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URBAN SOLUTIONS ANALYSIS. (FOREIGN EXPERIENCE)

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*This article examines the principles of sustainable urban development using the examples of leading countries in the world (Germany, Denmark, Singapore, the Netherlands, the United States, and Sweden). The research analyzes the effectiveness of ecological districts, strategies for achieving "carbon neutrality," integrated water resources management, and "closed-loop" energy systems. The purpose of the article is to systematize innovative approaches used to maintain ecological balance and improve the quality of life of the population in the process of urbanization, and to assess their impact on the urban environment.*

**Introduction.** The acceleration of urbanization in the 21st century has turned cities into the epicenter of ecological, social and economic crises. Climate change, air pollution and resource scarcity require the introduction of a completely new principle of "sustainability" in urban planning. Modern megacities are now being redesigned not just as a collection of buildings, but as living spaces that are in harmony with nature, energy-efficient and socially just. The relevance of this study is that, based on the experience of developed countries, "green" technologies and landscape design not only restore the ecological balance, but also open up new directions for economic growth. From Freiburg's energy-positive houses to Singapore's vertical gardens, experiments serve as the "gold standard" for the cities of the future.

**The main part.** Although implementing sustainable principles initially requires large investments, in the long run they bring high returns for the city economy. For example, the experience of New York and Portland shows that street improvements and the introduction of "Green Streets" projects have led to an increase in real estate values by 15-20%. The "plus-energy" houses in Freiburg are not only an ecological but also a social protection tool. Residents do not pay for energy, but instead earn income by selling excess energy to the city

grid. This eliminates the problem of "energy poverty" at its root. An analysis of the bicycle infrastructure in Copenhagen showed that each kilometer traveled by bicycle brings a net benefit to society of approximately 0.25 euros (due to reduced medical costs and increased work capacity). On the contrary, each kilometer traveled by car causes a loss of 0.15 euros to society due to environmental pollution and road accidents. The water management system seen in the Netherlands and Singapore has now sparked a new urban movement called the "Sponge City" worldwide. Unlike ordinary canals, this system does not simply drain water, but filters rainwater using special plants and soil layers. More than 900 bio-culverts installed in Portland have reduced the load on the city's sewage system by 60-70%. In Singapore, this concept has turned water bodies into aesthetic centers of the urban landscape. In place of concrete channels that previously served only to drain water, open ecosystems have now been built, which have reduced the Urban Heat Island effect by 2-3°C. The Hammarby model is the most striking example of the transition from "linear consumption" (resource-product-waste) to a "circular system" (circular system) in urban planning. You will not see traditional garbage trucks on the streets of Hammarby. Instead, the waste is sucked into a central station at a speed of 70 km/h through pneumatic tubes. This reduces noise and air pollution from trucks by 90%.

The experience of European cities, especially Paris and Copenhagen, sees sustainability not only in technology, but also in time management. All necessary services (schools, hospitals, shops, parks) should be within a 15-minute walk or bike ride from any point in the city. This reduces the need for cars and ensures social equality - even the poorest have equal access to all amenities. In the district of Nordhavn (Denmark), residential buildings, offices and recreational facilities are located in the same building or in adjacent buildings. This ensures that the area does not become a "dead zone" during the day (for example, office districts empty at night).

Modern sustainable cities now allow not only "green" but also "wild" nature. Parks within the city should be connected to each other by green corridors. This will help birds and insects move freely within the city, which in turn will ensure natural pollination of urban plants. The experience of Milan (Bosco Verticale) and Singapore shows that trees grown on the facades of tall buildings absorb tens of tons of carbon dioxide per year and reduce noise levels by up to 30 decibels.

