

DOI: <http://doi.org/10.32750/2024-0120>

UDC 332.8

JEL Classification: R23

**Sergiy Obushnyi**

PhD in Economics, Associate Professor  
Borys Grinchenko Kyiv Metropolitan University  
Kyiv, Ukraine  
ORCID ID: 0000-0001-6936-955X  
*e-mail: s.obushnyi@kubg.edu.ua*

**Artem Novikov**

postgraduate student  
Borys Grinchenko Kyiv Metropolitan University  
Kyiv, Ukraine  
ORCID ID: 0009-0004-7245-4535  
*e-mail: a.novikov.asp@kubg.edu.ua*

## CROSS-NATIONAL STUDY OF RESIDENTIAL DEVELOPMENT NEAR INDUSTRIAL PARKS: SYNERGY AND PRACTICES

**Abstract.** The article examines the needs of Ukrainian Internally Displaced Persons (IDP) who arose as a result of war on the territory of the state in 2022–2024. The main attention is paid to the prospects for creating new comfortable living areas and places of employment for IDPs. These goals determine the key requirements for the development of industrial parks, the analysis of the historical context of their formation and evolution, as well as the prospects for their use to create a symbiosis between residential settlements and industrial zones. The article examines examples from countries such as Germany, Israel, Italy and China to demonstrate the current advantages and disadvantages of industrial parks, as well as their role in ensuring the balanced development of regions. A comprehensive assessment of international practices regarding the integration of residential and industrial infrastructure is conducted within the scope of this study. This analysis facilitates the identification of the most effective models that can be implemented in the Ukrainian context. Particular attention is paid to the potential of industrial parks in Ukraine to solve urgent social and economic problems related to the people internal displacement. The article provides recommendations for the development of strategies aimed at the sustainable development of residential areas in the immediate vicinity of industrial facilities, which can contribute to the creation of new jobs and improve the quality of life of the population.

**Keywords:** electro real estate; development; smart cities; investment attractiveness; sustainable development; internally displaced persons; industrial parks; synergy; residential zones; kibbutz; industrial zones; ESG principles; strategic prospects for development.

## INTRODUCTION

As a result of many years of hostilities on the territory of Ukraine, it is obvious that upon reaching peacetime, there will be a significant need to restore residential, industrial, social and public infrastructure almost throughout the country. One of the priority development scenarios is decentralization in the development of infrastructure, as this can ensure a higher level of security and efficient allocation of resources. In 2023–2024, the launch of a number of initiatives to create new industrial zones in the format of industrial parks was announced. Of course, this is not only relocation and redistribution of production capacities in the country, but also changes in the future structure of the country's population settlement. New jobs will require the concentration of skilled labor in new areas for the creation of industrial parks. The movement of families closer to places of employment will determine new requirements for residential, social and public infrastructure that will be located in close proximity to such industrial zones. The need to create new effective models of settlement in places where industrial zones are concentrated presupposes the solution of a number of problems, in particular, the effective use of investments in the creation of such settlements that would not

lose their relevance for several decades. And which, actively developing, would remain a comfortable, sustainable and safe environment for the families living there.

The key goal of the article is to study the best international practices of successful creation of residential settlements adjacent to industrial zones, in particular industrial parks, the concepts of which have shown their effectiveness in terms of the rational use of investment resources, the creation of a comfortable and safe living environment, as well as their promising organic integration into the existing settlement system in their regions.

## RESEARCH RESULTS

About 3.7M people are registered in Ukraine as internally displaced persons. Of these, 81% live in households consisting exclusively of IDPs. As of October 2023, almost 3M people left their permanent place of residence [1].

