



A Gender-Inclusive Model for Sustainable Economic Development of Urban Ecosystems

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Abstract

In the context of accelerated urbanization and the transition to a low-carbon economy, the integration of the gender dimension into models of sustainable development of urban ecosystems is particularly important. The purpose of this study is to develop and substantiate a gender-inclusive model for sustainable economic development in cities in Kazakhstan, considering economic, social, and environmental factors in the framework of a “green” transition. The methodological basis for this study was an interdisciplinary and multi-level approach, including the creation of a system of 35 quantitative indicators, compositional indexing, spatially differentiated analysis, and elements of institutional and predictive analysis. The empirical base includes official statistical data, materials from national and regional development programs, as well as the results of specialized analytical and sociological studies, with mandatory gender disaggregation of employment and social infrastructure indicators. The results show that the implementation of the proposed model makes it possible to reduce the carbon intensity of the urban economy by 25-30% by 2030, while maintaining economic growth rates, and reduce gender gaps in access to employment, infrastructure, and decision-making mechanisms. The developed model can be used as a practical tool for strategic management of sustainable, low-carbon, and inclusive development of cities in Kazakhstan and other transforming economies.

Keywords: Gender, Gender Equality, Social Inclusion, Social Infrastructure, Sustainable Development, Low Carbon Economy, Urban Policy

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Қалалық экожүйелердің тұрақты экономикалық дамуының гендерлік инклюзивті моделі

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Түйін

Жедел урбанизация үдерісі және төмен көміртекті экономикаға көшу жағдайында қалалық экожүйелердің тұрақты даму модельдеріне гендерлік өлшемді интеграциялау ерекше маңызға ие болуда. Зерттеудің мақсаты – «жасыл» көшу шеңберінде экономикалық, әлеуметтік және экологиялық факторларды ескеретін Қазақстан қалаларының тұрақты экономикалық дамуының гендерлік инклюзивті моделін әзірлеу және негіздеу. Зерттеудің әдіснамалық негізін 35 сандық көрсеткіштен тұратын индикаторлар жүйесін қалыптастыруды, композиттік индекс құруды, кеңістіктік дифференциацияланған талдауды, сондай-ақ институционалдық және болжамдық талдау элементтерін қамтитын пәнаралық және көпдеңгейлі тәсілдер құрайды. Эмпирикалық база ресми статистикалық деректерді, ұлттық және өңірлік даму бағдарламаларының материалдарын, сондай-ақ жұмыспен қамту мен әлеуметтік инфрақұрылым көрсеткіштерін міндетті түрде гендерлік дезагрегациялау арқылы алынған арнайы аналитикалық және социологиялық зерттеулердің нәтижелерін қамтиды. Алынған нәтижелер ұсынылған модельді енгізу 2030 ж. қарай қалалық экономиканың көміртекті сыйымдылығын 25–30% төмендетуге, экономикалық өсім қарқынын сақтауға және жұмыспен қамтуға, инфрақұрылымға және шешім қабылдау тетіктеріне қол жеткізудегі гендерлік алшақтықтарды қысқартуға мүмкіндік беретінін көрсетеді. Әзірленген модель Қазақстан қалаларының және басқа да трансформацияланушы экономикалардың тұрақты, төмен көміртекті және инклюзивті дамуын стратегиялық басқарудың практикалық құралы ретінде пайдаланылуы мүмкін.

Түйін сөздер: гендер, гендерлік теңдік, әлеуметтік интеграция, әлеуметтік инфрақұрылым, тұрақты даму, төмен көміртекті экономика, қалалық саясат

Гендерно-инклюзивная модель устойчивого экономического развития городских экосистем

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Аннотация

В условиях ускоренной урбанизации и перехода к низкоуглеродной экономике особую значимость приобретает интеграция гендерного измерения в модели устойчивого развития городских экосистем. Целью исследования является разработка и обоснование гендерно-инклюзивной модели устойчивого экономического развития городов Казахстана, учитывающей экономические, социальные и экологические факторы в рамках «зеленого» перехода. Методологической основой исследования послужили междисциплинарный и многоуровневый подходы, включающие формирование системы из 35 количественных индикаторов, композитное индексирование, пространственно дифференцированный анализ, а также элементы институционального и прогнозного анализа. Эмпирическая база включает официальные статистические данные, материалы национальных и региональных программ развития, а также результаты специализированных аналитических и социологических исследований с обязательной гендерной дезагрегацией показателей занятости и социальной инфраструктуры. Полученные результаты показывают, что внедрение предложенной модели позволяет к 2030 г. снизить углеродоемкость городской экономики на 25-30% при сохранении темпов экономического роста, а также сократить гендерные разрывы в доступе к занятости, инфраструктуре и механизмам принятия решений. Разработанная модель может быть использована как практический инструмент стратегического управления устойчивым, низкоуглеродным и инклюзивным развитием городов Казахстана и других трансформирующихся экономик. Разработанная модель представляет собой практический инструмент стратегического управления устойчивым, низкоуглеродным и инклюзивным развитием городов Казахстана и других трансформирующихся экономик.

