive substances; the regulations set in keeping with physical parameters of environment, including level of radioactivity and heat; regulations set in accordance with biological parameters of the state of the environment including species of plants, animals and other living organisms used as the indicators of environment quality as well as regulations of maximum admissible concentration of microorganisms; other standards regulating environment quality.

It should be noted that when setting standards, one must take into account natural features of lands and basins, designation of natural and natural-anthropogenic sites, environmentally sensitive areas, in particular, natural reserves and landscapes with environmental significance.

Regulations of admissible environmental impact are the regulations set in compliance with the parameters of impact of commercial and other activities on environment while environment quality norms are met. These norms are aimed at prevention of negative impact on environment arising due to commercial and other activities of entities and persons – natural resource users. These norms comprise: norms for permissible discharges and interception of substances and microorganisms; norms of industrial waste formation and consumption and the limits for waste disposal; norms for admissible physical impact (heat, noise level, vibration, ionizing radiation, electromagnetic field strength and others); norms for admissible withdrawal of environmental components; norms for permissible anthropogenic load; norms of other permissible impact on environment when carrying out commercial and other type of activity.

Obligation to evaluate the impact on environment when making decision in relation to commercial and other type of activity is one of the main principles of environment protection. The purpose of evaluation of environmental impact is environmental and social mitigation measures. The main principles of evaluation of the impact on environment include: the principle of assumption of potential environmental hazard of any projected commercial or other activity; the principle of non-admittance (prevention) of possible harmful interference on environment and social, economical and other related consequences when conducting projected commercial and other activity; the principle of obligatoriness of consideration and evaluation of impact on environment caused by alternative variants of pursuing an objective of projected commercial and other activity, including so-called zero option (refusal to perform an activity); the principle of scientific validation and authenticity of the materials for evaluation of impact on environment.

The results of the evaluation of impact on environment are the following: information regarding the conditions and scope of exposure caused by a projected activity, the alternatives methods of its implementation, assessment of ecological and other related social, economical and other
consequences of such impact and their significance, the possibility to minimize negative effects; identification and control over social suppositions while making decisions related to a projected activity; decisions about determining alternative variants of a projected activity realization (incl. location of a facility, technology selection and others) or refusal to carry out a projected activity conditioned by the results of evaluation of the impact on environment. All the above-mentioned factors should facilitate prevention of appearance of the goods and services of environmental concern on the market and correspondingly, prevention of potential negative effects on environment; introduction of environmentally friendly technologies and equipment, manufacturing of environmentally benign products throughout all stages of lifecycle, improvement of the quality and competitiveness of goods; creations of environment for arrangement of manufacture meeting relevant ecological standards; improvement of management system of commercial and other type of activities; integration of economies into the world market and fulfillment of international commitments.

Ambient monitoring or the system of long-term environmental surveys, evaluation and forecast of the change of its state under the influence of natural and natural-anthropogenic factors could be seen in three capacities: as one of the measures of environmental protection, as a function of state administration and also as a legal institution of the general part of ecological law. Ambient monitoring includes monitoring of outdoor air, lands, and forests, bodies of water and wildlife objects. While carrying out ambient monitoring, the following issues could be solved: organization and conduction of surveillance over quantitative and qualitative parameters (parameter part) determining the state of environment, including the areas where the sources of anthropogenic impact are located; evaluation of environmental conditions, early detection and prediction of the development of negative processes having effect on the state of environment; information support of all the aspects of environmental conditions.

Ecological control represents the important legal step for provision of rational nature management and protection of environment against harmful effects, legal institution of ecological law. The number of objects that are subject to ecological control include primarily the objects of power system, nuclear power, transport, as well as the objects having a negative effect on natural objects included in the List of World Heritage Sites, designated conservation areas, natural reserves and other natural complexes of protected environmental, scientific, historical, cultural, aesthetic, recreational and other importance. Moreover, the objects facilitating cross-border pollution of environment and leading to the negative consequences are subject to compulsory ecological control. They include the objects used for disposal of more than 10 000 tons of waste of 1st and 2nd hazard category per year; the objects having more than 15 million cubic meters of annual waste water disposal or relatively smaller gross emissions of more toxic waste; the objects having more than 500 tons of annual disposal of hazardous substances (contaminants) into outdoor air; the objects located on the territory of water-collecting areas of cross-border bodies of water engaged in disposal and removal of hazardous substances (contaminants) from drainage and ground waters; the objects used for production, utilization, processing, formation, storage, transportation and disposal of harmful substances.

