

Exposition mechanism for promoting technologies for creating environmentally sustainable cities

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Abstract. The environmental agenda of global development, temporarily suspended by the sanctions regime due to objective circumstances, cannot be lifted, it needs to be reset, taking into account the logistical, technological and investment constraints that have arisen. Possibly less ambitious and locally focused eco-projects are required. The analysis of the experience of eco-cities recognized as the best has shown that the effectiveness of the integrated use of cleaning and recycling technologies, methods of reproduction and consumption of energy resources, technologies of transportation and organization of public spaces, smart regulation of the housing and communal system, etc. it is sufficient to compensate for the impact of rising cost factors. At the same time, the frontal implementation of eco-technologies in practice is hindered by political instability, low investment activity, and the lack of development of technologies, especially bearing in mind the confirmation of the effectiveness of their use in practice. Taking into account the practical results and the identified problems, the author suggests using an exposition mechanism for promoting eco-projects with the possibility of iterative, as soon as ready, expansion of innovative technological content of projects.

Keywords: environmentally sustainable cities, technological maneuver, exposition mechanism, urban development programs, environmental problems, construction organizations

1 Introduction

The next 27th UN Climate Change Conference will be held in Egypt (Sharm El-Sheikh) in November this year. Predicting the agenda for reducing emissions into the atmosphere, it can be argued that the overwhelming number of commitments will not be fulfilled. The problems of financing sustainable development, including the replacement of coal with renewable sources and natural gas, are becoming more complicated. Most developed countries are reviving coal-fired thermal power plants, coal purchases are increasing, and the planned energy transition from fossil fuels to clean energy sources is clearly suspended.

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But this does not mean that the activities of designing the energy systems of the future, as well as the creation of technologies to ensure the environmental sustainability of cities, etc., should be suspended. With the enlargement and development of cities, their ecology is increasingly in need of urgent improvement. Despite the impact of many negative factors of a political, economic and social nature, a number of Russian cities, together with local development companies, realized the need for sustainable development in the long term. Development companies are increasingly demonstrating commitment not only to economic goals, but also to social meanings of activity. Modern large business in the investment and construction sector strives for a harmonious, stable and socially oriented format of activity. This format not only opens up new markets, but also gives competitive advantages. In the future, these are the use of reduced lending rates, participation in urban development programs, guaranteed sales of construction products, etc. At the same time, the space of ways to promote and scale technologies for creating environmentally sustainable cities is currently only being formed. Among them are the widely used program-target approach, stock mechanisms, etc. At the same time, the potential of regional exhibitions of environmentally sustainable settlements in Russia remains beyond the innovation and development mainstream. The disclosure of its mechanisms and possibilities for ensuring environmental sustainability can not only support, but also accelerate the process of transformation of the urban environment.

2 Materials and methods

Many countries took care of the problem of creating environmentally sustainable cities more than 20 years ago. The cities of Songdo (South Korea), Iskander (Malaysia), Masdar (UAE), Brazil (Brazil), about two dozen cities in China certainly claimed to be a kind of showcase of the new economy. But development and scaling did not happen. There are many reasons. Their analysis [1, 2, 3, 4] showed that in all cases there was no comprehensive approach to the structure of urban real estate. In some cases, the administrative center dominated, in others innovative, in the third residential development, etc. Even being the most comfortable living environment, such as in Songdo, but in the absence of jobs and the need to spend time on the way to work, residents preferred to move to densely populated Seoul. Also, the super layout of architect O. Niemeyer and the comfort of the new capital of Brazil, which turned out to be too expensive for residents, turned into deserted neighborhoods in the center and favelas around it. In contrast to unsuccessfully implemented projects, in all successful environmentally sustainable cities, one can observe a balanced real estate structure using various innovative methods to solve the problems of resource support for the vital activity of cities. At the same time, smart technologies, energy-efficient solutions are used in all cases, the principles of a barrier-free environment, accessibility of services, services and technologies, environmental safety, including processing of production and consumption waste, etc. are implemented. For example, the Japanese city of Fujisawa with artificial intelligence for organizing and managing public utilities, electric vehicles with recharging in each house, special treatment of walls that heat and cool depending on air temperature, provision of social infrastructure facilities and, of course, employment security. The city has a city-forming enterprise - Panasonic Corporation. Job security gives the city not only attractiveness at the moment, but also the possibility of long-term planning for the development and improvement of the urban environment. This, in turn, pulls up the accelerated solution of problems of education, intellectual development, career growth, etc., ensuring the advanced development of human capital.