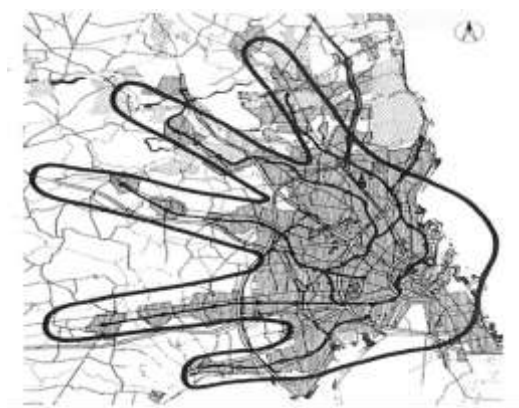
**The following discusses the experiences of several countries that have implemented sustainability principles in Central Cities:**

Germany - Freiburg (Vauban district): Freiburg set high standards for eco-neighbourhoods as early as the 1990s. All housing in the Vauban eco-district is built using Passivhaus and "plus-energy" technologies – meaning that the houses generate more solar energy than they consume on a daily basis. The district is equipped with car-free zones and wide pedestrian and bicycle paths. In terms of landscape, the Vauban area preserves biodiversity thanks to open green spaces and parks, which are widely used by residents.

Vauban introduced a participatory planning model: residents were involved in the project from the beginning, strengthening social cohesion. Overall, “Freiburg’s Vauban urban space is one of the most exemplary projects that has been rebuilt based on the principles of ecological sustainability, social equity and community management”.

Denmark - Copenhagen: The city of Copenhagen aims to become the world’s first carbon-neutral capital by 2025. To this end, the city has implemented long-term planning (the Finger Plan and the Climate Plan). According to the 1947 “Finger Plan”, the New Areas of the city were developed around four major corridors of intensity, with extensive green open spaces between them (Copenhagen Finger Plan; Figure 1 below).

Copenhagen also places nature at the centre of its modern neighbourhoods. The Nordhavn neighbourhood has green spaces connected to water bodies, and the St. Kelds area has landscape elements designed to manage water. 49% of people in the city cycle to work or school, a world record (Figure 2). Millions of euros have been invested in street infrastructure, including excellent parkland and open spaces. Overall, Copenhagen has demonstrated that “the integration of mixed-income housing, public transport and cycle paths is a key factor in achieving carbon neutrality.”



**Figure 1.** Copenhagen's "Fingers" plan scheme (1947) each finger corresponds to a transit corridor.



**Figure 2.** Copenhagen’s famous Cykelslangen (Bicycle Snake) bridge is an example of the city’s focus on elevated bike lanes.

Singapore - “The Connected City”: Singapore has been pursuing a policy of increasing green space in the city since the 1960s. The 2008 Master Plan, based on the “Connected City” concept, expanded the network of parks and parkways throughout the city. For example, despite a 68% increase in population between 1986 and 2007, the total green cover increased from 35.7% to 46.5%. Therefore, the Master Plan included “parks-nature plans” and described parks as follows: the need to create “park connectors” connecting the city’s parks of different sizes (large provincial parks, local youth parks). Under the ABC Waters (Active, Beautiful, Clean Waters) initiative to expand irrigation systems and canals, artificial dams have been removed and water bodies have been transformed into gazelle gardens. New buildings, rooftop gardens and vertical green walls are increasingly being used in Singaporean architecture. These steps have transformed Singapore into a true “City under a Garden”: the city’s green infrastructure not only provides recreation for residents, but also brings water and drainage systems closer to the ecosystem.

Netherlands: Many Dutch cities are leading the way in water-related landscape solutions. For example, in Rotterdam’s Hofbogen mountain park (on a disused railway line) (Figure 3), rainwater is filtered through natural filters and stored in the aquifer; in droughts, it is used to irrigate plants. “Rotterdam is at the forefront of the cluster: it is an international leader in sustainable water management.” In Amsterdam, the IOOR has developed an integrated design method for heat reduction and flow management in its municipal buildings. In general, Dutch cities demonstrate “integrated partial-delta solutions” in water management and green landscape design.