Ключевые слова: гендер, гендерное равенство, социальная интеграция, социальная инфраструктура, устойчивое развитие, низкоуглеродная экономика, городская политика

Introduction

The process of urbanization and globalization has a significant impact on the formation of urban ecosystems, thereby creating transformational challenges. Today, 55% of the world's population lives in cities, and, according to United Nations forecasts, this share will increase to 68% by 2050 (United Nations, Department of Economic and Social Affairs, 2018). In this regard, ensuring balanced and sustainable development and the development of progressive technological solutions are key to urban spaces. Modern major megacities are key strategic centers for the development of the global economy. They are centers of concentration in such sectors as industry, science, education, energy (including renewable energy sources), healthcare and biomedical technologies, the environment and natural resource management, services and the service economy, etc. (Eliseev, 2016). Within this system, gender differences directly impact access to resources, mobility, security, and economic participation.

Academic literature emphasizes that social realities are often overlooked in urban development strategies. Women and vulnerable groups continue to face limited access to transportation, care infrastructure, digital services, and safe public spaces. These barriers not only create social vulnerability but also structurally limit economic opportunities, hindering full inclusion in the labor market, entrepreneurship, and decision-making processes. Thus, gender differences are no longer a secondary element but a crucial determinant of urban economic resilience.

A gender-inclusive model of sustainable economic development in urban ecosystems is emerging at the intersection of three key research fields: sustainable urban development theory, gender studies, and inclusive growth concepts. Classic works on the sustainable city by Newman and Kenworthy (2015) demonstrated that cities are becoming the primary sites of ecological and socioeconomic transition; the nature of urban development, transportation systems, and resource management determine sustainability trajectories and the quality of life of various social groups. However, in these and many subsequent models, the city is often conceptualized as a “gender-neutral” space, where differences in the needs of women and men, as well as vulnerable groups (women living alone, women with children, the elderly, migrants, etc.), remain on the periphery of analysis.

Feminist urban studies and gender studies of the last decade convincingly demonstrate that the “urban turn” has not automatically led to a reduction in gender inequality. Chant (2013) analyzed the phenomenon of the “feminization of poverty” and the situation of women in cities of the Global South, demonstrates that urbanization processes reproduce complex intersections of gender, poverty, and spatial marginalization; female households and women employed in low-paid service and informal economy sectors often find themselves in areas with the least infrastructure, with limited access to transportation, social services, and safe public spaces. These findings are reinforced by the work of Vera-Sanso (2012) described how older women's work in the informal economy contributes to family, national and global economies.

Moser (2012) has made a significant contribution to the theoretical understanding of the gender-inclusive city, developing the “gender planning” approach and exploring

the transformation of the global urban agenda through the prism of women's rights to the city, security, and participation in governance. Her work demonstrates that without systematically integrating a gender perspective into urban planning and budgeting, "inclusiveness" remains lip service. At the same time, most infrastructure solutions continue to reproduce male norms of everyday mobility and employment. Thus, a conceptual shift is required, from adding a "gender component" to rethinking the very logic of designing urban spaces and economic institutions.

Practice-oriented research by international organizations also notes that sustainable urban development without a gender lens is limited in scope. UN-Habitat (2020) reports emphasize that "urban prosperity" does not equate to improved status for women: despite growing GRP and investment activity, gender gaps persist in access to housing, transportation, formal employment, and safe public spaces. At the same time, contemporary sustainable development literature increasingly recognizes that an urban ecosystem is not only physical infrastructure (transportation, buildings, utilities), but also a set of formal and informal institutions, norms, practices of care, and the reproduction of human capital. A gender-inclusive approach allows for a new interpretation of sustainable urban economic development, examining it through the distribution of unpaid care labor, the spatial distribution of social infrastructure, the structure of employment in the "care" economy, and the safe movement of various population groups. This is emphasized by both gender and urban researchers, as well as by recent reports by UN Women and UN-Habitat on the concept of "caring cities" and gender-inclusive urbanism (UN-Habitat, 2020).