Synthesizing methods and approaches to the creation of sustainably developing cities [5, 6, 7, 8], we note that in all cases, measures to ensure security and social balance, as well as transparent and inclusive management rules established in an interactive mode by all participants in urban development, taking into account national values, became a kind of unconditional priority of development programs and projects and traditions of business turnover. This approach created conditions for reaching a consensus of economic interests and conflict-free implementation of urban development programs and projects. These methods have worked flawlessly in the conditions of the development of new attached or released urban areas. It is certainly necessary to use these methods in the conditions of historical development, but as practice shows, it is not enough. The requirements for creating a comfortable, environmentally sustainable urban environment are complemented by the need to preserve historical heritage, the functional restructuring of capital funds, and the withdrawal of environmentally toxic industrial funds outside the city limits. At the same time, the task of ensuring industrial and non-industrial activities carried out in urban conditions, transport and social infrastructure must meet constantly updated requirements and requests for accommodation formats, models of recreation and nutrition, methods of health support and treatment, types of education and trends of personal development, forms of leisure, types of entertainment and tourism. The variety of a kind of forks in consumer demand and expectations requires the creation of not only multifunctional, easily adaptive, but also alternative urban real estate (anti-cafes, kolivings, apartment hotels, condo formats of joint activities, etc.). The development of urban real estate activates the development of business models of its creation and operation. In this part, the principles of solidary accumulation are updated in order to increase the general welfare. In practice, this is expressed in creating urban conditions for personal development and achieving the maximum level of realization of the potential of all participants in the urban economy.

The modern arsenal of methods for achieving sustainable development of Russian cities in the real estate sector over the past 5 years has generally made it possible to overcome the pandemic recession. The results of the commissioning of construction projects, the pace of resettlement from emergency housing and infrastructure construction by the efforts of the construction complex and measures of state support could not fail to impress! [9]. But success during the coronacrisis period should not slow down the extremely important search for new opportunities in the face of sanctions pressure. We need a clear response to the challenges. The main thing is that this answer should open up *new horizons for the development of Russian cities, their Environment, People and Society*. We emphasize that the horizon is not an abstract concept, but as concrete as possible, accurately describing not so much quantifiably measurable parameters as qualitative shifts and limitations. In this regard, the economic policy of cities should not just reboot. In the conditions of increasing sanctions pressure, new development scenarios are in demand. To do this, urban development models must be "disassembled" in order to identify and replace worn-out and obsolete elements. Putting together a virtually new socially oriented economic model of the city, its participation in ensuring environmental safety becomes an absolute priority. The analysis of the directions of scientific research on the creation of environmentally safe models of life activity has shown that the efforts of the world community are concentrated in the following areas:

- firstly, in the search for effective innovative solutions focusing, on the one hand, on cleaning methods, on the other, preventive measures for pollution;
- secondly, the development of adequate evaluation mechanisms as a basis for monitoring and ranking;

- thirdly, in the justification and introduction of demanded institutional changes (norms, rules, organizational structures, regulations, procedures, etc.);
- fourth, the formation of mechanisms for promoting eco-models of life (grants, economic levers and incentives, discussions, contests, exhibitions, etc.).

It should be noted that the first two directions are developing quite systematically in modern Russia. Russian companies are ranked annually according to the ESG agenda. Every year more and more domestic companies, including the construction complex, take part in it. The ranking of the sustainable development of the regions and federal districts of Russia also annually makes it possible to identify not only the most successful, but also problematic regions [10].

A systematic view of environmental security (E^s), as an integral part of the Sustainable Development Goals, within the framework of the UN–Habitat Urban Prosperity initiative assumes the protection of the urban environment and its natural assets [11] in the direction of:

1. ensuring the availability of housing and services, the creation of green spaces, new public places, additional water supply systems, satisfactory sanitary conditions ($f_1^a \dots f_n^a$);
2. protection of the ecosystem of urbanized territories, including lakes, forest parks, wetlands, expansion of biodiversity, etc. ($f_1^3 \dots f_z^3$);
3. increasing resilience to climate risks and natural disasters, creating environmental infrastructure (storm drainage systems, emergency services, etc.) ($f_1^y \dots f_m^y$).

