

SCIENTIFIC ARTICLE

COMPARATIVE ANALYSIS OF SUSTAINABLE URBAN DEVELOPMENT IN INDUSTRIAL CITIES: ECOLOGICAL INITIATIVES IN BIRMINGHAM AND YEKATERINBURG

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ABSTRACT

Introduction. In the 21st century, the strategic approach to territorial development management has become increasingly relevant. Environmental issues have emerged as some of the most pressing challenges on the international agenda. Rising pollution levels, climate change, and the depletion of natural resources necessitate proactive measures by nations and international organizations. Strategic planning is particularly complex for large urban agglomerations due to the diversity of interests among different population groups. This article examines the development strategies of Yekaterinburg (Russia) and Birmingham (UK), which share similar characteristics yet strive to individualize their approaches. A comparative analysis is presented, exploring how each city addresses these challenges through innovative policies, community engagement, and sustainable practices.

Materials and methods. In this study, documentary analysis served as the foundational method, enabling the systematization of key directions in environmental policy. Statistical analysis was applied to process empirical data reflecting trends in environmental indicators. Based on open-source materials (official portals, environmental reports), an assessment was conducted on air pollution levels, greenhouse gas emissions, urban greening rates, and other relevant parameters. Comparative analysis acted as the primary tool for juxtaposing the initiatives of the two cities. The study employed evaluation criteria such as policy effectiveness, stakeholder engagement scale, and degree of innovation.

Results and conclusions. The conducted study revealed significant divergences in the approaches of the two industrial cities toward implementing sustainable development principles. Regarding waste management systems, two distinct models were identified: Yekaterinburg is developing infrastructure for municipal solid waste (MSW) sorting and recycling. Birmingham emphasizes waste prevention (particularly food waste) through circular economy principles. Of particular scientific interest is the comparative analysis of urban greening strategies. While both cities actively implement vegetation programs, Birmingham additionally establishes ecological corridors to connect natural habitats and enhance biodiversity conservation. The investigation demonstrated substantial potential for cross-city knowledge transfer and best practice exchange in sustainable urban development.

Discussion. The conducted comparative analysis revealed significant divergences in the sustainable development approaches implemented by Birmingham and Yekaterinburg. Birmingham demonstrates an integrated strategy combining technological solutions (such as the «Low Emission Zone» initiative) with social instruments, including environmental awareness programs. In contrast, Yekaterinburg prioritizes infrastructure projects, particularly in renewable energy systems and waste processing facilities.

KEYWORD

Sustainable urban development, environmental initiative, Birmingham, Yekaterinburg, industrial city, environmental policy, public engagement, green infrastructure.

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CONFLICT OF INTEREST

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НАУЧНАЯ СТАТЬЯ

СРАВНИТЕЛЬНЫЙ АНАЛИЗ УСТОЙЧИВОГО ГОРОДСКОГО РАЗВИТИЯ В ПРОМЫШЛЕННЫХ ГОРОДАХ: ЭКОЛОГИЧЕСКИЕ ИНИЦИАТИВЫ В БИРМИНГЕМЕ И ЕКАТЕРИНБУРГЕ

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АННОТАЦИЯ

Введение. В 21 веке стратегический подход к управлению территориальным развитием становится все более актуальным. Экологические проблемы стали одними из наиболее актуальных в международной повестке дня. Растущий уровень загрязнения окружающей среды, изменение климата и истощение природных ресурсов требуют активных мер со стороны государств и международных организаций. Стратегическое планирование особенно сложно для крупных городских агломераций из-за разнообразия интересов различных групп населения. В этой статье рассматриваются стратегии развития Екатеринбурга (Россия) и Бирмингема (Великобритания), которые имеют схожие характеристики, но при этом стремятся к индивидуализации подходов. Представлен сравнительный анализ того, как каждый город решает эти проблемы с помощью инновационной политики, вовлечения сообщества и устойчивых практик.