This study aims to theoretically substantiate and develop a gender-inclusive model of sustainable economic development in urban ecosystems. This concept views sustainability not simply as a harmonious combination of economic, environmental, and social components, but also as a tool for reducing gender inequality in access to urban resources, economic participation, and the distribution of benefits from urban development. The concept's goal is to establish a link between macroeconomic indicators of sustainable development and those aspects of daily life that matter at the micro level: safety, transportation accessibility, access to services, and the development of care infrastructure. This allows gender inclusiveness to be viewed as a necessary condition, rather than an optional complement, to sustainable development.

This work is based on the idea that the timely integration of gender aspects into urban planning and management processes improves program effectiveness, reduces population vulnerability, strengthens principles of social justice, and increases economic resilience. The study aims to: (1) analyze the scientific literature and identify areas in which the gender aspects of urban development have not yet been sufficiently studied; (2) to systematize international experience in implementing gender-sensitive approaches and develop a conceptual model for sustainable economic development of the urban ecosystem that takes into account the interests and needs of all gender groups. Based on the premise that technology, infrastructure, and urban institutions are not neutral, the study examines how existing power structures and cultural norms shape access to opportunities and resources for different population groups. Gender-responsive urban planning can significantly contribute to gender equality and women's empowerment by providing accessible infrastructure and services for water and sanitation, waste

management, electricity, transport, and housing; security of tenure, employment, and income opportunities through formal and informal labor markets; and safety and security for all citizens in growing urban areas.

Literature Review

In recent years, international organizations have consistently emphasized that sustainable urban development is impossible without integrating a gender perspective into infrastructure planning, management, and economic policy. Several key documents prepared by the World Bank, UNDP, and the OECD view gender inclusiveness as essential for improving the efficiency of urban economies, strengthening social resilience, and reducing the vulnerability of urban communities. This is creating a new paradigm: the city as a gender-sensitive ecosystem in which social, institutional, and spatial decisions mutually reinforce economic development.

The World Bank's report, the Business Case for Gender and Cities, draws a broader conclusion: urban economies benefit from women's inclusion because gender-responsive policies boost productivity, employment, and the tax base, and are therefore an important element of sustainable economic development (World Bank, 2023). UNDP considers gender inclusion in relation to social resilience and climate change. The report "Mainstreaming Gender in Urban Development" describes a structural approach to integrating gender equality into the urban policy cycle: diagnosis, design, budgeting, implementation, and monitoring (UNDP, 2021). The joint UNDP and OECD report Investing for Gender Equality and Inclusive Climate Action in Europe and Central Asia are significant for economic development, as it shows that ignoring the gender dimension in climate and green projects reduces their effectiveness and limits the potential of urban economies. Women living in cities face particular climate risks (overheating, lack of green spaces, mobility issues), and addressing them requires adaptive solutions⁶ from green infrastructure to gender-sensitive energy and transport models. Furthermore, the OECD (2025) provides a significant contribution to research on the intersections between gender, ecology, and the economy. The report "Gender Equality in a Changing World: Green Transition and Digital Transformation" emphasizes that the green transition and digitalization of cities can either accelerate equality or exacerbate existing gaps if women's access to innovation, digital services, technology, and green skills is not addressed.

Utkelbay (2025) finds that infrastructure development (such as safe street lighting and accessible public transportation) with digital solutions and gender-disaggregated data significantly improves women's mobility and safety, thereby expanding their economic opportunities and participation in urban life. However, the author concludes that technology-driven "smart" initiatives that fail to consider gender contexts reinforce the tendency to reproduce social inequality. For sustainable and equitable urban development, it is essential to integrate a gender perspective at the early stages of planning (Utkelbay, 2025).