Summarizing this approach, environmental safety is defined as:

$$E^s = F(f_1^a \dots f_n^a, f_1^3 \dots f_z^3, f_1^y \dots f_m^y) \quad (1)$$

where:

E^s – the level of environmental safety can be assessed in points or in conventional units;

$f_1^a \dots f_n^a$ – the level of security of housing, various types of real estate serving life;

$f_1^3 \dots f_z^3$ – the level of protection of ecosystems: lakes, forest parks, land, etc.;

$f_1^y \dots f_m^y$ – the level of resilience to climate risks, natural disasters, etc.

These indicators assume interval estimates relative to reference values, which are identified empirically in each region and take into account the specifics of the incoming territories.

3 Results

In general, since the end of the twentieth century, the European Environment Agency (EEA) has developed 15 main indicators for assessing the environmental sustainability of cities [12]. These indicators were supplemented by a 100-point scale of the environmental sustainability index of the UN-Habitat Urban Prosperity Initiative [13]. The index made it possible to clarify the evaluation approach to air quality, waste management and the level of sustainability of energy supply. It should be noted that modern approaches abound in

various assessment options and each city can choose an index suitable for assessing the dynamics of solving key problems.

The use of evaluation indices makes it possible to focus urban development programs and projects on solving environmental problems. Among them, typical for Russian cities are changes in the microclimate and deterioration of the geo-ecological situation, air and water pollution (noise, electromagnetic, video, waste), degradation of soil cover, flooding, which generally worsens the sanitary and epidemiological situation. At the same time, replication of methods and mechanisms of sustainable development is not intensive enough [14]. The formed system of stimulating investment and construction activities for the implementation of urban projects of integrated development fragmentally changes the nature of the urban environment, and buyers of residential real estate still focus solely on its location and price parameters as the main criteria for choosing real estate. A survey of the Department of Investment and Construction Business and Real Estate Management of RANEPA showed that only 5% of home buyers pay attention to operational and environmental characteristics. The vast majority (more than 70%) of buyers do not have information about the advantages and new innovative approaches to the quality of buildings (materials, parts, structures, equipment, etc.) and the living environment. Moreover, examples of a "healthy" environment in a complex building are not actually available. The novelties are dispersed across various exhibitions, technoparks, etc. Computer graphics are also not perceived by everyone. Youth (under 25 – 30 years old) participates in only 15% of real estate transactions. Middle and older age is the main contingent that prefers to "see everything in kind", to experiment and evaluate new products in reality. It is no coincidence that the highest sales rate at various stages of housing readiness is among those developers who have proven their reliability, and their projects have been practically implemented.

The ecological literacy of the population cannot yet be considered satisfactory, because so far no building project in Russia can claim to be a self-sustaining sustainable format with the functions of natural ecosystems. This means the absence of harmful emissions and waste, that is, a "zero trace" of vital activity. To obtain the desired result, it is necessary to coordinate and establish a conflict-free implementation of the project. This will require the integration of new eco-technologies, investment and construction processes and an assessment of their impact on the natural environment. The *basic signs* of such interaction are:

1. synchronization of consumption and production of resources (we consume what we produce!);
2. the balance of waste and recycling (we throw away no more than we can recycle!);
3. elimination of toxic emissions (including for neighboring ecosystems!);
4. implementation of the principles of social justice (striving for a consensus of economic interests");
5. ensuring a comfortable life.

It is obvious that the orientation to the basic features contribute to the formation of the basic properties of the created multifunctional infrastructure and autonomous power systems. Such properties are proposed to include:

1. resource replenishment (including energy sources);
2. transport accessibility (minimization of dependence on personal and public vehicles);
3. healthy nutrition (including the creation of agricultural areas within the city);
4. smart and energy-efficient housing (independent energy production, optimization of the housing and communal system);
5. landscaping on an extended basis (including walls and roofs of buildings, overhead spaces, etc.), waste water collection, etc.