Generation of electric energy in increasing volume is closely related to environmental situation and requires undertaking certain measures, in particular: provision for commissioning and renovation of existing power plants provided compulsory suppression and collection of sulfur and nitrogen oxides; utilization of ashes and slag waste; low-grade fuel processing; creation of additional capacities for coal beneficiation, production of low-sulfur fuel oil; generation of electrical energy on the power plants with nonconventional power sources [1]. All the above mentioned requires large material expenditures. That’s why the issue of energy use reduction and preservation of natural wealth and resources for succeeding generations is of utmost importance nowadays [2-4].

2.2. Differences between low-energy and green houses
For some time past, so-called low-energy and ecological houses [5-9] have become one of the partial solutions of the energy-saving problem.
Let’s turn attention to some mistakes in identifying these objects. Low-energy houses are often presented as green houses (energy-saving and causing less pollution for environment); also the houses with ‘living roof’ are also considered green ones.

Be it noted that an object should be considered ‘green’ if it is erected from natural building materials with low conversion rate and fits into natural environment. Green houses should comply with the following criteria: they should be manufactured (built) from naturally occurring materials, such as stone, wood, clay, and sand; they should not be a potential threat to the local flora and fauna; they should fit into the existing urban environment; having completed the useful life of a building, the buildings materials could be recycled.

For example, will a wooden dwelling with stove heating be considered ‘green’? At first glance, yes. It is erected from naturally occurring building materials that after completion of the useful life of a building could be recycled or reused. No visible pollution of environment caused by stove heating is observed.

Along with that, such a house mustn’t be considered green as combustion of any fuel inevitably contaminates the environment. Moreover, while the number of incidents connected with household waste combustion in domestic furnaces at low temperatures (200-500°) is growing, unrefined fumes containing toxic and hazardous substances such as nitrogen oxide, sulfur dioxide, heavy metals (cadmium, nickel, stannum, quicksilver), chlorine and fluorine compounds are emitted into outdoor air. Thus, when burning 1 kg of polyvinylchloride waste (plastic bottles, films, etc.), up to 280l of hydrogen chloride is emitted that interacts with water vapors forming chlorine hydride [10]. Evidently, this causes an essential damage to environment.

Due to the great number of such houses in the country side, this problem urgently requires a solution. Over recent years, the special attention is paid to rejection of stove heating and equipping the houses with appliances for utilization of solar and wind energy.

Low-energy houses are the houses consuming lower amount of energy while in service if compared with other objects of this type. These houses should not only consume less energy but their construction should be energy-saving and less raw materials intensive [11, 12].

It is stated that maximum amount of energy in single-family dwellings, about 65%, is used on heating, while about 15% - on water heating-up and 20% for cooking food, lighting, power supply of radio- and TV-sets and other household activities [13].

It’s calculated that for a single-family brick dwelling with a garret, 4 bedrooms and utility rooms, the annual energy requirement accounts for 20000 kWh. Along with that, if thermal insulation capability increased twofold, electrical energy is used efficiently, and equipment is installed for solar energy use (figure 1 and 2), it is possible to achieve energy saving in the scope of 40-42% [13]. Further installation of equipment for solar energy use with photovoltaic module with the power 53 Wt (for residential house) accounts for 425 USD [14].

![Figure 1. Example of placement of solar panel on the southern side of a roof](image-url)
Figure 2. Scheme of installation of equipment for warming up water by means of solar energy and electric heating unit

3. Conclusions
It can be affirmed that every house with low energy consumption could be considered green, but not every low-energy structure could be called low-energy. For example, a house equipped with appliances transforming solar energy into electric one sufficient for its proper functioning, with reliable insulation but constructed with the use of bottom-ash blocks and polymer compounds, would rather be considered a low-energy house than a green one.

Furthermore, it’s vital for residents not only to create microclimate in the premises but also provide comfortable outdoor environment building-ambience-vegetation, combination of a structure with other architectural objects. These conditions can often times be more important than benefit from energy saving.

Thus, while erecting a house, it’s important to take into account not only the benefits of energy saving but also the state of environment, traditions, historical architectural look of a town or settlement.

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