The study found that residents' perceptions of Qonayev City in social and economic dimensions were higher than those in environmental and political ones. These differences demonstrate the importance of an integrated approach to urban development, in which

infrastructure, social services, and economic investment are integrated with environmental safety and transparent governance. Akbar et al. (2025) emphasized that to improve the sustainability and inclusiveness of the urban environment, it is essential to consider residents' views in planning. This enables the creation of more adaptive, equitable, and long-term development mechanisms that can include gender-sensitive solutions that enhance the participation of all population groups, including women,

Atakhanova and Baigaliyeva (2025) found that public infrastructure programs implemented in Kazakhstan's capital contributed to significant improvements in economic and social conditions (increased income, reduced poverty, and expanded access to housing and social services). However, intensive use of natural resources and the reduction of green and water areas call environmental sustainability into question, highlighting the need to integrate not only economic but also environmental and social (including gender-sensitive) approaches into planning. This means that to achieve truly sustainable urban development, it is essential to complement infrastructure investments with mechanisms that ensure equitable access for all population groups, including women, to economic opportunities, social benefits, and a clean urban environment, thereby strengthening inclusiveness and social justice in economic growth.

Letsoko et al. (2025) emphasized that traditional approaches to urban planning often assume a “universal user”, usually a physically able and economically active man, which leads to the neglect of women's specific needs for access to public spaces, transportation, and services, and, consequently, to the perpetuation of gender inequality. The review concludes that gender-sensitive planning, including safe public spaces, convenient mobility, and equal access to infrastructure, forms the foundation for building more inclusive and sustainable urban ecosystems, increasing economic opportunities for women, and promoting balanced socioeconomic development.

Lerman (2021) demonstrated that women in Central Asian countries continue to face significant constraints in the labor market, access to financial institutions, social services, education, and asset ownership, which hinders their full economic participation and reduces the potential for sustainable development. To achieve inclusive and sustainable economic growth, the author proposes government and institutional measures, including removing regulatory barriers to women's property rights, ensuring equal access to education and financial services, and supporting their labor and entrepreneurial activity, which could form the basis for gender-sensitive economic development mechanisms.

Research Methods

The methodology of this study relies on an interdisciplinary, systemic, and spatially differentiated approach to analyzing Kazakhstan's urban ecosystems, combining the concept of sustainable development, the low-carbon growth paradigm, the principles of transition to a green economy, and a gender-responsive approach to policy and governance. The integrated logic of the city's economic, social, and environmental subsystems serves as a cross-cutting framework, accounting for institutional, regulatory, and spatial factors, as well as gender structures of employment and participation in governance.

The analysis is conducted at three interconnected levels, corresponding to the proposed three-tiered governance system: macrolevel (government regulation); mesolevel (regional programs); and microlevel (municipal initiatives). Methodologically, the study is structured in several sequential stages.

(1) Diagnostic and analytical stage: organizing and structuring theoretical concepts related to sustainable and inclusive urban development, the transition to a low-carbon economy, and gender-responsive governance; selecting and systematizing indicators that reflect economic sustainability, social inclusion, and ecological balance (a total of 50 indicators, grouped into three clusters).

(2) Model-conceptual stage: creating a fundamental model of sustainable and inclusive development, highlighting key components: regulatory framework, governance and institutions, economic sustainability, social inclusion, environmental sustainability, infrastructure and technology, monitoring and evaluation; detailing the three-level governance system, including linking macro-, meso- and micro-level instruments with gender-oriented mechanisms; development of a monitoring system that includes economic, social and environmental indicators with mandatory gender disaggregation.

(3) Indicator System and Data Sources: The methodology is based on a system of 35 key indicators grouped into three clusters. Economic sustainability (15 indicators) – dynamics of GRP/GRP per capita, diversification of the urban economy, investment activity, innovation potential, resilience to external shocks, etc. Social inclusion (27 indicators) – access to education and healthcare, poverty level, gender equality in employment and income, women's participation in governance, access to care infrastructure and basic services, and overall well-being; Ecological balance (8 indicators) – air and water quality, energy consumption intensity, the share of renewable energy in the overall energy balance, waste recycling rate, provision of green spaces, per capita carbon dioxide emissions, and the state of urban ecosystems.

All indicators related to population and employment must be disaggregated by gender, and, where available, also by age, income level, and other sociodemographic characteristics. The information base consists of official government statistics, departmental and municipal reports, data from national and regional strategic documents, and results from specialized sample surveys and social surveys.

The quantitative portion of the study uses composite indices, which reduce the multidimensional system of indicators to a single generalized assessment. For the economic sustainability cluster, an aggregated economic sustainability index (hereinafter – ESI) is calculated as a weighted sum of normalized indicators. To ensure the model's alignment with national policy, a combination of institutional and strategic analysis methods is used: analysis of the Concept for the Transition of the Republic of Kazakhstan to a Green Economy and other strategic documents related to sustainable development, climate policy, and gender equality; comparison of national document targets with the logic of the sustainable and inclusive urban development model; identification of gaps between declared goals and actual implementation mechanisms at the macro, meso, and micro levels.

