Energy and Resource Saving in Urban Development and the Problem of Sustainable Development of Territories

Olga Zueva 1 and Alexander Gorovoy 1

1 Saint Petersburg National Research University of Information Technologies, Mechanics and Optics, ITMO University, Kronverkskiy prospekt, 49, St. Petersburg, 197101, Russia

E-mail: gorovoy@limtu.ru

Abstract. The article is devoted to the main problems of energy and resource saving in the development of urban areas. The necessity of restricting the growth of cities with the aim of reducing the anthropogenic load on the natural environment for harmonizing the relationships between society and nature, maintaining the energy balance of the developed territories is identified. The assessment of the energy meteorological activity was carried out. The main directions of sustainable development of the city and the surrounding territories are sketched.

1. Introduction

Urbanized territories become areas of interaction of spiritual, socio-cultural, ecological, economic, material needs, aspirations of residents, both in person and in social terms. Here, many communities of people of different mentalities, interests and professions are often represented. Settlements of various types are characterized by inherent features of consumption and transformation of various types of energy, substances and information, various features of management and organization of production of the real sector. These are historically developed and evolving complex systems. They depend on their natural environment, which is the necessary source of their existence. Natural ecosystems that adjoin to human settlements experience anthropogenic impact, directly proportional to the number of people living there, the number and complexity of man-made objects. These are residential houses, local areas, industrial enterprises, cultural, tourism, sports facilities, transport infrastructure, various engineering communications. Geological (geographic) shells of the Earth - geospheres: lithosphere, hydrosphere, the atmosphere in conjunction with the energy of the Sun are life-supporting resources for all life on our planet. The host environment experiences multiple effects [1-4] This issue remains complicated and time consuming in its decision. Currently, environmental problems are particularly acute in urban areas. Rapid urban growth leads to marked disruptions in life-supporting processes in surrounding natural ecosystems. Mass development of natural areas for industrial and residential development leads to the fact that significant areas of ecosystems are subjected to increasing human impact: forests are cut down, habitats of various species of animals and plants, including rare ones, are destroyed, resulting in a decline in the species diversity of living organisms. There is a pollution of the components of the natural environment with numerous foreign substances, industrial and domestic wastes, pathogenic microorganisms and parasites. There is a change in local microclimatic, hydrological and geological conditions. The load from massive buildings and structures for various purposes, especially in areas with sealing construction, can cause uneven sedimentation of soils in the grounds and lead to emergency situations. The diversity of unfavorable factors of the urban environment requires finding solutions to
environmental, social, economic and other problems caused by disorderly and short-sighted development. From this point of view, it is important to search for models of ecologically balanced development of urban areas. One of these models is the urban development model of sustainable development of the city, which determines the border of the urbanized (built-up) city territory and prevents uncontrolled expansion of the urban space (the model of reasonable (intensive) growth of the city) [5-8].

2. Methodological approaches and analysis
The city is an area of the interaction (intersection) of interests as individuals, which are original, unique in their kind personalities and human communities - various public associations, educational institutions, science and culture, industrial enterprises and other environment-forming objects, spheres and structures. A vital source for them is the biosphere area, containing the urban natural-technical system (Urboecosystem). From the natural environment, energy, matter and information flow into the urboecosystem. In the course of their activities, people transform these flows, involving them in the cycle, ensuring the functioning of a complex system and determining the historical way of forming the urban environment. The prerequisites for choosing the direction of urban space development are spiritual, social, economic, environmental and other aspects of the life of citizens. In the area of consideration, many issues related to the interaction of various aspects of social life, which take into account the specific features of the development of urban areas, fall into this area.

The undoubted merit of such a general scientific theory of systems, allowing to explore the development of cities, is the possibility of describing and analyzing systems of varying degrees of complexity and formalization - from systems of "well-organized" or completely formalizable, that is, quantifiable by traditional mathematical methods of accounting and modeling of all elements System, their interrelations, the rules of association and functioning, to "poorly organized" or completely informalized systems that have a large neoprex Separation in the description of their properties and characteristics. In the latter case, the main attention is paid to the organization of the formulation of the problem and the formation of options for their solution on the basis of heuristic or expert methods of analysis, the use of human experience, his preferences, which cannot always be expressed in quantitative estimates.