Examples of ecological cities are few: Reykjavik (Iceland), Zurich (Switzerland), Bristol (Great Britain), Malmo (Sweden), Copenhagen (Denmark). Each of them is characterized by renewable sources of electricity, waste recycling, extensive use of environmental materials and cleaning technologies. But perhaps the most critically important difference is the position of local authorities, who are not only developing the concept of an eco-city, but also consistently investing in exhibitions, "days of action", innovative urban development programs, the creation of information platforms that support dialogue modes of interaction with citizens. The exchange of residents' experience, the promotion of a healthy lifestyle, a civilized attitude to waste, replication and training in environmentally acceptable ways of organizing the life of the district/municipality/house have become the norm for eco-cities. "Open Days" in the UK, specialized Exhibitions of eco-settlements in the Netherlands and Finland have shown high efficiency in terms of additional investment inflow [15, 16, 17].

We are talking about exhibitions of residential settlements or urban areas with residential real estate built according to original projects in compliance with the requirements of environmental friendliness and energy efficiency, using the most modern achievements in construction and engineering technologies. The exhibition mechanism assumes that at the end of the exhibition, residential premises are sold, and the funds received are directed to the implementation of the next project [18, section 8.5]. The development format of the implementation of the full life cycle of an innovative project of integrated development and residential development of the territory with subsequent operation and provision of access, viewing, familiarization and evaluation of the quality of design solutions at any point of the phase of the project cycle is proposed to be designated as an *exposition mechanism*. Its essence is to demonstrate a residential development project built specifically as a sample / template / model for replicating innovative, including environmental technologies. Such integrated development projects are characterized by low/close to zero environmental impact. This, as practice shows, is the best propaganda of an "ecologically healthy" city [18]. The Department of "Organization of Construction and Management of Real Estate" of the Moscow State University of Civil Engineering has been engaged in the development of exposition mechanisms for more than 5 years [19, 20]. The scientifically based Concept of thematic Exhibitions is just perfect for the purposes of promoting eco-cities. It should be noted that Moscow currently has favorable conditions for the implementation of the exposition model. We are talking about the City program "Industrial Quarters" [21]. It provides for the construction of 35 million square meters of real estate on the territory of the so-called "rust belt" (actually abandoned industrial zones), of which 13 million square meters are general, business and social buildings and 11 million square meters are housing. The largest developers are already analyzing the benefits and risks. The latter can be leveled with the participation of city authorities and municipalities, as well as a new semantic content of the project idea with environmental technologies. This is due to the full or partial repayment of construction costs guaranteed by the city, advertising and possible benefits for shareholders. The synthesis of the advantages of exposition mechanisms, urban development programs and renewal of industrial areas, new life models popular among the population under the auspices of not only conservation, but also improvement of Nature, will make it possible to accelerate all the processes of the environmental agenda.

4 Conclusion and discussion

Modern formats of complex development are closely related to the implementation of programs for the renovation of territories of industrial areas of large cities. In particular, in Moscow, the city renovation program involves the use of projects for the construction of multi-apartment residential buildings. Meanwhile, their popularity among the population has been falling for the 3rd year in a row. The only argument for the purchase of this type of residential real estate remains the price and government support for preferential mortgage programs. While the developers of renovation projects have not been identified and the projects themselves have only been designated, it is proposed to study a possible range of options for the development of the territories of the "rust belt". In any case, they are directly related to the sections of the national project "Ecology" [22].

In order to analyze the prospects of various building options, based on the practice of foreign countries, we will distinguish three main building models.

Option 1 is a model of a vertical self-sustaining city. This model is characterized by a circular layout with dense buildings, the use of solar panels and a minimum of cars, following the example of Great City (China). Around the block, depending on the landscape, there may be parks, lakes, sports facilities, etc. The vertical city model is characterized by an emphasis on the formation of an ecological living environment.

Option 2 is a model of scientific, educational and innovation centers. The epicenter of this model is an educational and/or scientific center, a student campus and housing surrounded by parks, public spaces, sports and medical facilities, shopping and business centers. In eco-cities, unmanned electric taxis, self-provision of energy and complete waste recycling are provided everywhere. The concept of the model of scientific centers is complemented, as in Masdar (UAE), by programs to stimulate scientific research and startups.

Option 3 is a model of complete self-sufficiency of living conditions. A striking example is ReGen Villages (the Netherlands), aimed at full self-sufficiency of residents not only with water, energy, but also with organic vegetables and fruits grown in special vertical greenhouses and hydroponics. A fragment of such a village was demonstrated at Expo 2020 (Dubai). This model provides for the use of an exposure mechanism. A functioning eco-settlement will be available for review. Future residents will have the opportunity to get acquainted with the building in detail, make adjustments and suggestions. If the project is deemed successful, similar towns are planned to be built not only in the Netherlands, but also in other countries.