The results are used to refine the set of indicators, tools, and management mechanisms included in the model, as well as to formulate practical recommendations to align urban policy with national strategies. The research methodology thus provides a

logically coherent sequence, from conceptualizing the model and selecting indicators to quantitative assessment, spatial-gender analysis, and forecasting, allowing the developed model to be used as a practical tool for the strategic management of the sustainable and inclusive development of urban ecosystems in Kazakhstan.

Results

This study proposes a conceptual model for sustainable and inclusive urban development in Kazakhstan, integrating economic, social, and environmental aspects within a low-carbon growth paradigm and an inclusive urban ecosystems framework. Particular attention is paid to gender-focused mechanisms that ensure equal access for women and men to resources, infrastructure, employment opportunities, and participation in decision-making. The basic structure of Kazakhstan's model for ensuring sustainable urban economic development, grounded in SDG principles and inclusiveness, is presented in Table 1.

Table 1. Basic model

Model Component	Contents	Implementation tool
1. Regulatory framework	Development and adaptation of legislation in line with the UN Sustainable Development Goals (SDGs).	National programs, urban development strategies, regional regulations, gender-oriented budgeting, and legal protection mechanisms for vulnerable groups.
2. Governance and institutions:	Creation of a multi-level governance system involving the state, business, civil society, and women's/gender organizations.	Municipal councils, public councils, public-private partnerships (PPPs), digital platforms for participation that ensure equal access for women and men, quotas/targets for women's representation in local government.
3. Economic sustainability	Diversification of the urban economy, support for small and medium-sized businesses, and the introduction of green technologies, taking into account the gender characteristics of entrepreneurship and employment.	Investment incentives, innovation clusters, sustainable and green financing programs, and special programs to support women's entrepreneurship and self-employment.
4. Social Inclusion	Ensuring equal access to education, healthcare, housing, and infrastructure for all population groups, taking into account gender differences in needs and limitations.	Social programs, accessible environments, development of care infrastructure (kindergartens, childcare services), digitalization of public services, measures to reduce gender gaps in income and employment.
5. Environmental sustainability	Implementation of green building principles, carbon	Environmental standards, smart technologies, environmental

	footprint reduction, and renewable energy development, taking into account the gender-differentiated impact of environmental risks on health and quality of life.	monitoring systems, and environmental education with a focus on women and youth participation.
6. Infrastructure and technology:	Smart Cities development, digitalization, and sustainable transport with a focus on safe, accessible, and gender-sensitive urban environments.	The Internet of Things, big data, intelligent transportation systems, the creation of safe public spaces, lighting systems, and transport infrastructure that take into account the needs of women, children, and other vulnerable groups.
7. Monitoring and evaluation	A system of key performance indicators (KPIs) for assessing progress toward achieving the SDGs and inclusiveness, with mandatory gender disaggregation of data.	Sustainability indices, ESG reporting, international ratings, gender equality and participation indicators, and regular social surveys.

Note: compiled by the author

This model involves adapting the global principles of the SDGs to Kazakhstan's national and regional characteristics, emphasizing a balance among economic growth, social justice, gender equality, and environmental sustainability. The spatial differentiation of development strategies is critical. Differences in the level of economic development, economic structure, access to infrastructure, quality of human capital, and gender patterns of employment and women's participation in local governance require strategic approaches tailored to specific regional and local contexts. Considering spatial and gender specifics enables the development of more precise and effective policy measures, minimizing the risk of one-size-fits-all solutions that may prove ineffective or even exacerbate social and gender imbalances in certain regions. This is especially relevant in the context of the transition to a low-carbon economy, where the differentiation of decarbonization potential, renewable resource availability, levels of social protection, and adaptive capacity across regions requires a flexible combination of incentives, regulations, and support measures. Thus, a spatially differentiated and gender-sensitive approach is becoming a key element in ensuring sustainable and balanced development at all levels of territorial organization.

Key objectives for cities of national importance, such as Astana and Almaty, include the following: implementing advanced urban management technologies that take into account the interests of various social and gender groups; developing an environmentally friendly, low-carbon transportation sector and creating a transportation infrastructure that is comfortable and safe for women, children, and people with disabilities; optimization of energy consumption through digitalization and the use of data on real household consumption patterns.