The development of cities is associated with the satisfaction of many sociocultural and socioeconomic interests of people, which involves the consumption of natural ecosystem resources adjacent to or part of urban areas. At the same time, the city manifests itself as being energetically dependent on the environment, that is, an open ecosystem. The impact of human economic activity on the natural environment is higher the larger the city. Many of the resources consumed by industries, transport, housing and communal services, objects of culture, tourism, etc. are involved in the life-support of the city. Energy consumption of these core industries can exceed the ecological capacity of the territory, which includes the Urboecosystem itself and the surrounding natural ecosystems. In this case, the entropy of the processes of real-energy exchange, and hence the intensity of destructive phenomena-the disintegration of intra-economic structures and connections, the inhibition and destruction of ecosystems as a whole or a significant part of living organisms, is inevitable [9]. These processes are caused by the loss of recovery capabilities of local (local, territorial) components of planetary natural environments (geosphere - atmosphere, hydrosphere, lithosphere, pedosphere and biosphere). Therefore, being one of the industries with a high consumption of resources, urban planning should rely on such spatial planning principles that would allow the city to develop harmoniously in different directions with the smallest ecological trace. Approaches to this need to be improved on the basis of combining urban planning with ensuring the protection and sustainable functioning of natural and natural-technical systems (ecosystems) surrounding the city and its constituent parts.

As the experience of urban development shows, one of the important directions in saving energy resources in the operation of buildings is the improvement and development of planning solutions.

Energy consumption of the municipal sector accounts for about 40 % of the total amount.
It is necessary to take into account payback period of investments aimed to additional heating insulation of external walls of buildings (Figure 1)

![Predictable payback period, years](image)

**Figure 1.** Dependency graph of discounted payback period of facades heat insulation investments and thickness of additional heat insulation layer [1,2]

Energy-saving technology in the field of construction is also the development of constructive efficient solutions for exterior walls of buildings.

The problem of energy saving in public and housing construction is complex, it includes a number of tasks. Therefore, the solution of individual problems does not give a good result. It is necessary to consider the factors influencing energy consumption interconnected, to find the optimal combinations, only in this way it is possible to achieve the desired effect.

For construction companies paying for energy at the highest prices, you need to provide the possibility of mortgage lending. To introduce modern energy-saving production and construction technologies, carry out sanitation work, etc. Every construction company should be able to obtain a loan. A serious problem on this path is inflation.

The main technical problems affecting the energy consumption are: obsolete heat networks, low thermal insulation of buildings, large energy consumption by domestic household appliances, inefficiency of lighting and heating systems, and large heat consumption by urban transport. There are also obstacles of informational and organizational nature: insufficient attention to energy saving at the time of making architectural decisions and in town planning, problems of financing measures for sanitation and building modernization, lack of calculation of energy costs for an individual family based on its individual consumption, inability to influence the consumer.

The deformed system of pricing (for enterprises, energy prices are much higher than for citizens) and the forms of calculation inhibit the use of energy-saving technologies in construction. Subsidizing the price of electricity leads to irrational consumption of electricity (it is pointless to install expensive instruments to regulate the flow of gas and heat energy, since gas and heat tariffs are focused on living space, rather than on actual energy consumption). Measures that can affect the situation: increasing the thermal insulation of buildings, increasing the capacity of the CHPP and expanding the network of gas pipelines, the introduction of heat- and gas- meters in houses.
3. Results
Ways to solve the problems of sustainable development of territories, energy efficiency and energy saving in the field of construction:
- natural ecological infrastructure (natural areas in natural state, a combination of natural protected areas, green areas, parks, protective forests, ecological corridors);
- structures and systems that preserve the living environment (ecologized traditional infrastructure, facilities that prevent and eliminate hazardous phenomena, monitoring system);
- ecological, resource-saving buildings; Nature protection and nature conservation facilities;
- ecologized production infrastructure;
- ecological social infrastructure (socio-psychological and socio-economic infrastructure, social ecology, human ecology);
- metainfrastructure (natural resources, including renewable, and their sustainable consumption, living conditions of society).
- environmental and economic monitoring;
- geo-information systems;
- means of assessing the state of the environment of life;
- indicators of sustainable development;
- ecological examination, audit, certification, certification and control of the construction complex and specific projects.
- close to natural indicators of cleanliness of air, water, soil;
- biodiversity, justified volume of natural nature;
- sensory environment close to natural indicators - visual, odor, sound; Beautiful, environmentally sound, well-founded by area and volume housing;
- ecological beauty of the city;
- ecological satisfaction of labor needs; Satisfaction of needs in education, improvement of professional skill;
- ecological satisfaction of economic needs;
- ecological ethnic environment;
- ecological socio-economic and socio-psychological environment;
- satisfaction of environmentally sound information, spiritual, cultural needs;
- environmentally friendly, historically conditioned food.

