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MODERN TECHNOLOGIES FOR THE UTILIZATION OF RENEWABLE ENERGY SOURCES IN THE MODERNIZATION OF URBAN AREAS

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Abstract: The article analyzes modern technologies for utilizing alternative energy sources in the process of urban modernization. It examines the integration of solar, wind, geothermal, and bioenergy systems into the urban environment, as well as their role in enhancing energy efficiency and ensuring environmental sustainability. Based on international experience, recommendations are developed for advancing urban infrastructure in an energy-efficient direction.

Keywords: alternative energy, urban modernization, renewable energy sources, solar technologies, wind energy, smart-city systems, energy efficiency, innovative technologies, urban infrastructure, sustainable development.

Introduction

In the context of contemporary urbanization, the continuous increase in urban energy consumption, the intensification of environmental pressures, and the limitations of conventional energy sources have necessitated the adoption of renewable energy technologies. Today, the integration of solar, wind, geothermal, and bioenergy systems into urban infrastructure is considered one of the key determinants for enhancing energy efficiency and achieving sustainable development indicators.

In many countries, the implementation of “green economy” policies has positioned the utilization of renewable energy technologies as a strategic priority in the modernization of urban environments. In the conditions of Uzbekistan as well, improving the energy efficiency of urban infrastructure, reducing emissions, and ensuring environmental security have become urgent and critically important tasks.

Methods

The modernization of urban areas within the framework of a “green economy” requires the application of comprehensive methodologies that support the integration of renewable energy technologies. These methodologies encompass modeling approaches, system-level assessment criteria, and practical implementation mechanisms aimed at improving urban energy sustainability.

At the national and municipal levels, the methodological framework covers the following strategic directions:

• Energy diversification — increasing the share of solar, wind, geothermal, and bioenergy sources within the urban energy mix.

• Decarbonization roadmap — defining sequential measures and milestones for achieving carbon neutrality.

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• Institutional environment for the green economy — strengthening legislative frameworks, subsidy mechanisms, tariff policies, and the implementation of ESG standards.

International experience from developed countries such as Germany, Japan, and the United States demonstrates that the successful deployment of renewable energy technologies at the urban scale is unattainable without consistent and long-term political support. Tariff-based incentive mechanisms (e.g., Feed-in Tariff, Net Metering), green bonds, carbon taxation systems, and intercity energy cooperation strategies constitute the primary driving forces enabling this transition.

Results (Translated — Scopus Academic Style)

Global renewable energy capacity has been expanding at an average annual rate of 14–18%. Solar energy has emerged as the most promising source for enhancing the energy independence of urban areas, and due to the significant decline in its generation cost, photovoltaic (PV) systems have become one of the primary urban energy solutions in many countries.

The overall penetration of urban photovoltaic systems is projected to increase fourfold by 2040 [5].

Furthermore, modern façade engineering technologies provide substantial opportunities for improving building energy efficiency. The use of lightweight and cost-effective construction materials, along with the installation of ventilated façade systems, enables older residential buildings to achieve superior thermal performance while also improving their architectural appearance. In addition, façade cladding solutions support the establishment of a unified architectural identity across entire building blocks [1].

Discussion.

Let us consider several cases of urban modernization through the integration of renewable energy sources. There are numerous examples of incorporating wind turbines into the design of urban structures. One of the earliest buildings in which wind turbines were fully integrated—either by adapting the building form to the turbines or vice versa—was the Bahrain World Trade Center (BWTC). The complex, completed in 2008, is recognized as the first high-rise structure to employ large-scale, building-integrated wind turbines (Figure 1).

Figure 1. Bahrain World Trade Center

Another approach to integrating wind turbines into the architectural structure has been implemented in the Strata skyscraper located in London (Figure 2). In this case, the turbines are

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installed inside a wind tunnel situated at the top of the building. The underlying concept is to capture the prevailing wind flow and direct it toward the rotors by utilizing the phenomenon known as the Venturi effect.

Figure 2. The Strata Tower during the construction phase.

Several examples of stand-alone and free-standing wind turbines implemented in Copenhagen, Denmark, are presented (Figure 3).

Figure 3. Independent (free-standing) wind turbines.
Left: A Savonius-type turbine integrated into a lighting pole in Japan (photo by P. Friis).
Right: Proven wind turbines installed in Blackpool, United Kingdom.

In contemporary practice, the global installed capacity of solar energy generation has increased by nearly 50% [3].

Furthermore, international experience demonstrates that photovoltaic (PV) technologies are increasingly integrated into residential modernization projects. A more detailed analysis shows that, in 2025, Canada implemented a large-scale retrofit program aimed at equipping multi-apartment residential buildings with solar photovoltaic modules (Figure 4) [3,4].