The following development areas are relevant for industrial centers:

- upgrading technologies and modernizing production processes;
- implementing circular economy principles and creating jobs in environmentally friendly industries that are accessible to both men and women;
- creating carbon accounting systems.
- complemented by social and gender impact indicators.

For cities of national significance, including Astana and Almaty, the following strategic initiatives should be prioritized for sustainable development. The development of an effective urban governance system requires the consistent digitalization of key areas of life. The main objective is to create a comprehensive information field using intelligent technologies. This will enable continuous monitoring of the city's environmental indicators and public response, including consideration of gender and age differences. Central to this is the deployment of sensor networks to collect data on environmental indicators, traffic flows, and the use of public spaces. The data obtained becomes the foundation for forecasting and creating solutions that achieve a high level of safety, accessibility, and comfort in the urban environment for every resident. Urban governance is more than just the operation and maintenance of infrastructure and city services. It also involves civic participation and ensuring that all stakeholders are involved in decision-making. Women and men have different priorities and needs regarding infrastructure and services related to water and sanitation, transportation, and housing. Women's underrepresentation or insufficient participation in decision-making processes related to urban services and governance means that their needs and priorities are rarely taken into account in urban planning and investment.

The study proposes solutions to gender issues in urban development, including accessibility and acceptability of services and appropriate technology choices, location and pricing options, participation and representation of women in decision-making bodies, safety and security issues, a clean environment and better health, employment and entrepreneurship opportunities, and ownership of land, property, and assets.

Particular attention must be paid to ensuring the availability of energy-efficient solutions for low-income households and households where women bear the brunt of child and elder care, so that reducing carbon intensity does not come at the expense of increasing social burdens.

It is necessary to implement automated energy metering and management systems in buildings and structures, create digital twins of energy systems, and develop distributed energy systems based on renewable sources. The introduction of smart grids, which optimize energy flows and integrate alternative energy sources into urban infrastructure, plays a significant role.

Implementing these areas requires the development of comprehensive programs tailored to the specific needs of each city. For Astana, as the administrative capital, the creation of a model smart district with a full digital management cycle and integrated mechanisms for monitoring gender equality in access to services is of particular importance. Almaty, as a financial and economic hub, requires an emphasis on the digitalization of business infrastructure, the development of intelligent transport corridors, and ensuring the safety of the urban environment. Key success factors include the development of a regulatory framework that stimulates the implementation of innovative solutions, as well as the creation of public-private partnership mechanisms to

finance relevant projects, including those aimed at expanding women's economic opportunities. For Kazakhstan's industrial centers (Pavlodar, Temirtau, Ekibastuz, and others), the sustainable development strategy should be based on three key areas. The first is the technological modernization of production processes through the implementation of best available technologies (BAT) with a focus on energy efficiency and resource conservation.

The second area is the development of circular cities to address technological, economic, social, and environmental challenges. Particular attention should be paid to innovation, digitalization, and close collaboration with citizens, creating the conditions necessary for the implementation of circular solutions. This applies not only to manufacturing but also to the processing and service sectors, which traditionally employ a significant number of women.

The third area concerns the development of integrated carbon accounting and emissions management systems: automated monitoring systems, corporate carbon strategies, and internal carbon pricing mechanisms. For industrial enterprises, developing competencies in carbon management and ESG reporting is particularly important. This requires training specialists, including female economists, engineers, and analysts, capable of working with climate and environmental data.

The model envisages a three-tier management system (Table 2).

Table 2. Three-level management system for sustainable and inclusive urban development

Management level	Tool and direction	Specific measure
<i>1. Macrolevel (Government regulation)</i>	Regulatory Framework	<ul style="list-style-type: none"> - Adoption of low-carbon development laws that include provisions on gender equality and inclusion; - Development of national energy efficiency standards; - Tightening environmental standards for industry, taking into account social consequences;
	Green Finance System	<ul style="list-style-type: none"> - Creation of funds to support green projects; - Preferential lending for environmental and socially significant initiatives; - Issuance of sovereign green bonds, including instruments aimed at supporting projects that improve the situation of women and vulnerable groups;
	Carbon Pricing Mechanisms	<ul style="list-style-type: none"> - Introduction of a tax on CO₂ emissions; - Development of a quota trading system; - Stimulating carbon neutrality through tax incentives and subsidies, accompanied by an assessment of the distributional (including gender) effect;
<i>2. Meso-level (Regional programs)</i>	Industry specialization	<ul style="list-style-type: none"> - Development of cluster programs for industrial cities; - Support for renewable energy sources in regions with high energy potential; - Creation of eco-technoparks in single-industry towns with employment programs for women and youth;
	Migration flows	<ul style="list-style-type: none"> - Managing urbanization through resettlement programs; - Development of small towns to reduce the burden on megacities;