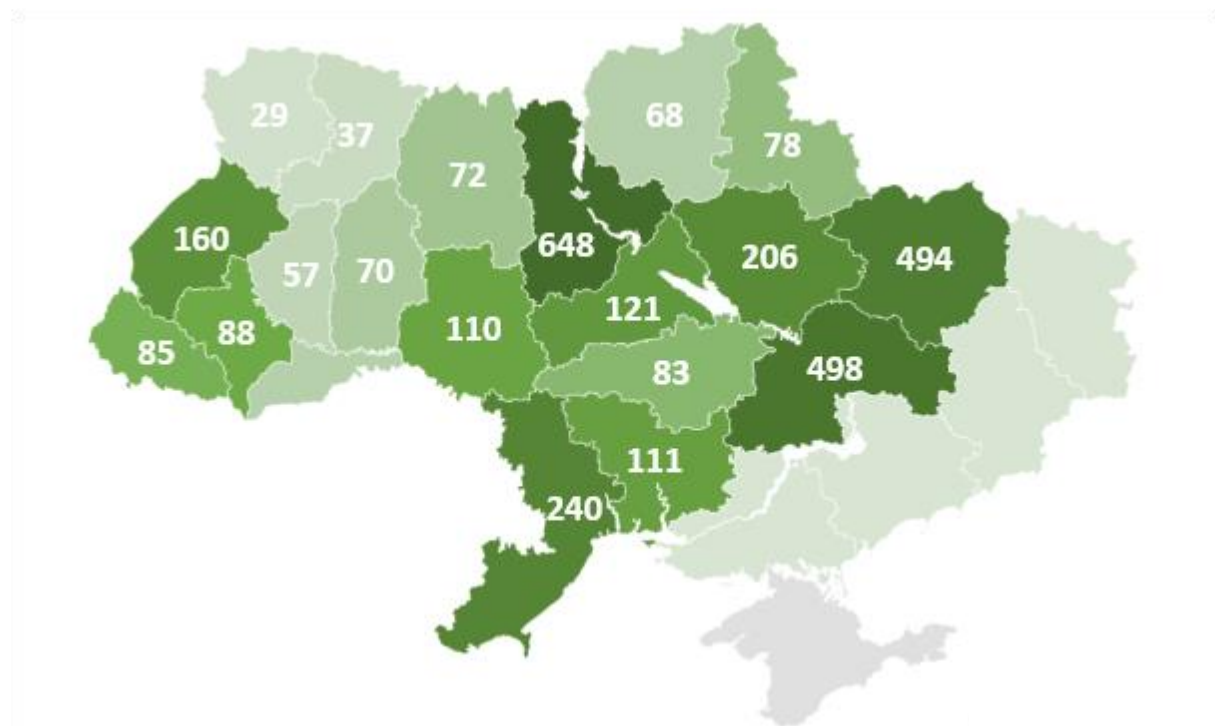


Fig. 1. Presence of IDPs by regions of displacement in 2023, thousand persons

*Note. October 2023*

*Source: [1]*

The potential total number of working-age IDPs is 1.5M people. 33% of IDPs are provided with jobs, and 67% ( $\approx 1$ M people) need employment. On average, one family consisting exclusively of IDPs has 3 people. According to the WHO classification, the population over 60 years of age is considered elderly who lose their ability to work and have certain health problems. However, in Ukraine, some pensioners continue to work and can also be involved as the labor force. In Ukraine, only about 483 thousand people are officially registered unemployed, not taking into account “hidden unemployment” among IDPs.

According to preliminary estimates, in order to provide social infrastructure facilities for IDPs, it is necessary to build 628 pre-school educational institutions, about 1000 schools, as well as 476 clinics and hospitals.

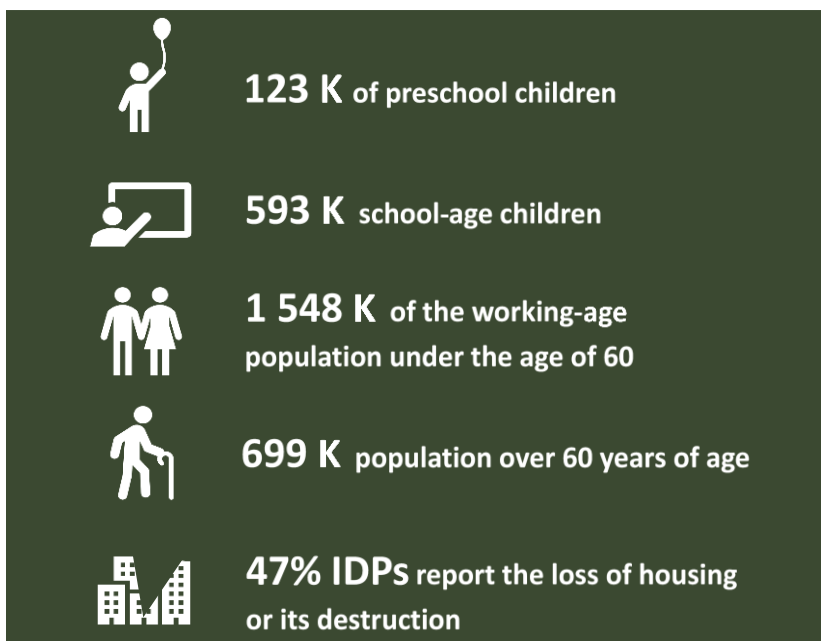


Fig. 2. Structure of distribution of IDPs by age in 2023, thousand persons  
 Source: [1], author’s personal insights

Due to the uncertainty of further scenarios for the continuation of the military conflict, the number of IDPs may increase. In addition, about 60% (3.6M people) of refugees are expected to return to Ukraine under favorable conditions or after the end of the war. Some of them will also need housing, work and social infrastructure.