Материалы и методы. В данном исследовании в качестве базового метода был применен анализ документации, позволивший систематизировать ключевые направления экологической политики. Для обработки эмпирических данных, отражающих динамику изменения экологических показателей, использовался статистический анализ. На основе материалов из открытых источников (официальные порталы, доклады о состоянии окружающей среды) была проведена оценка уровней загрязнения атмосферного воздуха, объемов выбросов парниковых газов, показателей озеленения городских территорий и иных релевантных параметров. Сравнительный анализ выступил основным инструментом для сопоставления инициатив двух городов. В исследовании были задействованы такие критерии оценки, как результативность политики, масштаб вовлечения стейкхолдеров и степень инновационности.

Результаты и выводы. Проведенное исследование выявило существенные расхождения в подходах двух промышленных городов к реализации принципов устойчивого развития. В области систем обращения с отходами были идентифицированы две различные модели: Екатеринбург развивает инфраструктуру для сортировки и переработки твердых коммунальных отходов (ТКО), в то время как Бирмингем делает акцент на предотвращении образования отходов (в особенности пищевых) через внедрение принципов

циркулярной экономики. Особый научный интерес представляет сравнительный анализ стратегий озеленения городских территорий. Если оба города активно реализуют программы по высадке растительности, то Бирмингем дополнительно создает экологические коридоры для соединения природных ареалов и повышения эффективности сохранения биоразнообразия. Проведенный анализ продемонстрировал значительный потенциал для межгородского трансфера знаний и обмена передовыми практиками в сфере устойчивого городского развития.

Обсуждение. Проведенный сравнительный анализ выявил существенные расхождения в подходах к реализации концепции устойчивого развития, применяемых Бирмингемом и Екатеринбург. Бирмингем демонстрирует комплексную стратегию, интегрирующую технологические решения (такие как инициатива «Зона с низким уровнем выбросов») с инструментами социального характера, включая программы экологического просвещения. В свою очередь, в Екатеринбурге приоритет отдается инфраструктурным проектам, в особенности в сфере развития возобновляемой энергетики и объектов переработки отходов.

КЛЮЧЕВЫЕ СЛОВА

Устойчивое городское развитие, экологическая инициатива, Бирмингем, Екатеринбург, промышленный город, экологическая политика, вовлечение общественности, зеленая инфраструктура.

ДЛЯ ЦИТИРОВАНИЯ

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Introduction

The relevance of this topic is underscored by several critical factors. First, industrial cities contribute significantly to environmental degradation, characterized by elevated levels of air and water pollution, excessive waste generation, and habitat destruction, requiring a comprehensive understanding of sustainable practices to mitigate these adverse effects and promote ecological restoration. Second, the public health consequences of pollution in these urban areas are significant, with residents facing an increased risk of respiratory diseases and other health problems; therefore, research into sustainable urban practices is essential to improve air quality and overall health outcomes. Furthermore, industrial cities are major contributors to greenhouse gas emissions, making climate change mitigation a pressing issue; exploring sustainable development strategies is crucial to identify effective measures to reduce carbon footprints and build resilience to climate-related impacts. Furthermore,

a shift to sustainable practices can bring economic benefits by reducing operating costs associated with energy use and waste management, promoting innovation, and creating new economic opportunities in industrial sectors.

The purpose of the research is to investigate and compare environmental initiatives and strategies for sustainable urban development in the industrial cities of Birmingham (UK) and Yekaterinburg (Russia), to identify key factors contributing to or hindering the successful implementation of these initiatives.

Sustainable urban development is a concept aimed at creating and maintaining an urban environment that meets the needs of the current generation without compromising the ability of future generations to meet their own needs. It involves a balanced combination of economic progress, social justice and environmental sustainability. Sustainable urban development involves the rational use of resources, reducing negative impacts on nature, developing infrastructure accessible to all residents and actively involving

local communities in the decision-making process. This approach contributes to the development of a comfortable, safe and viable urban environment.

Industrial cities play an important role in the process of sustainable development, as they are centers of production, innovation and economic activity. However, they face special challenges related to environmental, social and economic aspects [1, p. 9].

