Problems of the development of international standards of "green building" in Russia

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Abstract. Problems of environmental friendliness and energy efficiency in recent decades have become not only the most important issues of economic development of the main industrial economies, but also the basis for the processes of maintaining the security and relative stability of the global ecosystem. The article presents the results of the study of the status and trends of the development of environmental standards for the construction and maintenance of real estate in the world and particularly in Russia. Special market instruments for assessing the compliance with the quality of real estate projects under construction and modern principles of environmental friendliness and energy efficiency include voluntary building certification systems that are actively used in international practice. In Russia there is active use of the following international systems of certification: BREEAM, LEED, DGNB, HQE. Also in the Russian certification market, the national standard STO NOSTROY 2.35.4-2011 "Residential and public buildings" is being implemented, which summarizes the best international experience of the rating evaluation procedure. Comparative characteristics of the "green" standards and the principles of rating assessments of the ecological compatibility of buildings give an idea of applying these standards in Russia.

1. Introduction

The buildings and facilities are among the main energy consumers and sources of environmental pollution [1]. The total resource consumption of buildings around the world is about 40% of all primary energy, 67% of electricity, 40% of raw materials and 14% of all water resources, and buildings produce about 35% of all carbon dioxide emissions and almost half of all solid domestic waste. According to data provided by the forecasts of the development of world energy until 2035 by the largest oil and gas company BP, world demand for energy resources from 2013 to 2035 will increase by 37%, or on average by 1.4% per year [2]. All this testifies to the high level of problems of issues of environmental friendliness and energy efficiency of real estate. In the world practice, various instruments are actively developing, providing the initial stage of solving energy saving problems and reducing the negative impact on the environment from the production of building materials, construction and operation of real estate. One of the first steps to solving such problems in the Russian construction industry is the adaptation of international standards and the formation of such systems that change the approach of construction participants to projects, creating a new vision of real estate.

In Russia, the first regulatory and legal acts, evidencing the importance of energy conservation and energy efficiency, appeared in the late 1990s. Low energy efficiency of production, distribution and consumption of energy, taking into account the Russian climatic conditions, determine the high level of
energy intensity of the Russian economy, taking the third place in the world in terms of the total energy consumption.

Despite the active rulemaking for the whole previous period, the data of official bodies of statistics presented in energy balances, as well as information on the level of depreciation of fixed production assets, indicate a low level of effectiveness of measures taken to reduce the energy intensity of the economy and increase the energy efficiency of various economic activities.

From the point of view of financial support for energy saving and energy efficiency projects, the analysis of government documents shows that the total volume of investments in energy saving measures has declined year by year and decreased by 28% in 2015 compared to the presented. Data for 2016 by the beginning of 2017 are not reflected in official documents, however, the current trend of reducing investments in this direction remains. This circumstance is largely due to fundamental economic factors, the general turbulence of financial markets and the current budget constraints.

One of the key source documents that determined the energy-efficient and ecological development of Russia is the Decree of the President of the Russian Federation No. 889 "On Some Measures to Improve the Energy and Ecological Efficiency of the Russian Economy" adopted in 2008. To implement the goals of the Decree, the following measures are required in the document: taking measures for the technical regulation of economic sectors, which are aimed at increasing energy and environmental efficiency; preparation of the regulatory framework (at the level of federal laws), which provide for economic mechanisms that stimulate the use of energy-saving measures and form a system of responsibility in cases of non-compliance with permissible standards; determination of budgetary allocations for implementation of energy saving projects [3].

In pursuance of the Presidential Decree, the Federal Law "On Energy Saving and on Increasing Energy Efficiency" (Federal Law "On Energy Saving") No. 261-FZ of November 23, 2009 was adopted. Its purpose is to form the organizational, legal, economic foundations of energy saving and energy efficiency [4].