One of the most effective ways to solve the problems of IDPs and restore production infrastructure is to create and develop industrial parks with closely located residential clusters. This initiative existed in pre-war times, but did not have high performance indicators, so some industrial parks were only registered, but not operating. Today, a small part of the declared parks operates in Ukraine, but the trend of their development is now quite positive.



Fig. 3. The key parameters of industrial parks in Ukraine in 2023  
 Source: [2], author’s personal insights

In order to understand the long-term success of the development of residential areas near industrial zones, one of the urgent issues is to study the key development trends inherent in modern industrial parks. Taking into account international experience, the following can be singled out among the main ones [3]:

1. **Development of Industry 4.0 technology.** Industry 4.0 technology allows you to combine automated production, data exchange and production technologies into a single self-regulating system. This allows you to increase work efficiency, optimize resource allocation, and facilitate data-driven decision-making.
2. **Creating collaborative ecosystems.** Industrial parks are being transformed into interconnected ecosystems in which there is an effective symbiosis of different functions (cooperation, knowledge exchange, innovation).
3. **Sustainable development and green initiatives.** The concept of sustainable development is becoming the basis for development for businesses around the world. Industrial parks implement eco-friendly solutions to reduce carbon emissions and reduce the negative impact on the environment.
4. **R&D and innovation centers.** Industrial parks are undergoing transformation, turning into innovation centers that promote the development of cooperation, technology, developing a culture of innovation, and creating a favorable environment for research and development.
5. **Focus on employee well-being.** Industrial parks allocate resources to the development of amenities that support the well-being of its employees. This is the creation of recreation areas, sports and medical facilities, the construction of housing for both employees and their families near the park, the implementation of projects of educational and social institutions for children.

Historically, residential settlements were formed next to industrial zones, which ensured the relationship between earning a livelihood and, on the other hand, providing production with labor. In fact, this is the labor market in its original understanding and format. The development of industrialization in the 19<sup>th</sup> century led to the rapid growth of cities and the emergence of a new type of settlements—workers' quarters located near factories and plants. These neighborhoods, which often sprang up spontaneously around industrial zones, were often characterized by overcrowding, unsanitary conditions, and poverty. For example, the first working quarters in Europe and the United States were built without taking into account sanitary standards and basic amenities. Housing usually was cramped, one-room shacks built of low-quality materials. Lack of sewerage, clean water and ventilation led to unsanitary conditions and the spread of diseases.

At the beginning of the 20<sup>th</sup> century, due to the growth of the labor and trade union movement and the awareness of the problems associated with living conditions in working-class neighborhoods, the first attempts were made to improve them. States and private companies began to build more comfortable housing for workers, with access to clean water, sewerage and ventilation. For example, in Germany at the beginning of the 20<sup>th</sup> century, Krupp built the Margarethenhöhe settlement for its workers. which was distinguished by green streets, houses with amenities and social facilities [4].

After World War II, with the rapid growth of cities, architects and urban planners began to develop concepts for the comprehensive reconstruction and modernization of working-class neighborhoods. These plans provided not only for the construction of new housing, but also for the creation of infrastructure, landscaping and improving transport accessibility. One example of this historical period is the large-scale reconstruction of a number of working-class

neighborhoods carried out in Milan in the 1980s, as a result of which modern residential complexes with green areas and pedestrian streets were created [5].

In recent decades, there has been a trend towards a revival of interest in housing near industrial zones. This is due to a number of factors, such as the rise in real estate prices in the center of cities, the solution of logistical problems, the desire for a more sustainable lifestyle and the change in production technologies in a number of industries towards their environmental friendliness and safety for living in the immediate vicinity.

One of the most illustrative cases of the synergy of residential and industrial zones is the development of such a format of settlements as a kibbutz in Israel. The location of residential neighborhoods near industrial areas in the kibbutz has been a key feature of the layout of these communities since their founding in the early 20<sup>th</sup> century.

The first kibbutzim were based on the principles of collectivism and self-sufficiency. Kibbutz members worked in shared businesses, such as farms and factories, and lived in shared barracks. Locating residential neighborhoods near these workplaces was a practical solution that reduced travel time and allowed kibbutz members to commute quickly and easily. Over time, the kibbutz format evolved into more modern and comfortable settlements, where the family became to play the key role. At the same time, the creation of industrial zones near residential areas in the kibbutz had a number of positive consequences, of which the following can be distinguished [6].

