

# Implementation of energy efficiency measures in school construction projects taking into account the green zoom standard

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**Abstract.** The article deals with the introduction of energy-efficient technologies in the design process of general educational institutions with a focus on sustainable development and environmental safety. Using the example of school assessment according to the GREEN ZOOM system, the authors analyze the key aspects related to the choice of modern solutions aimed at reducing energy consumption and optimizing utility resources. Methodological approaches to assessing the energy efficiency of educational buildings are highlighted, and examples of successful practices in the construction and operation of educational institutions are discussed. It concludes by emphasizing the importance of integrating energy-efficient technologies into architectural projects to improve the quality of the educational environment and reduce environmental impact. The article is intended for architects, designers and specialists in the field of education and ecology.

## 1 Introduction

Green standards in construction are a set of principles and practices aimed at reducing the negative impact of construction projects on the environment and ensuring the health and comfort of their users [1]. These standards are especially important in the context of construction of educational institutions, such as schools, as schoolchildren 60% of the time of day are in the premises of the educational institution, which can significantly affect the state of their health.

Over the past decades, there has been a growing awareness of the need to create sustainable spaces where children can not only learn but also develop without health risks [2]. The use of environmentally friendly materials, energy optimization, efficient water use and environmental literacy education are all necessary to create healthy environments.

However, the impact on students' health is a key aspect: clean air, natural light and a comfortable microclimate contribute to increased concentration and, consequently, better learning outcomes [3]. Building institutions with green standards not only prepares the future generation to interact responsibly with nature, but also creates awareness of the importance of sustainability. Thus, integrating these principles into school construction becomes not just relevant, but mandatory for the development of a healthy and sustainable society.

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## 2 Materials and methods

Consider existing standards for evaluating green buildings, such as:

- LEED (Leadership in Energy and Environmental Design),
- BREEAM (Building Research Establishment Environmental Assessment Method),
- Habitat Sustainability Rating System Green building. Buildings and civil construction. Rating estimation of Sustainability in building construction,
- Green Zoom.

The listed standards play a key role in promoting sustainable building. These systems offer different approaches to assessing the environmental performance of buildings.

What they have in common is a commitment to reducing negative environmental impacts, increasing energy efficiency and improving the quality of life of people [4]. All of them take into account such aspects as the use of renewable resources, waste management and indoor environmental quality.

However, the differences in assessment methods and criteria are significant. LEED and BREEAM are internationally recognized and have strict rating systems, whereas the Green building and Green Zoom Habitat Sustainability Rating System are mainly focused on the Russian market and can take into account local climatic conditions and norms, which allows for more effective integration of environmental approaches into sustainable construction. This contributes to the creation of a comfortable and safe urban environment that meets the needs of the local population.

Assessment systems such as LEED and BREEAM also promote green technologies and projects, working at the level of developing sustainable building standards around the world [5]. These standards often create additional interest among investors and tenants, as certification implies high quality and reliable buildings. The attractiveness of such properties increases, which can become an important aspect in the competition on the market [6].

It is important to note that despite their differences, all of these systems should be seen as tools to help solve global environmental problems. By combining best practices from different methodologies, architects and builders can create more sustainable and environmentally friendly buildings, which in turn will improve people's quality of life and reduce the negative impact on nature.

Green schools are educational institutions that actively implement sustainable practices and environmental initiatives. In Russia, examples of such schools are the Green School in Moscow in the Gorky Park and the Green School educational complex in Krasnodar. The Green School in Moscow in Gorky Park and the Green School educational complex in Krasnodar. These institutions practice energy saving, waste recycling and environmental studies as part of the educational process [7].

At the international level, a few outstanding examples stand out. In the USA, the Green School in California is characterized by experiments with sustainable agriculture and mandatory environmental education [8].

One of the greenest schools in the world is considered to be an eco-school from Ontario. The Canadian school has received the highest award both for its form - the school has been modernized over the past five years - and for the content of the curriculum. The students are not just involved in the process, they are initiators and leaders of eco-projects.

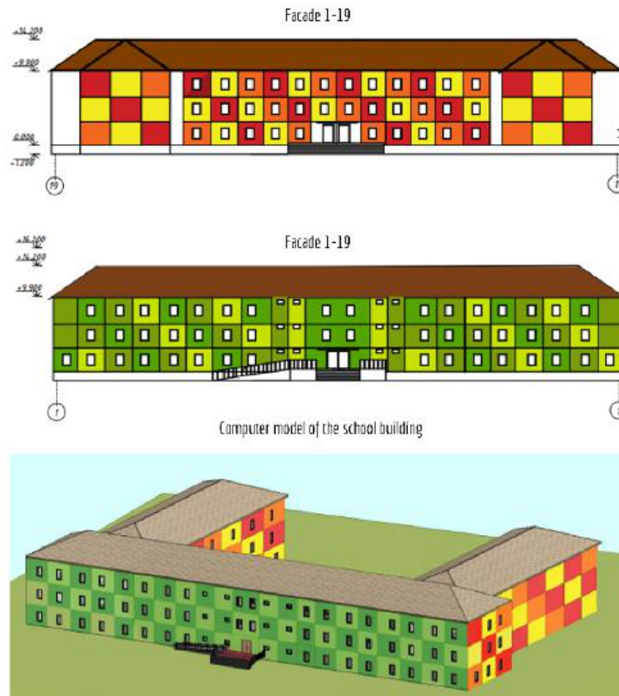
In Norway, the school "Nordahl Grieg" is known for its green roof and uses solar panels to generate electricity.