Given that the increasing pressure on natural resources, industrial cities must apply the principles of sustainable resource use. This includes optimization of production processes, reduction of energy and water consumption, as well as efficient waste management. The introduction of circular economy concepts helps to minimize waste and reuse resources as much as possible, which helps to reduce the ecological footprint.

In recent decades, environmental issues have become one of the most pressing in the international arena. Increasing pollution levels, climate change and depletion of natural resources require countries and international organizations to take action. In this context, many environmental programs have been initiated to address these issues.

For example, in 2015, the UN adopted 17 Sustainable Development Goals (SDGs) to be achieved by 2030. These goals cover a wide range of issues, including combating poverty, providing quality education and protecting ecosystems. SDG 13 “Climate Action” and SDG 15 “Preserve Ecosystems” emphasize the importance of environmental sustainability at the global level [2, p. 7].

Materials and methods

The research employed three principal methodologies: documentary analysis (systematizing environmental policies), statistical data processing (assessing trends in ecological indicators), and comparative analysis (evaluating urban initiatives across different contexts).

Birmingham (UK) and Yekaterinburg (Russia) are located over 3,900 kilometers apart; however, despite this considerable distance and their differing historical, industrial, and socio-cultural developments, they share several commonalities.

The common features of the socio-economic development of Birmingham and Yekaterinburg can be traced back to the 18th century and are associated with the onset of the first industrial revolution. Both cities began their active development as industrial centers in their respective countries, with key industries emerging in metal production, machine engineering, metalworking, and electrical engineering. These sectors were complemented by construction, stone-cutting, and food industries, as well as an expansion in jewelry manufacturing.

According to the National Health Service (NHS) of the United Kingdom, air pollution represents the most significant environmental risk to public health in the country. It has been demonstrated that air

pollution can cause or exacerbate a range of pulmonary and cardiovascular diseases, including asthma, chronic bronchitis, chronic heart conditions, and stroke. Research indicates that air pollution attributed to nitrogen dioxide (NO₂) and particulate matter (PM_{2.5}) may lead to approximately 36,000 premature deaths annually [3, p. 5].

Birmingham is among the five cities that the government has mandated to establish a «Clean Air Zone» to combat emissions of nitrogen dioxide and PM_{2.5} particulates. The study revealed that an eight-year-old child could die up to seven months earlier if exposed to toxic air throughout their lifetime. It was found that life expectancy in Birmingham is lower than in several other major cities in the UK, including Manchester [4, p. 88].

The investigation focused on NO₂ and PM_{2.5}—two primary contributors to health deterioration due to air pollution—across ten electoral districts in the city. The findings showed that air pollution has the most significant impact on the most disadvantaged areas, with men being more adversely affected than women. In Erdington, air pollution is responsible for an average of 91 deaths annually, compared to 59 in Edgbaston and 57 in Hall Green.

In response to this issue, Birmingham has implemented the following environmental initiatives:

1. Low emission zone implementation

Birmingham has established «Low Emission Zones» that restrict access for high-polluting vehicles. This initiative aims to reduce the amount of toxic emissions released into the atmosphere, particularly in the city center.

2. Birmingham «Clean Air Zone»

The Birmingham «Clean Air Zone» was launched on June 1, 2021. It encompasses the area within the A4540 Middleway ring road, excluding the road itself, but including the Jewelry Quarter, the Chinese Quarter, the main shopping district, the area surrounding Birmingham New Street railway station, and the remainder of central Birmingham. The objective of this zone is to improve air quality in the city by requiring the drivers of the most polluting vehicles to pay a daily charge [5, p. 3].

– the charge for private cars, taxis, and minibuses is £8 per day, while the fee for SUVs and long-distance buses is £50 per day.

– compliance with the charge is determined according to European emissions standards.