**Economic:**

- Reduce travel time. Kibbutz members could walk or bike to work, saving time and money on transportation.
- Productivity growth. Proximity to the workplace could lead to increased productivity, as kibbutz members could spend less time and effort commuting.
- Cost reduction. The kibbutzim did not need to spend money on the construction and maintenance of transport infrastructure.

**Social:**

- A sense of community. The proximity of residential neighborhoods to workplaces contributed to homogeneity and a sense of unity among kibbutz members.
- Convenience for families. It was convenient for parents to take care of their children as they could quickly get to home or schools from work.
- High motivation. Kibbutz residents understood that they worked in local industries, the income from which directly or indirectly went to the benefit of the kibbutz in which they lived.

Despite a number of advantages, the location of kibbutz residential areas near industrial zones also had some negative consequences.

**Environmental:**

- Plants and factories in industrial zones have at times been sources of air, water and soil pollution.
- Noise from industrial enterprises could disturb the inhabitants of the kibbutzim.

**Social problems:**

- The location of residential areas near industrial zones led to a gender-based division of labor, with women more likely to work in the social sphere and men in industrial enterprises.
- Kibbutz dwellers living near industrial zones and away from major cities may have limited access to educational and cultural institutions that were usually located far from these areas.

Another interesting case is the development of similar projects in Germany in the second half of the 20<sup>th</sup> and early 21<sup>st</sup> centuries. Germany is one of the European countries where the practice of building residential areas in the vicinity of industrial zones has become widespread. One such example is the city of Freiburg, where the residential area of Vauban was built on the site of a former military base. Vauban is known for its eco-friendly solutions, such as the use of solar energy, rainwater recovery and modern urban planning with the dominance of pedestrians and cyclists in the transport scheme [7].

Another modern example is the Schumacher Quartier in Berlin. Its total area is 48 hectares. It is a residential area on the territory of the former Tegel Airport in Berlin. It is located next to the Urban Tech Republic technology park, which includes about 1,000 enterprises with 20,000 employees. The residential quarter itself provides more than 5,000 residential dwellings for 10,000 people. Most of the housing (at least 50%) will be built of wooden structures. It is planned that the area will be as climate-neutral as possible and the houses will comply with the Passivhaus concept. In addition to housing, several schools, kindergartens, sports and shopping facilities are planned in the structure. Another feature of the Schumacher Quartier is the presence of state-of-the-art energy-efficient and environmentally friendly solutions [8]:

- Low-temperature heating network (LowEx) with decentralized renewable heat supply.
- Production and storage of renewable energy for on-site power supply.
- Use of environmentally friendly building materials (wooden structures, insulation).
- Promotion of the concept of mobility—bike paths, car sharing, self-driving cars.
- “Sponge City”—installation of water-saving structures, reuse of water, rainwater management.



Fig. 4. Schumacher Quartier, Berlin

Source: [8].

The rapid development of industrial parks in modern China, which leads to an increase in the need for affordable housing, especially in large metropolitan areas and industrial zones, has pushed the country's authorities to actively build residential areas in the immediate vicinity of industrial zones. This phenomenon, known as “industrial-residential integration”, is driven by the desire to use land more efficiently, stimulate economic growth and improve the quality of life.

Nanjing's Jiangning district is a prime example of the successful implementation of the concept of industrial-residential integration, demonstrating how a harmonious combination of residential and industrial zones can contribute to the sustainable development of the territory.

This area, due to its strategic planning and effective management, has become a role model in other regions of China and beyond [9].

One of the key aspects of Jiangning's success is the balance between residential and industrial facilities. Modern residential complexes equipped with the necessary infrastructure are located in close proximity to industrial parks, which makes it easy for residents of the area to get to work. This proximity not only reduces transport costs and travel time, but also reduces the strain on the city's transport system, contributing to environmental sustainability.

The integration of residential and industrial zones in Jiangning is supported by a developed social infrastructure, including educational institutions, medical centers, shopping complexes and recreation areas. This creates comfortable conditions for life and work, attracting qualified personnel and ensuring the stable socio-economic development of the region. Industrial parks in Jiangning, specializing in high-tech manufacturing and innovative industries, attract significant investment and contribute to job creation, which in turn stimulates the development of residential areas.

An important element of success is the environmental policy of the new residential clusters. Industrial enterprises are introducing modern technologies aimed at minimizing the harmful impact on the environment, which creates favorable living conditions. Much attention is also paid to green areas and parks, which improves the quality of life of residents and contributes to the formation of a healthy urban environment.