The mechanism for implementing basic models of environmentally sustainable cities and settlements is shown in Figure 1.

An analysis of the implementation of various models of environmentally sustainable settlements has shown that most projects do not yet have clear prospects, having faced not only investment problems, but also imperfection of technological support. Public opinion is polarizing in this regard. Some are ready to continue the search, despite the additional costs of operation and the initial rise in the cost of housing, others are moving away from the idea of sustainability. The first group forms a layer of elite communities, which increases inequality and does not contribute to a systematic solution to the problem of environmental pollution. As for the main groups of the population interested in improving housing conditions, it is proposed to use the exposition mechanism of annual exhibitions of settlements with an expanding range of innovative environmental technologies. For the Russian Federation, the urgent need for waste recycling, the great potential for the use of building materials from ecological raw materials, the existing experience and a variety of design solutions for low-rise housing construction already allow us to create and demonstrate prefabricated ecological housing.

The exposition mechanisms provide for their development under the condition of an initial innovative advantage of an ecological nature. It is important to emphasize that the successful implementation of eco-settlement projects will require the status of a federal targeted program using a hybrid financing model: from the state budget, funds from developers, innovation funds, regional budgets, funds from manufacturers of technological equipment and the population. The content of this model should be the result of an open discussion of the mode of achieving consensus of the interests of the participants of the eco-project and future consumers who are members of expert groups at its initial phase. In all cases, the wider the reach of the public, the more accessible and focused the information environment, the faster the progress of the project from a local exhibition format to scaling and, in general, solving global environmental problems.

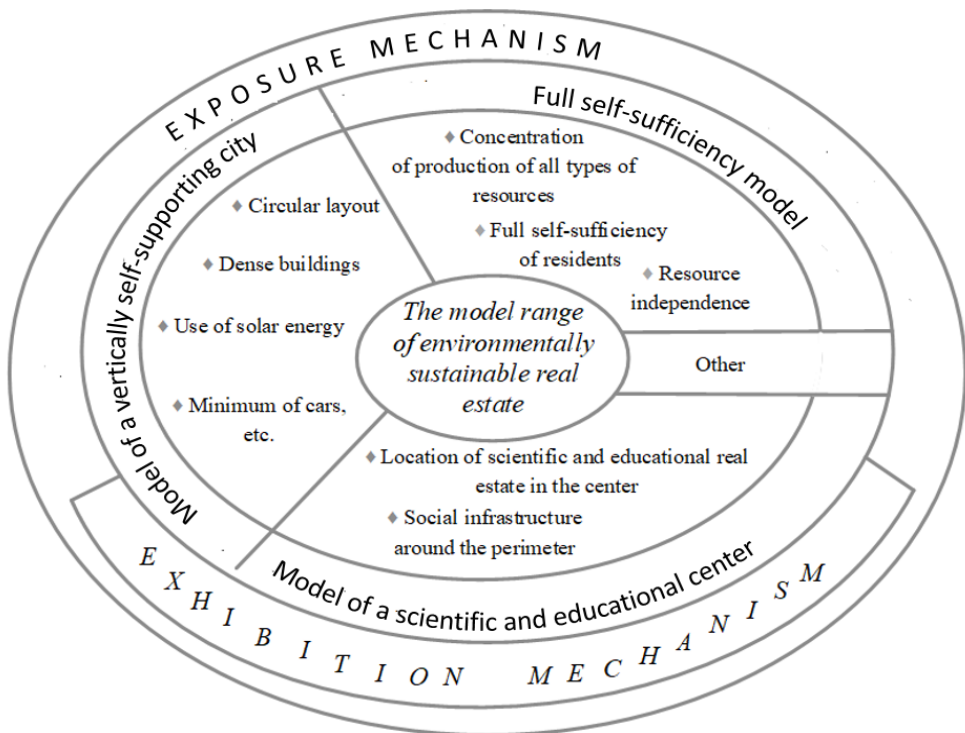


Fig. 1. The mechanism of implementation of basic models of environmentally sustainable cities and settlements

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