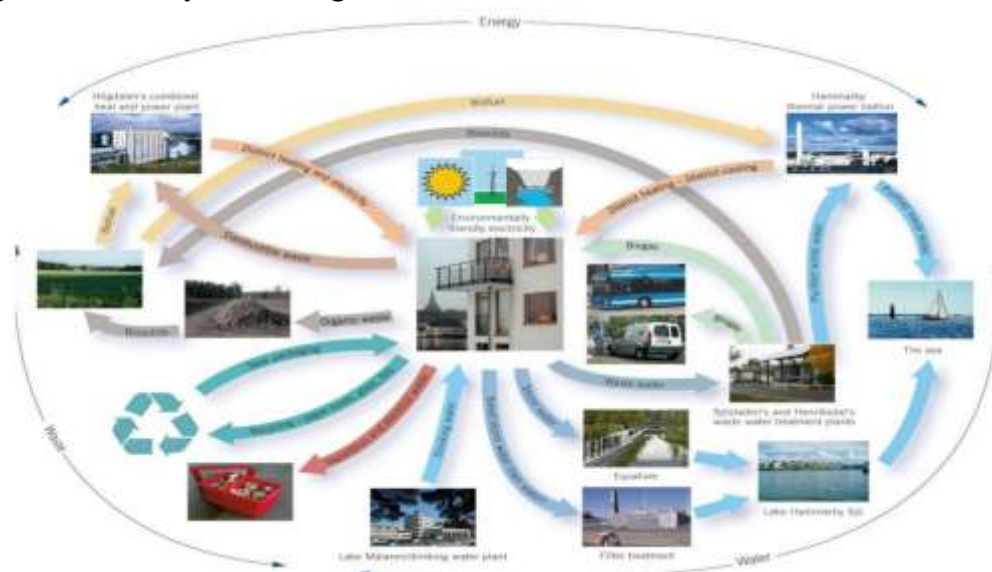


**Figure 3.** Hofbogenpark: Rotterdam's newest green landmark



**Figure 4.** Evaluating Urban Green Space Inequity to Promote Distributional Justice in Portland, Oregon

USA: In the USA, cities such as Portland (Oregon) and New York are leaders in sustainability. Portland was the first city to introduce a green belt in 1973 to limit urban growth (Figure 4), which prevented the city from developing too quickly . Later, projects such as “Green Streets” and “From Ashes to Green” were implemented, which led to the installation of more than 900 bioswales and 398 green roofs throughout the city, and over 32,000 streets were landscaped with trees. New York City, meanwhile, adopted the PlaNYC strategy in 2007, initiating an environmentally responsible approach. The Green Infrastructure plan, developed in 2012, opened more than 300 hectares of new parkland (e.g., the High Line, the Hudson River Park expansion); planted more than 500,000 trees; and implemented 257 “green street” projects. These examples show that green infrastructure (transportation corridors, urban ecosystems) is also being widely used as a means of enhancing sustainability in leading US cities.



**Figure 5.** The Hammarby Model: The core of the environmental and infrastructural.

Sweden - Hammarby Sjöstad: The former industrial area of Hammarby (Stockholm) was redeveloped into an advanced ecological model. It introduced a closed infrastructure loop system, the so-called "Hammarby model," (Figure 5), which uses waste heat from residential buildings for heating and recycled water for cooling. For example, 34% of the district heating system's heat is generated from wastewater, 47% from solid waste incineration, and the remaining 16% from biofuels. In addition, biogas from household wastewater is used for cooking and heating, reducing electricity consumption by 20%. The Hammarby project has tested battery models, solar panels, and Bio-Features, and energy is fully recycled. Here, the natural landscape - canals, ecological gardens, and pedestrian walkways - is integrated into the system, serving the quality of life of the residents.

**Conclusion.** Analysis of international experience shows that the following strategic directions are important for the formation of sustainable cities:

Integration: Transport, energy and landscape must be planned as a single system.

Natural solutions: Replacing concrete infrastructure with green and blue (water) elements ("Sponge City" and "Biogullies").

Population participation: Sustainability is not only related to technology, but also to the lifestyle and social cohesion of the population.

Circular economy: Turning waste into a resource (Hammarby model) is the main way to ensure energy independence.

These models can become the foundation for the urban planning policy of rapidly developing countries like Uzbekistan, especially in building "smart" and "green" cities.

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