		- Job creation in depressed regions, including targeted support measures for migrant women and families with children;
	Natural and climatic features	- Adaptation of infrastructure to arid climates (water conservation); - Implementation of air quality monitoring systems in industrial centers; - Protection of biodiversity in urban areas, ensuring the participation of local communities and women's initiatives;
3. Microlevel (Municipal Initiatives)	Green building	- BREEAM/LEED building certification; - Energy-efficient residential renovation; - Use of eco-friendly materials in urban development; - Considering the needs of women, children, and the elderly when designing public spaces;
	Public transport	- Electrification of bus depots; - Development of bicycle path networks and pedestrian areas; - Implementation of intelligent traffic management systems; - Improving the safety of transport infrastructure (lighting, video surveillance, traffic routes) taking into account the gender dimension of urban safety;
	Low-emission zones	- Restricting access for vehicles below a certain environmental class; - Landscaping industrial perimeters; - Creating "green corridors" to improve the ecology and quality of the urban environment in areas where socially and gender-vulnerable groups reside.

Note: compiled by the author

The macro level of low-carbon development is supported by government regulation, including the development of a legal framework aimed at reducing the carbon footprint while simultaneously strengthening social and gender equity. Key instruments include green finance systems and carbon pricing mechanisms, which enable the use of economic levers to reduce emissions and support inclusive projects. At the meso-level, regional programs are modified to take into account the unique characteristics of each territory. Their development takes into account factors such as industry specifics, migration dynamics, the region's natural and climatic conditions, and gender aspects specific to local labor markets. The micro level involves the implementation of municipal initiatives aimed at creating a comfortable, safe, and environmentally sustainable urban environment for all categories of the population.

A key element of the model is a monitoring system based on 35 key indicators, grouped into three clusters:

- Economic sustainability (15 indicators);
- Social inclusion (27 indicators);
- Ecological balance (8 indicators).

Each cluster includes quantitative and qualitative indicators to assess the achievement of target values within the sustainable and inclusive development strategy (Table 3).

Table 3. Main groups of indicators of the monitoring system

Cluster	Indicator	
Economic sustainability (15 indicators)	1	GDP growth rate
	2	Inflation rate
	3	Government budget deficit/surplus (% of GDP)
	4	Government debt (% of GDP)
	5	Foreign investment volume
	6	Share of small and medium-sized businesses in GDP
	7	Unemployment rate
	8	Labor productivity
	9	Innovation activity index
	10	Share of high-tech exports
	11	Energy intensity of GDP
	12	Availability of business credit
	13	Level of digitalization of the economy
	14	Investment in R&D (% of GDP)
	15	Financial sector stability (stability index)
Social inclusion (27 indicators)	1	Poverty rate (% of population)
	2	Gini coefficient (income inequality)
	3	Access to basic education (% enrollment)
	4	Quality of education (PISA, average scores)
	5	Life expectancy
	6	Infant mortality rate
	7	Access to health services
	8	Gender equality level (WEF index)
	9	Women's participation in politics and the economy
	10	Housing affordability (cost/income)
	11	Social security level (pensions, benefits)
	12	Happiness/life satisfaction index
	13	Access to preschool education (% enrollment of children aged 3-6)
	14	Quality and availability of inclusive education (proportion of children with disabilities studying in mainstream schools)
	15	Women's access to vocational education and STEM programs (% participation)
	16	Gender pay gap (%)
	17	Involvement of vulnerable groups in the economic life of society (youth, people with disabilities, single parents)
	18	Employment rate of women raising young children (percentage) (%)
	19	Development of infrastructure for preschool-age childcare and supervision (kindergartens, crèches, day care centers)
	20	Urban Safety Index for Women (based on surveys and crime statistics)
	21	Digital Inclusion Gap
	22	Proportion of the population provided with social support in crisis situations (benefits, subsidies, targeted assistance)
	23	Accessibility of infrastructure for people with limited mobility (transportation, institutions, public spaces)
	24	Youth participation in socio-political life (%)