According to the data presented in the annual report of the Ministry of Energy on the state of energy conservation and energy efficiency in the Russian Federation (based on the results of monitoring the current results of energy saving programs of large and medium-sized Russian companies related to various sectors of the economy and aimed at achieving the best indicators in energy saving and energy efficiency) should apply a unified approach to energy management that includes: - formation of a system of key indicators of energy efficiency of ongoing programs and management of organizations, taking into account the analysis of previous performance results, industry characteristics, data of ratings of organizations, etc.; - the introduction of the energy management system, which is an organizational and management mechanism that allows for the continuous improvement of companies' activities in the field of energy conservation and energy efficiency; - technical and technological regulation in enterprises based on standards, the formation and implementation of regulations and corporate standards that take into account the requirements of energy efficiency and the use of «best available technology». Recommended for use: GOST R ISO 50001-2012 "Energy Management Standard"; Standards for energy management in industry: GOST R 54195-2010 "Resource-saving. Industrial production. Guidelines for the determination of indicators (indicators) of energy efficiency ", GOST 54196-2010" Resource Saving. Industrial production. Guidelines for the Determination of Energy Efficiency ", GOST R 54197-2010" Resource Saving. Industrial production. Guide to the planning of indicators (indicators) of energy efficiency " [3]. One of the universal and most popular in the world is the international standard ISO 50001: 2011 "Energy management systems - Requirements with guidance for use", which corresponds to the national standard GOST R ISO 50001-2012.

2. Methods
According to the Road map for cooperation with the European Union in the field of energy, the development of energy management in Russia is defined as one of the most important tasks of interaction. The national standard GOST R ISO 50001-2012 defines the requirements for the integration in the organization of a systematic approach to achieve improvements in the state of the energy system,
including energy consumption, energy efficiency and energy security. The ISO 50001 standard provides the organization with a detailed strategy of actions in managerial and technical fields with a view to improving the efficiency of its energy systems. This standard has a high degree of compatibility with the systems of "Quality Management" ISO 9001 and "Environmental Management" ISO 14001. The standard ISO 50001 is based on the American standard ANSI / MSE 2000: 2008, the Korean standard KS A 4000: 2007, and also the standard EN 16001, which has integrated many European standards.

A distinctive feature of ISO 50001 is the introduction of the concept of "energy profile", identifying the current and previous energy levels, defining a "baseline assessment". The organization must integrate and maintain documented procedures to improve its energy profile, which correspond to the developed energy management system and are updated at specific intervals.

It is also advisable, in the context of the research topic, to consider the meaningful characterization of environmental aspects in the construction sector that are inextricably linked to energy saving and energy efficiency of real estate.

As indicated, the buildings account for a large amount of harmful emissions of carbon dioxide and waste. The existing methods of cleaning dangerous toxic elements in the atmosphere do not allow to significantly improve the existing situation. At the same time, pollution of surface water bodies is revealed due to technical reasons, carried out by the washing product.

Global environmental problems are a challenge for the construction industry, which faces challenges not only to improve the quality of life of people, but also to save resources for future generations and create an enabling environment for their development.

The key documents that determined the significance of environmental aspects in the country's national policy were: - UN Framework Convention on Climate Change (UN FCCC) - Framework Convention on Climate Change, UN FCCC - ratified in 1994; - The Kyoto Protocol (an international agreement that is an additional document to the United Nations Framework Convention on Climate Change) was ratified in 2005, in 2011, Russia officially withdrew from the agreements; - Presidential Decree No. 889 "On Some Measures to Improve the Energy and Environmental Performance of the Russian Economy" (June 4, 2008).

In the world construction practice, the issue of environmentally responsible use of resources is reflected in the intensively developing direction of construction of environmentally friendly real estate ("green building"). In economically developed countries, the vast experience of leading organizations has been accumulated, which are developing guidelines and standards for the design and construction of green buildings, as well as the creation of systems for their rating evaluation. Russia is also actively working in this direction.

The most famous and used both abroad and in Russia are the following standards, presented in the order corresponding to the prevalence level: British Building Research Establishment

Environmental Assessment Method (BREEAM) - method of environmental impact assessment (UK); Leadership in Energy and Environmental Design (LEED) - a guide to energy and environmental design (USA); German Sustainable Building Council (DGNB - Deutsche Gesellschaft für Nachhaltiges Bauen e.V.) - Certificate of Sustainable Construction (Germany); Haute Qualité Environnementale (HQE) - the concept of high quality of the environment (France). The last standard at the moment in the Russian market is presented only in 2016.