4. Discussion
For St. Petersburg, as part of the development program, many problems related to the planning and urban development sectors have been identified, as well as programs to address them. The most acute issue is the uneven distribution of passenger and traffic flows "center-periphery" [10]. The most concentrated places of work are the central areas in which significant flows of motor vehicles are concentrated, which leads to severe air pollution. Also, the central areas are characterized by fewer green spaces in comparison with the peripheral areas. All this has a negative impact on the social and economic development of the city. St. Petersburg has great territorial potential, but it is not used because of inefficient land use policies. There were imbalances in the functional use of territories and the provision of various territories with social, engineering, transport infrastructure and other types of facilities. It is necessary to determine the criteria for assessing the urban environment and consistency. An integrated assessment is needed, taking into account economic, social and environmental factors. The indicators arise in the analysis of the urban environment and are based on the local unique characteristics of the city in accordance with the fundamental principles of planning. The redevelopment of the city's infrastructure also brings with it a change in the social factors and social life of the city, reducing crime, social stability.

A sufficient number of reconstructions of the urban environment were conducted abroad, which had its success and allowed the creation of an ecological infrastructure. These projects can be taken as a model for holding similar events in Russian cities. To make our habitat more comfortable allows
rational, environmentally sound urban development. Such methods as "ecological reconstruction" and "ecological restoration" contribute not only to restoration of the properties of the natural environment favorable for man and other living beings, but also to their improvement.

5. Conclusions
Increasing energy efficiency and resource saving in urban development, as well as maintaining a favorable environment for urban planning - the problems are multifaceted and require solutions in several planes.

The use of environmentally friendly and energy-efficient materials in construction, energy-saving technologies and well-grounded architectural and planning solutions, multilateral measures to improve the environmental situation will significantly reduce energy losses and maintain the ecological, social and economic balance of the territories of settlements and the well-being of the surrounding natural ecosystems.

References
[1] Gorshkov A S, Murav'yev P A and Tarakin A V 2016 Povysheniye urovnya teploizolyatsii naruzhnykh sten maloetazhnogo doma Energosberezheniye 8 pp 30-34
[2] Murav'yev P A, Lukina-Lebedeva M A, Tarakin A V and Gorshkov A S 2016 Energoeffektivnyy demonstratsionnyy zhiloy dom, realizuyemyy po programme PROON-GEF v g. Porkhove Inzhenernye sistemy 4 pp 34-45
[3] Gorshkov A, Murgul V and Oliynyk O 2016 MATEC Web of Conferences 53, 01045 DOI: https://doi.org/10.1051/matecconf/20165301045
[4] Pimenova A, Kuzmina S, Morozova N and Mottaeva A 2016 The Functional Model Approach to the Consulting for Vertically-Integrated Construction Group MATEC Web of Conferences 07018 DOI: https://doi.org/10.1051/matecconf/20167307018
[5] Moskalenko A 2003 Economics of Nature Management and Environmental Protection (Moscow, Mart) 224
[6] Sadovnikova N 2013 News of Volgograd State Technical University 8 (111) 16
[7] Sanzhapov B 2013 Bulletin of VolgGASU 31 (50) 2 pp 577-584
[8] Sadovnikova N 2013 Methodological bases of support of decision-making in problems of maintenance of ecological safety of development of the urbanized territories (Volgograd)
[9] Mahmudova D 2012 Problems of Modern Economics 3 (43) pp 261-264
[10] Moiseev Yu 2010 Bulletin of the International Academy of Sciences (Russian section) 2 pp 30-36