These institutions not only foster environmentally conscious citizens, but also actively participate in local and global environmental initiatives. Teaching in green schools is aimed at fostering sustainable lifestyles among students, ensuring harmony between human interaction with nature.

### 3 Results

To evaluate the project of the educational institution we chose the Green Zoom standard [10], which implies an in-depth analysis of all aspects related to environmentally friendly and energy-efficient construction. This international standard is aimed at minimizing the negative impact of construction processes on nature.

This article will examine the evaluation process using the example of a 875-seat school project in the Oktyabrsky District of Rostov-on-Don (Fig. 1).



**Fig. 1.** School for 875 students in Rostov-on-Don, Oktyabrsky District

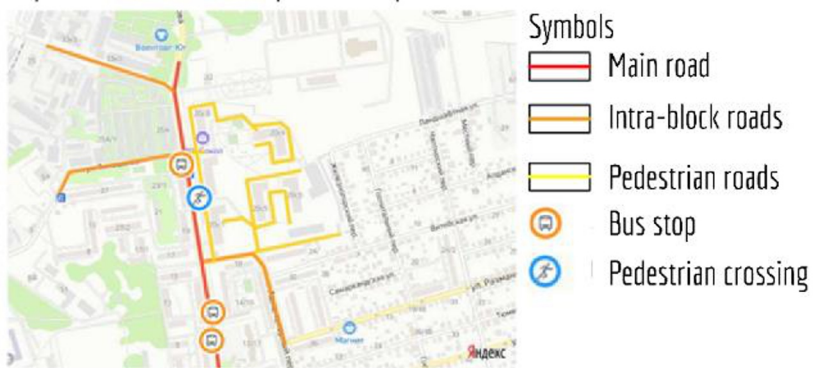
The Green Zoom assessment of the 875-person school construction project in the Oktyabrsky District includes an analysis of eight key indicators aimed at environmental sustainability and energy efficiency (Table 1).

- Transport accessibility: the project is located 400 m from bus stops with provided bicycle lanes [9] - 5 points.
- Environmental sustainability: permeable pavements and rainwater harvesting systems - 2.5 points.
- Water efficiency: use of water saving devices and sustainable plants - 6 points.
- Energy efficiency: installation of regenerative ventilation and automated heating units - 9 points.
- Material selection and waste management: certified sustainable materials [10] and reuse - 4 points.
- Indoor ecology: CO2 sensors [11] and energy-efficient lighting - 12.5 points.
- Innovation: vertical gardening [12] for thermal regulation and microclimate improvement - 6 points.
- Regional characteristics: attention to local conditions - 2 points.

**Table 1.** Summary of maximum scores for the Green Zoom standard indicators

No	Name of indicator	Maximum possible score
1	Location of the built-up area and organization of transport provision	8
2	Environmental sustainability of the built-up area	5
3	Water efficiency	10
4	Energy efficiency and reduction of harmful emissions into the atmosphere	15
5	Ecologically rational choice of building materials and waste management	6
6	Ecology of the internal environment of buildings	18
7	Innovation	9
8	Regional specifics	2
	Total	73

First of all, the project assessment starts with the assessment of the location of the built-up area and the organization of transport provision. The projected object is located not more than 400 m away from the existing bus stops (Fig.2). It is planned to create bicycle lanes as well as bicycle storage areas. For children and adolescents on the territory of the school there will be various developmental sections: basketball and volleyball sections, courses to prepare for final exams in the 9th and 11th grades, developmental classes for elementary school children. According to the first indicator, the projected object scores 5 points.



**Fig. 2.** Analysis of pedestrian accessibility of the territory under consideration

The next indicator in the assessment is the environmental sustainability of the built-up area. Application of a water-permeable paving system, which allows water not to accumulate inside the pavement, does not form puddles, preserves the grass layer of the soil. It is planned to use systems of rainwater collection and use in technical needs, reduce consumption from centralized water supply. According to the second indicator, the projected object scores 2.5 points.

The third indicator in the Green zoom standard assessment is water efficiency, as well as the installation of water-saving devices, such as low-water-consumption sanitary appliances. Planting of plants that require minimal watering: flowers - perennial aster, clematis; shrubs - bush lapwort; trees - common spruce, birch. Reduction of water consumption with the help of two-button drainage mechanism, which save up to 40% of consumption. According to the third indicator, the assessment object scores 6 points.