The first BREEAM standard is the most popular, due to the flexibility of the standard and adaptability to local building codes and practices. It relies on Eurocodes, British standards and local regulations. In the BREEAM system, indicators are grouped into nine sections: Management; Health; Energy; Transport; Water; Materials; Waste disposal; Use of land; Pollution. Depending on the number of points scored during certification, a rating is assigned in the BREEAM system (table 1).

The second most popular is the LEED standard, based on American standards ASTM, ASHRAE. In the LEED-2009 (v3) system, six sections were key: a construction site (site for development) that takes into account future needs (sustainable sites, SS); Efficiency of water consumption (WE); Energy consumption and atmospheric parameters (energy and atmosphere, EA); Consumption of materials and resources (MR); Indoor environment quality (IEQ); Innovation in design (ID). Currently, the current
version of LEED-2009 (v4) includes: location and transport, sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality. A special section, since version LEED-2009 (v3), has been allocated for analysis of regional priorities (RP). Depending on the number of points scored during certification, a rating is assigned in the LEED system (table 1).

The next most popular is the DGNB certification. DGNB certification addresses the most important aspects of sustainable construction. The assessment takes into account the entire life cycle of the building and in accordance with more than 50 criteria, grouped into six categories: Quality of the environment; Economic efficiency; Socio-cultural qualities and functionality; Technical equipment; Process quality; Quality of location. Depending on the number of points scored during certification, a rating is assigned in the DGNB system (table 1).

| Table 1. Certificate levels in BREEAM, LEED, DGNB |
|-------------------------------------------------|
| Rating in BREEAM | Estimated total score | Rating in LEED | Estimated total score | Rating in DGNB | Estimated total score |
| Not certified | < 30 | Not certified | < 40 | Not certified | < 35 |
| Certified | ≥ 30 | Certified | ≥ 40 | Certified | ≥ 35 |
| Good | ≥ 45 | Silver | ≥ 50 | Bronze | ≥ 50 |
| Very good | ≥ 55 | Gold | ≥ 60 | Silver | ≥ 65 |
| Excellent | ≥ 70 | Platinum | ≥ 80 | Gold | ≥ 80 |
| Outstanding characteristics | ≥ 85 |

The remaining standards (including HQE) are not yet widely spread in Russia, as well as around the world, where only two international standards are singled out - BREEAM and LEED.

National standards are successful only in some cases (Australia - Green Star, UAE - Estidama), since it depends on government support. In Russia has developed standards: - GOST R 54964-2012 "Conformity assessment. Ecological requirements for real estate objects ", - STO NOSTROY 2.35.4-2011 «"Green building". The buildings are residential and public. Rating system for assessment of habitat stability», - STO NOSTROY 2.35.68.2012 «"Green building". The buildings are residential and public. Consideration of regional peculiarities in the rating system for assessing the sustainability of the habitat». These standards cover the provisions of LEED, BREEAM, Russian GOSTs, SNIPs, and even take into account the regional peculiarities of climate and intellectual structural objects by the institution, but, as mentioned above, the success of these standards will largely depend on the level of state support.

The difference between the standards is the degree of detail of the parameters and the significance of the specific criteria included in the evaluation system (figure 1). Evaluation criteria are regularly reviewed, which leads to the actualization of certification products.

The standards should be applied at various stages, starting with the design, construction, reconstruction and operation of real estate, and ending with the voluntary certification of real estate and relevant project documentation, subject to compliance with the safety requirements that are established by technical regulations in the construction industry [5].
When constructing "green" real estate objects, all participants in the process can benefit: investors, designers, architects, developers, contractors, owners and end-users.