– vehicles that meet specific emissions standards, as well as fully electric or hydrogen fuel cell vehicles, are exempt from the fee. According to the Birmingham city council, in the first six months following the implementation of the «Clean Air Zone» initiative, nitrogen dioxide (NO₂) levels decreased by 13%, while the number of polluting vehicles traversing the city center was halved. Revenue generated from the «Clean Air Zone» is reinvested into promoting walking, cycling, public transportation, and installing air

quality monitors in schools. The introduction of air quality monitors throughout schools in the city also serves to enhance awareness of issues related to poor air quality, identify the sources of these problems, and encourage lifelong behavioral changes.

3) Support for electric transportation

Birmingham is actively developing its electric vehicle infrastructure, including the installation of charging stations across the city. This initiative facilitates the transition to cleaner modes of transportation. To encourage both individuals and companies that own such vehicles to adopt low-emission vehicles or shift to active transportation modes, the city administration is conducting several initiatives. For example:

- incentives are provided for private individuals and businesses to transition to low-emission vehicles or engage in active transportation options.
- enterprises seeking to modernize their vehicle fleets may apply for grants. These measures contribute to achieving long-term improvements in the air quality that we breathe.

4) Greening programs

In 2022, the Birmingham city council approved the «City of Nature» plan, which aims to restore natural resources and increase green spaces within the city over a 25-year period. Project proponents urge local authorities to transform Birmingham into not only a «city of a thousand professions» but also a «city of a thousand green spaces». The implementation of this plan is financed through the city budget, while residents are encouraged to support initiatives aimed at environmental cleanup and maintenance.

Architects in Birmingham strive to incorporate green space projects into the landscaping of residential areas, thereby enhancing the city's livability. Small green patches are being developed along local highways and in public squares, which may initially appear insignificant, consisting of one or several trees, shrubs, or small fenced lawns. However, their role is crucial, as natural landscapes not only impact the ecological situation within the city but also influence the well-being and mood of local residents. For instance, Naomi Fisher, a prominent Birmingham architect who leads playground design projects, asserts that «local children live in overly dense environments». She advocates for the expansion of green spaces within the city and actively participates in projects to create them. By 2025, new green areas featuring trees and shrubs will be expected to emerge in the majority of courtyards adjacent to playgrounds in high-rise residential buildings [6, p. 10].

Yekaterinburg is among the cities with the highest levels of air pollution. The atmospheric pollution in Yekaterinburg is primarily attributed to two key factors: industrial enterprises and vehicular emissions. The main industries contributing to air pollution include machine engineering, energy production, chemical manufacturing, and the production of construction materials. Industrial emissions amount to approximately twenty thousand tons per year, while

emissions from road transport exceed one hundred forty thousand tons [7, p. 8].

The primary pollutants released into the atmosphere include formaldehyde, nitrogen dioxide, ammonia, benzopyrene, carbon monoxide, and phenol.

Potential solutions to the issues:

1) The strategic project «Clean Air», aimed at stabilizing the environmental situation and reducing the growth rate of atmospheric air pollution.

2) Installation of filtration systems at industrial enterprises: industrial enterprises are implementing emission control technologies to reduce the release of harmful substances into the atmosphere.

3) Implementation of new developments in automotive engineering: production of vehicles equipped with exhaust gas filtration systems, which allows for the reduction of harmful emissions. In 2023, it was reported that scientists at South Ural State University had developed a hybrid garbage truck that could run on both an internal combustion engine and electric traction. Such a car can move through the streets of large cities silently and without polluting the atmosphere with poisonous gases [8, p. 43].

4) Transition of road transport to gas-powered fuels: utilization of natural gas as a fuel for vehicles, which significantly reduces the content of carbon monoxide, nitrogen oxides, and soot in exhaust gases.

5) Enhancing the environmental culture of the population: promotion of the use of bicycles, pedestrian walks, and public transportation among residents to reduce personal automobile traffic. For example, clean-up days with the participation of volunteers and caring citizens. As a result of such events, for example, in 2023, 29 cubic meters of waste were removed to the MSW landfill.