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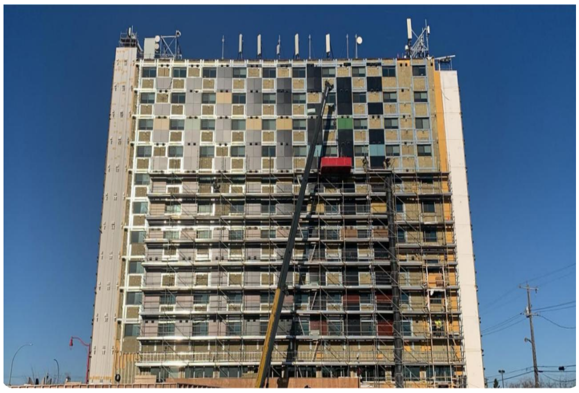

Figure 4. Retrofitting of residential buildings in Canada using solar photovoltaic (PV) modules..

In this ongoing project, Mitrex proposed a 267 kW building-integrated photovoltaic (BIPV) façade instead of the initially planned 60 kW system, exceeding decarbonization targets and ensuring a favorable investment return. This solution provided the necessary energy generation to achieve both modernization and decarbonization objectives.

Conclusion

The integration of renewable energy sources in urban environments contributes to the modernization of city infrastructure and enhances both ecological and economic sustainability. Key strategies include the diversification of energy systems, digitalized management, the implementation of efficient energy-harvesting technologies in architectural elements, and energy recovery from waste. These processes provide a scientific foundation for developing “smart,” energy-independent, and environmentally secure models of future cities.

REFERENCES

U'rinov M.Z. PhD dissertation titled “Increasing the operational efficiency of urban residential buildings using solar photovoltaic modules”. Tashkent – 2025
2. Zayni og, O. M. (2024). EXPERIMENTAL STUDY OF THE PROCESS OF INSTALLATION OF SOLAR PANELS IN MULTI-STORY HOUSES IN THE CITY OF TASHKENT. MODELS AND METHODS FOR INCREASING THE EFFICIENCY OF INNOVATIVE RESEARCH, 4(40), 347-349.
3. Kholbekov S. R. The Impact of Periodic Defects Allowed in Construction on the Lifespan of Buildings //Online Scientific Journal of Stability and Leading Research. – 2022.– P. 87-89.
4. https://stat.uz/uz/rasmiy-statistika/industry-2
5. UN-Habitat. Urban Energy Transition Report, 2023.
6. International Energy Agency (IEA). World Energy Outlook 2024
7. Omonova D. F. THEORETICAL ANALYSIS OF THE INSTALLATION OF ENERGY-EFFICIENT DEVICES IN MULTI-APARTMENT HOUSES IN THE REPUBLIC OF UZBEKISTAN //GOLDEN BRAIN. – 2023. – T. 1. – No. 1. – pp. 234-235.
8. Khotamov A. T., ugli Urinov M. Z., ugli Akhmedov S. A. THE ISSUE OF PROVIDING MULTI-APARTMENT BUILDINGS AND THEIR ADJACENT AREAS WITH SOLAR PHOTOVOLTAIC MODULE ENERGY //Pub_literatura. – 2025. – T. 1. – No. 1. – pp. 225-234.
9. Development of Solar Panels in Urban Planning and Industry Analysis A. Khotamov, M. Urinov, A. Abdurakhmanov - Urban Development Trends and Prospects, 2023
10. Khotamov A. T., ugli Urinov M. Z., ugli Akhmedov S. A. THE ISSUE OF PROVIDING MULTI-APARTMENT BUILDINGS AND THEIR ADJACENT AREAS WITH SOLAR PHOTOVOLTAIC MODULE ENERGY // Pub_literatura. - 2025. - Vol. 1. - No. 1. - P. 225-234.

11. Usmanov K., Rashidov S., Oltiev O. Functional Planning of Existing Transport Flows in the City // Urban Development Trends and Prospects. - 2023. - Vol. 1. - No. 1. - P. 21-25. 12. Abbas son, Akhmedov Shakhobidinkhan, Oltiyev O'tkir Abdishukurovich, and Jorayev Safarmurad Ramazanovich. "Analysis of Car Storage Places in Residential Areas of Tashkent City." Spanish Journal of Innovation and Integrity 37 (2024): 63-66.

12. Abdikhalil angle Abdikhalilov, F., Khurillo angle Kasimov, Z., Bakhtiyarovich Buranov, S., Ulugbek angle Rashidov, S., & Rakhmatullo angle Kholbekov, S. (2024). Experimental study of the operating condition of city road surfaces.

13. Kholbekov, S., Rashidov, S., Boymurodov, B., & Latipov, E. (2023). Foam concrete production technology and its structure. Trends and Prospects of Urban Development, 1(1), 439-442.