The fourth indicator is energy efficiency and reduction of harmful emissions into the atmosphere. Installation of supply ventilation with recuperation provides an opportunity to

regulate and adjust the temperature, humidity and other parameters of microclimate of premises, it is energy efficient, made of environmentally safe materials. Installation of automated heat points. Capital investments in heat networks and expenditures on construction and heat-insulating materials are reduced by 20-25%. Electricity consumption for pumping the heat carrier decreases by 20-40%. According to the fourth indicator, the object of assessment scores 9 points.

The next important indicator is the sustainable choice of construction materials and waste management. Use of materials made of certified wood, as well as environmentally friendly materials that have an ecological certificate. Minimizing the release of construction and demolition waste. Reuse of materials at the construction site. According to the fifth indicator, the assessment object scores 4 points.

The sixth indicator in the Green Zoom certification is the ecology of the indoor environment of buildings. CO<sub>2</sub> concentration monitoring in all public areas. CO<sub>2</sub> sensors are located at a height of 900 - 1 800 mm and have a visual indicator, which also transmits a signal to the building automation system. The lighting sources used for the entire project are energy efficient with a color rendering index of 80+ and a service life of 30,000 hours. According to the sixth indicator, the object of assessment scores 12.5 points.

The seventh indicator is the application of innovations in the project. The use of vertical landscaping, which can change the appearance of buildings and structures, as well as maintain a special microclimate in the building (Fig. 3). The main function of vertical landscaping is thermo-regulation, which provides heat retention inside the building in winter and cool temperature in summer, which significantly reduces heating (air conditioning) costs.



**Fig. 3.** Facade with vertical landscaping of the general education institution with axes 1-19

Also, vertical planting is able to maintain a special microclimate, which occurs due to the increase in air humidity, and promotes the accelerated conversion of carbon dioxide into oxygen. The project uses vertical landscaping by felt system. According to the seventh indicator, the assessment object scores 6 points.

The last indicator is to take into account the regional peculiarities of the location of the construction object. The designed general education institution is located in the Rostov region, Rostov-on-Don, which is the southern region of the country, so measures were taken to reduce the use of artificial cold in air conditioning systems [13], such as the installation of air conditioning systems using evaporative cooling. According to the eighth indicator, the assessment object scores 2 points.

Thus, the assessed object of the general education institution scores 47 points, which corresponds to the gold certificate according to the Green Zoom standard. The results of the assessment are summarized in Table 2.

**Table 2.** Result of Green Zoom evaluation of the projected object

№	Name of indicator	Evaluation result
1	Location of the built-up area and organization of transport provision	5
2	Environmental sustainability of the built-up area	2,5

3	Water efficiency	6
4	Energy efficiency and reduction of harmful emissions into the atmosphere	9
5	Ecologically rational choice of building materials and waste management	4
6	Ecology of the internal environment of buildings	12,5
7	Innovation	6
8	Regional specifics	2
	Total	47

Ultimately, the school project in Oktyabrsky District, taking into account all of the above factors and achievements, will be able to demonstrate high performance in accordance with the international Green Zoom standard, which will create the basis for a more sustainable and effective educational process in the future.

Additionally, the school project in the Oktyabrsky District envisages the integration of innovative approaches into the educational process. The introduction of STEM (science, technology, engineering and mathematics) programs in combination with environmental science not only promotes the development of critical thinking in students, but also the formation of active citizenship. Students will be involved in practical projects related to sustainable development, allowing them to apply theoretical knowledge in practice.

It is also important to note that regular activities are planned to strengthen ties between the school and the local community. For example, organizing open days, volunteer actions and environmental campaigns, which will make the school a center of community life and an active participant in the development of the district.

The project team also cares about the accessibility of educational resources for all groups of the population, including children with special needs. Installing modern technologies and creating an inclusive environment will help ensure equal opportunities for every student, which is one of the key factors of social sustainability.

Thus, the school will become not only an educational institution, but also an example of successful integration of sustainable development into social practice, which will further contribute to social progress in the Oktyabrsky District of Rostov-on-Don city.

## 4 Conclusions

In today's world, environmental friendliness and sustainability are becoming important criteria in the design of educational institutions. The application of Green Zoom methodology in school design significantly increases the efficiency of the educational process and improves the environment for students. One of the main benefits is providing a healthy atmosphere inside the buildings. The use of environmentally friendly materials and technologies improves air quality, which in turn has a positive impact on student concentration and performance.

In addition, Green Zoom emphasizes energy and resource conservation. Designing schools with sustainability in mind reduces energy and heat costs, which makes financing educational facilities more efficient. The introduction of solar panel systems and rainwater harvesting also helps minimize environmental impact.

The aspect of social responsibility is equally important [14]. Schools designed according to Green Zoom principles become community centers that draw attention to environmental issues. Thus, the application of this methodology not only enriches the educational environment, but also shapes the environmental consciousness of new generations.

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