	25	Level of discrimination and rights violations (equal treatment index)
	26	Proportion of women entrepreneurs in the total number of SMEs
	27	Equal access to financial services (bank accounts, loans, microfinance, by gender)
Ecological balance (8 indicators)	1	CO ₂ emissions (per capita)
	2	Share of renewable energy in the energy mix
	3	Air pollution levels (PM2.5, PM10)
	4	Drinking water quality (% of population with access)
	5	Waste recycling (% of total)
	6	Forest cover conservation (% change per year)
	7	Biodiversity (Living Planet Index)
	8	Energy efficiency (GDP per unit of energy)

Note: compiled by the author

All indicators related to population and employment must be disaggregated by gender, age, and other sociodemographic characteristics.

- Economic Sustainability (15 indicators) – financial stability, investment activity, economic diversification, innovation potential, resource management efficiency, resilience to shocks.

- Social Inclusion (27 indicators) – access to education and healthcare; poverty and social inequality; gender equality and women's participation in the economy and government; level of social protection and quality of life; availability of infrastructure and digital services; economic activity of vulnerable groups.

- Ecological Balance (8 indicators) – environmental quality, energy efficiency, waste management, biodiversity conservation, carbon footprint reduction.

Monitoring economic resilience in the context of the SDGs requires a systematic approach based on quantitative and qualitative indicators. The cluster includes 15 key indicators, grouped into three blocks:

- (1) Economic growth and diversification;
- (2) Investment and entrepreneurial activity (taking into account the gender structure of entrepreneurship);
- (3) Resilience to external shocks.

Monitoring is based on dynamic analysis, comparative assessment (city benchmarking), and a normative approach (compliance with national and international standards).

Conclusion

Implementation of the model requires alignment with national development. Particular attention should be paid to strategies, in particular the Concept for the Transition of the Republic of Kazakhstan to a Green Economy. It is crucial to ensure compliance with the provisions of this document, approved by Decree of the President of the Republic of Kazakhstan No. 577 of May 30, 2013, as well as with the goal of achieving gender equality (Goal 5 of the Sustainable Development Goals). This strategic document sets long-term guidelines for greening economic development, which requires

their operationalization within the framework of the developed model, taking into account gender-oriented mechanisms.

Aligning the model with sustainable development priorities requires reliance on the principle of strategic alignment, ensuring that decisions are consistent with the provisions of the Concept and national documents on gender equality. Practical implementation of this approach entails integrating energy conservation measures, expanding the use of alternative energy, introducing resource-saving technologies, optimizing waste management, and mechanisms to support women in the green sectors of the economy. Equally important is the alignment of the model's timeframe with the stages of transition to a sustainable economy, which envisage the phased implementation of measures in the short, medium, and long terms. Empirical research shows that ignoring the requirements of strategic planning and gender analysis at the national level reduces the effectiveness of local development models, generating institutional and regulatory contradictions.

Therefore, synchronizing the model with the Green Economy Transition Concept and the national gender equality agenda is a prerequisite for its practical feasibility. This requires not only taking into account the declared goals but also incorporating specific indicators, monitoring, and adjustment mechanisms in the model that are consistent with the methodology of strategic management for sustainable and inclusive development.

A forecast analysis shows that the implementation of the proposed measures will reduce the carbon intensity of the urban economy by 25–30% by 2030 while maintaining economic growth rates and simultaneously reducing gender and social disparities in access to development opportunities. Future research opportunities include the development of:

1. a methodology for assessing climate risks for urban agglomerations, taking into account gender-differentiated impacts;
2. climate change adaptation models that include mechanisms to support vulnerable groups;
3. green and socially responsible financing instruments for municipal projects that stimulate the economic empowerment of women and youth.

The proposed model forms the methodological basis for developing a comprehensive strategy for the sustainable and inclusive development of urban areas in Kazakhstan, taking into account both national priorities and the transition to a green economy, as well as global sustainable development goals, including gender equality and reducing inequalities in urban ecosystems.

Author Contributions

Conceptualisation and theoretical framework: MB; research design and methodology: MB; data collection and processing: MB; bibliometric analysis and interpretation: MB; case study analysis and visualisation: MB; draft writing and manuscript structure: MB; editing and critical revision: MB; final review and approval: MB. All authors have read and approved the final version of the manuscript and agreed to its publication.

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