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Development of a methodological approach for the analysis of urban metabolism

I.K. Iliev, A.V. Fedyukhin

A.V. Fedyukhin, fedyukhinav@yandex.ru

GOAL OF THE STUDY

The goal of the study is development of scientific basis for urban metabolism analysis. Urban metabolism is often considered in the context of political, historical or social sciences, leaving out of focus the energy, technological and environmental aspects of the functioning of the metropolis

METHODOLOGY OF THE INVESTIGATION

Urban energy systems are subject to intense and multidirectional influence of many technical, environmental, economic, social and cultural factors. The task of effective strategic planning of urbanized areas is one of the most important challenges facing our civilization in the 21st century. The key to solving this problem lies in the development of an interdisciplinary and scientifically based approach to the analysis of urban metabolism from the standpoint of energy efficiency and environmental safety.

MAIN RESULTS FROM THE STUDY

Results demonstrate that in the first decade of the twentieth century there was a significant (in some cases two- and three-fold increase) consumption of energy and fresh water by the world's megacities.

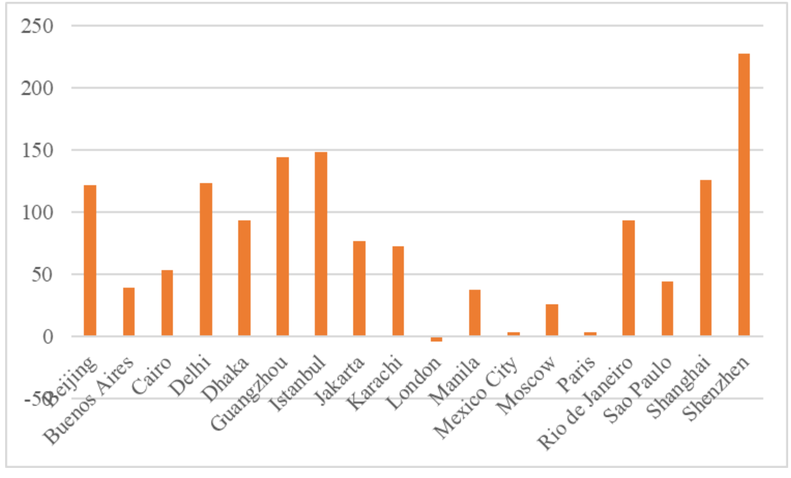

Fig. 1. Dynamics of energy consumption by stationary sources, % 2001 – 2011

Table 1. Ranking of megacities by metabolic level

Metabolic level	Cities	Features
Extremely low (up to 10 GJ/person year)	Kolkata, Mumbai	High population density in the absence of large industrial consumers.
Low (from 10 to 25 GJ/person year)	Cairo, Dhaka, Delhi, Karachi	Potential points of economic growth with the prospect of increasing metabolic levels.
Average (from 25 to 70 GJ/person year)	Beijing, Buenos Aires, Istanbul, Jakarta, Lagos, Manila, Mexico City, Paris, Rio de Janeiro, Sao Paulo, Shenzhen	Cities with an established energy and industrial structure, which are economic centers of regions and countries.
High (from 70 to 100 GJ/person year)	Guangzhou, London, Osaka, Seoul, Shanghai, Tehran, Tokyo	Capitals, as well as large industrial and economic centers of countries with a leading contribution to the world economy.
Extremely high (over 100 GJ/person year)	Los Angeles, Moscow, New York	World and regional economic capitals.

Strategic city planning is a multi-dimensional and multi-level task, covering interconnected aspects of human life and therefore, by its nature, can be solved exclusively in the context of an interdisciplinary scientific approach. As a rule, strategic urban development planning refers to a method of ensuring the competitiveness of a city in the context of globalization and with an emphasis on socio-economic indicators. At the same time, issues of strategic planning of the city's energy system are often considered in industry documents, such as Heat, Gas and Electricity Supply Schemes, Technical Policy of Local Energy Companies or the Energy Strategy (General Energy Supply Scheme) of the city.

It is important to note that approaches to assessing a city's metabolism with an emphasis on economic factors, such as GDP per capita or GDP per unit of energy consumed, carry speculative risks. The transition to cash equivalents when analyzing problems of a systemic nature is fraught with the choice of strategically incorrect decisions due to the strong volatility of the cost of a wide range of goods and services. Thus, it is important to operate exclusively with physical quantities on the basis of material and energy balances. At the same time, energy-ecological metabolism is not a balance method in its pure form, but a method for searching for directions for strategic planning of a city, based on the fuel and energy balance and other documents regulating its energy sector. This approach is dictated by the fact that the key problem of city development differs from object to object.

CONCLUSIONS

As promising tasks from the point of view of studying the energy-ecological metabolism of cities, it is worth highlighting:

- Calculation of fuel and energy balances of cities, taking into account dynamics in the context of the last 10 - 25 years.
- Development of a list of absolute and specific criteria for typology of cities.
- Construction of metabolic level forecasting models and a list of strategic measures for groups of cities with similar energy and environmental profiles.