For the investor: reducing the risks of moral obsolescence of assets, the risks of rising energy prices and improving corporate image. For designers and architects: confirmation of competence and increase of its rating. For the developer: the marketing advantage in the market (increase in the cost of leasing by 2-16%, the cost of sales by 6-35%), raising the capitalization rate, the possibility of attracting additional financing, securing solvent tenants.

For the tenant (end-user): creating a comfortable environment for residents or employees, increasing labor productivity, saving up to 25-30% on operating costs, strengthening the reputation in the market [6,7].

Consider the Russian rating system for assessing the ecological compatibility of residential and public buildings (table 2).

| Land use and ecology | Aria 23.7% | Location Quality - | Comfort and quality of the environment 11% |
|----------------------|------------|---------------------|------------------------------------------|
| 9.5 / 12.5%          | 23.7%      | Technical quality   | Quality of architecture and layout of the object 9.2% |
| Water 8 / 5.5%       | Rational water use 9.1% | Environmental quality 22.5% | Comfort and environmental quality of the internal environment 13% |
| Environmental pollution 14 / 13% | Energy saving and protection of the atmosphere 31.8% | Cost-effective 22.5% | Quality of sanitary protection and waste management 3.9% |
| Energy 26.5 / 31.5% | Materials and Resources 12.7% | Sociocultural and functional qualities 22.5% | Rational water use 6.1% |
| Transport 11.5 / 0% | Quality of the internal environment 13.6% | Quality of design and construction processes 10% | Energy saving and energy efficiency 18.5% |
| Health and wellness 17 / 15% | Innovation and organization of design 5.5% | | Application of alternative and renewable energy 9.2% |
| Materials 8.5 / 7.5% | Regional Priorities 3.6% | Regional Priorities 3.6% | Ecology of creation, operation and disposal of the object 9.8% |
| Garbage 5 / 0%       | Economic efficiency 10% | | Economic efficiency 10% |
| Management 0 / 15%   | Health and wellness 17 / 15% | | Quality of project preparation and management 9.2% |

Figure 1. Comparison of "green" standards (in the evaluation of construction projects / in the evaluation of operated buildings)
Table 2. Determination of the class of ecology and energy efficiency of the building

| Criterion for assessing environmental friendliness (S-factor, points) | 520-650 | 420-519 | 340-419 | 260-339 | 170-259 | 100-169 | 0-99 |
|---------------------------------------------------------------|--------|--------|--------|--------|--------|--------|-----|
| Classes for environmental assessment                          | A      | B      | C      | D      | (E)    | (F)    | (G) |

Estimation of the sustainability of the habitat (ecological compatibility of buildings) is conducted for the purpose of determining the level of design documentation, as well as the quality of residential or public buildings in operation.

The standard applies to all categories of designed, built and commissioned residential buildings and to the following categories of public buildings: administrative; office, business centers; hotels and hostels; educational (nurseries and gardens, schools, secondary and higher educational institutions); sports-entertainment, sports; shopping, shopping and entertainment; hospitals, hospitals, polyclinics.

The evaluation is carried out according to 46 criteria, grouped into 10 categories. Each of the criteria is expressed by one or a group of relevant indicators that have a numerical expression in the form of a parameter, a parametric characteristic, or a series of parameters with the accepted scoring equivalents of the estimate. The sum of scores of all categories determines the integral value of the level of sustainability of the quality of the habitat, and is designated as "S-factor" (from "sustainability"). Projects or operated real estate objects belonging to the E, F, G classes do not comply with modern environmental requirements and are not subject to certification.

In the case when the E, F or G class is evaluated for the energy efficiency of the facility, it is considered energy-intensive (with reduced, low or very low energy efficiency, respectively) and an information label is installed on the building.

The problem areas for bringing new and exploited properties into line with global environmental and energy requirements for building efficiency are very significant for Russia. However, a large number of forerunners in this phase of development of the construction industry testifies to a positive trend and the possible effectiveness of program activities aimed at the formation of energy and environmentally responsible subjects. Also, the consumer, characterized by the growth of social and consumer standards, influences the spread of environmental requirements to real estate objects [8-12].