Results

An analysis of the two cities' key environmental initiatives reveals the following comparative dimensions:

Having studied some of the key environmental initiatives of these two cities, a comparative analysis can be made on the following points:

– Focus on renewable energy

Yekaterinburg emphasizes the development of renewable energy sources, such as solar and wind power. The city actively invests in the construction of solar and wind power plants, aiming to reduce its dependence on traditional hydrocarbon sources. These efforts are aimed at reducing greenhouse gas emissions and increasing the energy independence of the region.

In contrast to Yekaterinburg, Birmingham is more focused on improving the energy efficiency of existing buildings and infrastructure. The city is implementing programs to modernize heating, lighting, and insulation systems, which allows for a reduction in energy consumption and emissions without significant investments in new energy sources.

Table – Comparative analysis of environmental initiatives in Birmingham and Yekaterinburg

Comparative criteria	Birmingham	Yekaterinburg
Renewable Energy	Focuses on energy efficiency (modernizing heating, lighting, insulation)	Develops solar/wind power plants; reduces hydrocarbons and emissions
Waste Management	Prioritizes waste prevention (food waste reduction, reuse, recycling infrastructure)	Invests in recycling plants and waste sorting; promotes environmental education
Greening & Urban Improvement	Develops «green corridors» and integrates nature; supports biodiversity	Creates new parks and public spaces; enhances city attractiveness

– *Waste management*

Yekaterinburg is actively developing a system of separate waste collection and recycling. The city is investing in the construction of modern waste recycling plants, which allow for the utilization of a large portion of municipal solid waste. Additionally, efforts are being made to increase the environmental literacy of the population and to encourage waste sorting.

Birmingham also pays significant attention to waste management, but focuses on reducing waste generation. The city is implementing programs to prevent food waste, encourages the reuse and repair of goods, and is actively developing infrastructure for the recycling of secondary raw materials. These measures help to reduce the environmental burden.

– *Greening and urban improvement*

Yekaterinburg is actively engaged in greening urban areas, creating new parks and squares. The city also pays attention to the improvement of public spaces, which contributes to improving the quality of life and attractiveness of the city for residents and tourists.

Birmingham also implements programs for greening and urban improvement, but places a greater emphasis on the creation of «green corridors» and the integration of natural elements into the urban environment. This not only improves the aesthetics of the city but also contributes to the preservation of biodiversity and the ecological functions of urban ecosystems.

Discussion

In today's world, environmental initiatives are becoming not just a fashion trend, but a necessity. However, their success largely depends on the participation of local residents. Birmingham, one of the leaders of urban ecology in the UK, actively involves citizens in «green» projects through education, motivation and convenient tools. Yekaterinburg, developing environmental programs, could adopt this experience, adapting it to the Russian realities.

It is possible to highlight the most effective ecological methods of Birmingham that can be implemented in the ecological practice of Yekaterinburg.

The food waste prevention program is a notable initiative that encourages residents to adopt eco-friendly habits and contribute to environmental preservation. Such a system not only reduces waste volumes but also fosters a culture of resource efficiency.

Another significant measure is Birmingham's expansion of electric public transport, which helps lower urban emissions. Transitioning to electric buses and trams could further enhance environmental sustainability while improving passenger comfort.

Additionally, Birmingham's approach to integrating eco-parks and green spaces into the urban landscape effectively improves air quality and the microclimate. Increasing such recreational areas could provide similar benefits, offering residents more accessible spaces for leisure and outdoor activities.

Also, Birmingham relies on environmental education: lectures, workshops and school programs are held explaining the importance of waste recycling and energy conservation. Yekaterinburg also has similar initiatives, but they are often formal in nature. To get people interested, it can:

– create interactive eco-lessons in schools with practical tasks (for example, sorting garbage for speed).

– launch social advertising in the spirit of «Do you know how much waste you produce?» with real figures for the city.

– to attract bloggers and opinion leaders who will show by personal example how to live more environmentally friendly.

These practices demonstrate effective strategies for sustainable urban development that could be adapted to other industrial cities.

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