3. Results
The certification process directly depends on the level of control of the construction project by the customer. Certification goes in two stages: design and construction. The facility is not considered certified until the certification report is prepared at the completion stage (commissioning). Therefore, the timing of certification is tightly tied to the timing of construction. In addition, you will need: - about two months to collect the documentation; - two weeks to prepare the report; - about one month for an independent peer review by the BRE Global certification authority (for BREEAM) or GBCI (for LEED).

For each specific project, the cost is determined separately. Payments to the certifying organization are about 5 000-10 000 USD. The cost of the appraiser's services is highly dependent on the scope of work (project rating, its size, technical complexity).

The rise in the cost of construction is difficult to calculate. It is not always clear what is the base line for such a rise in price and which decisions would somehow become part of the project regardless of certification. At the stage of establishing certification in Russia, this cost is quite high. In the future, with the development of experience, certification will become more accessible. This is natural for any developed market. Certification for compliance with the standards of green construction allows not only to obtain an independent assessment of the construction site, but also to increase the investment attractiveness of the project. In general, investors can expect to increase net operating income by 5.9% [6]. The factors of increasing the investment attractiveness of green building objects include: increasing
the rental rate by 2-16%; Increase in occupancy rates by 2-18%; Decrease in operating expenses by 25-30% due to reduction of energy consumption; Increase in the value of the sale by 5.8-35%; 1% increase in employee efficiency for LEED "Certified" and "Silver" and 1.5% for "Gold" and "Platinum" certificates; Attracting and retaining the most solvent and long-term tenants [13-23].

Marketing advantages of the object of certification: novelty and uniqueness of the proposal; Substantiation of the quality of the object, which the international community and tenants will believe; Attract tenants, whose corporate culture includes environmental responsibility, including rich and prestigious global brands; The results of certification can be used as a basis for an advertising campaign [24].

The achievement of basic standards leads to an increase in the cost of the building by 2-3% compared to a conventional building. Achieving the highest levels of standards requires additional costs of 5-7.5%. The average period for obtaining a certificate from the time of registration for new construction is 8-32 months.

4. Discussion
A drastic change in the environmental approach for construction projects has become possible due to the emergence of innovative technologies. It is necessary to take into account not only the qualitative characteristics of the project or the finished real estate object, but also the whole process of production of building materials, the logistic system, the approach of contractors to the construction processes, the fundamental features of its operation and the functioning of the waste management system. In order for real estate objects to be considered "green" and "energy efficient", certain standards and norms must be observed at all stages of construction. One of the possible solutions may be the use of building commissioning technical supervision (the process of exercising the control function, focused on the high quality of the construction project). This process is focused on documenting that the necessary requirements have been met at all stages of planning, design, installation, testing, operation and maintenance of the building, including in engineering systems and components (for example, for LEED certification through compliance Principles of ASHRAE Guideline 0-2005). The commission of enclosing structures and energy systems can be a key component of the integrated process, ensuring the exact implementation of the solutions laid down in the project and allowing with a high probability of obtaining the possibility of certification of the facility by international standards, with the appropriation of a worthy place in the rating.

5. Conclusions
Aspects of the implementation of modern concepts of environmental and energy-efficient development are mostly represented in such real estate objects as: commercial office buildings and profile unique structures (for example, international sports facilities). In this case, developers, owners and tenants are interested in declaring a high level of quality of the property. A separate category of sports facilities form part of the green building market, since for them this is an ecological certificate is an integral attribute ensuring compliance with mandatory international requirements for such facilities.

The first domestic practical experience in the design and construction of sports facilities by green standards falls on the Sochi 2014 Olympics. A number of buildings and structures were certified according to LEED, BREEAM standards and the corporate standard of Olimpstroy. The basic indicators were the data of the standard STO NOSTROY «"Green Building". Sports buildings and facilities. Accounting for features in the rating system for assessing the sustainability of the habitat». To conduct certification procedures for any of the previously presented international and Russian standards, it is necessary to conduct a large amount of preparatory work. First of all, it is necessary to designate the stage of the project - at later stages (after the beginning of construction works), the introduction of LEED is almost impossible. Then it is important to determine the composition and understand the competence of the team of designers - if the designers do not speak English, then it will be rather difficult to implement American design standards for ASHRAE.
To select the standard and certification scheme, it is recommended to conduct a detailed analysis of the project in each specific case. This is the only way to understand what will be most appropriate and applicable for this particular project.

References
[1] Meshcheryakova T 2017 *Journal of economy and entrepreneurship* 2-2 (79-2) pp 1032-1038
[2] Murgul V 2017 *MATEC Web of Conferences*, 106, 06001 DOI: https://doi.org/10.1051/matecconf/201710606001
[3] Chechevichkin V N and Vatin N I 2014 *Magazine of Civil Engineering* 50(6) pp 67-74 DOI: 10.5862/MCE.50.7
[4] Murgul V and Pukhkal V 2015 *Procedia Engineering* 117 pp 891-899 DOI: https://doi.org/10.1016/j.proeng.2015.08.173
[5] Tabunshchikov Yu 2012 *Energy saving* 7 pp 1-4
[6] Gorshkov A S, Rymkevich P P and Vatin N I 2014 *Magazine of Civil Engineering* 52(8) pp 38-48 and 65-6 DOI: 10.5862/MCE.52
[7] Hirkovskis A, Serdjuks D, Goremikins V, Pakrastins L and Vatin N I 2015 *Magazine of Civil Engineering* 57(5) pp 86-96 and 116-7 DOI: 10.5862/MCE.57.8
[8] Romanovich M and Simankina T 2016 *Procedia Engineering*, 165, 1587 – 1594, doi: 10.1016/j.proeng.2016.11.897
[9] Pimenova A, Kuzmina S, Morozova N and Mottaeva A 2016 *MATEC Web of Conferences*, 73, 07018 DOI: https://doi.org/10.1051/matecconf/20167307018
[10] Jevric M and Romanovich M 2016 *Procedia Engineering*, 165, 1478 – 1482, doi: 10.1016/j.proeng.2016.11.882
[11] Isaev S A, Vatin N I, Baranov P A, Sudakov A G, Usachov A Y and Yegorov V V 2013 *Magazine of Civil Engineering* 36(1) 103-9 DOI: 10.5862/MCE.36.13
[12] Poljakova I and Chibisova E 2016 *Journal of economy and entrepreneurship* 5(70) pp 579-582
[13] Pantaleeva M and Borozdina S 2017 *MATEC Web of Conferences* 106 080471
[14] Vatin N, Gamayunova O and Petrosova D 2014 *Applied Mechanics and Materials* 635-637 pp 2085-9 DOI: 10.4028/www.scientific.net/AMM.635-637.2085
[15] Rozhentsova I and Mottaeva A 2017 *MATEC Web of Conferences* 08076 DOI: https://doi.org/10.1051/matecconf/201710608076
[16] Mottaeva A 2016 *MATEC Web of Conferences*, 73, 07020 DOI: https://doi.org/10.1051/matecconf/201710608076
[17] Akimova E 2017 *MATEC Web of Conferences* 106 01043
[18] Verstina N 2017 *MATEC Web of Conferences* 106 08091
[19] Miroshnikova T and Taskaeva N 2017 *MATEC Web of Conferences* 106 08093
[20] Kisel T 2017 *MATEC Web of Conferences* 106 08094
[21] Glazkova V 2017 *MATEC Web of Conferences* 106 08095
[22] Karakozova I and Pavlov A I 2017 *MATEC Web of Conferences* 106 08046
[23] Vatin N, Gamayunova O and Petrosova D 2014 *Applied Mechanics and Materials* 635-637 pp 2085-9 DOI: 10.4028/www.scientific.net/AMM.635-637.2085
[24] Usanova K, Rechinsky A and Vatin N 2014 *Applied Mechanics and Materials* 635-637 pp 2090-4 DOI: 10.4028/www.scientific.net/AMM.635-637.2090