Another positive example of synergy can be seen in a number of pilot zones of projects that combine industry, housing and infrastructure in Shanghai. They are an example of the successful implementation of the concept of industrial-residential integration, which is confirmed by its harmonious development and high standard of living of the population [10]. Success is based on a strategically thought-out layout that takes into account the needs of both industrial and residential properties. Residential complexes are located in close proximity to industrial parks, allowing workers to easily commute to their workplaces, minimizing transportation costs and travel time. This location helps to reduce the load on the urban transport infrastructure, which, in turn, improves the overall environmental situation in the area.

The social infrastructure is developed at a high level, which creates comfortable conditions for life and work. There are modern educational institutions, medical centers, shopping and entertainment complexes and sports facilities in the zone. This approach ensures a high level of social integration and attracts qualified personnel, which contributes to the stable growth and development of the district. Residents have access to all necessary services and amenities, which improves their quality of life and stimulates the further development of residential and industrial areas.

Particular attention is paid to environmental issues and sustainable development. Industrial enterprises located in the zone are actively introducing modern environmentally friendly technologies and practices aimed at minimizing the harmful impact on the environment. This allows you to maintain a high level of environmental safety and create favorable living conditions. Green areas and parks provided for in the planning of the district play an important role in improving the quality of life of local residents, contributing to the formation of a healthy urban environment.

Effective management and strategic planning in Shanghai's new pilot zones attract significant investment, which contributes to the development of innovative industries and the creation of new jobs. This process stimulates the growth of residential areas and the improvement of social infrastructure, creating conditions for sustainable socio-economic development.

In general, it should be noted that during the analysis of international experience, it turned out that the development of residential areas near industrial zones can be an effective solution

for optimizing the use of land resources, stimulating economic development and providing affordable housing for residents of industrial zones. However, it is important to approach the implementation of such projects comprehensively, taking into account all potential risks and opportunities [11].

Among the main advantages are the following:

- Efficient use of land. Placing residential areas near industrial parks allows for more efficient use of land, reducing the need for new housing estates in the cities.
- Reduced transport costs. Residents living near their place of work can reduce transportation costs.
- Job creation. The construction of residential zones can stimulate the creation of new jobs in the service and trade sectors.
- Saving investments in road transport infrastructure. Close transport accessibility to places of employment ensures a reduction in capital investments in the creation of a road transport network.
- Improvement of the ecology of the region. Due to the absence of daily pendulum migrations of the population to workplaces in vehicles over long distances, less emissions of exhaust gases from vehicles into the atmosphere are provided, which has a positive effect on the ecology of the region. This trend is especially manifested in those regions where there is an opportunity for the working population to get to work by bicycle or other environmentally friendly models of transport.

It is also necessary to highlight some disadvantages:

- Impact on the environment. Industrial parks can be sources of air, water and soil pollution, which negatively affects human health and the environment.
- Noise. Noise from industrial enterprises can interfere with residents living nearby or require additional architectural and engineering solutions to minimize noise pollution.
- Risk of accidents. In the event of an accident at an industrial enterprise, residents of residential areas may be at risk.

In addition, measures should be developed to reduce the negative impact of industrial parks on residential areas, such as the creation of buffer zones, landscaping, the use of noise-absorbing solutions and the introduction of modern technologies for the treatment of wastewater and emissions into the atmosphere. It is important to note that it is necessary to strive for a balanced approach that will combine economic development with the preservation of the environment and ensuring a high quality of life.

As a result of population growth and urbanization trends in the future, the trend of building residential areas near industrial zones is expected to continue. This is due to the growing need for affordable housing, limited land resources in large metropolitan areas, and the desire to create more compact and energy-efficient cities while minimizing commuting populations.

Among the priority spheres of development are the following [12]:

- Development of innovative construction technologies that minimize the negative impact of industrial zones on the living environment.
- Creation of “smart” residential areas that use modern technologies to ensure a comfortable and safe life.
- Increased attention to environmental and sustainable development issues.
- Development of social infrastructure and providing the affordability of residential areas for people with different income levels.

Implementation of ESG principles and philosophy of the circular economy.



## CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

The development of residential areas near industrial parks can be an effective solution for optimizing the use of land resources, stimulating economic growth and providing affordable housing for a increasing population. But only with a responsible approach to the planning and implementation of such projects, it is possible to achieve the creation of comfortable and safe new residential clusters that meet modern requirements for quality of life and sustainable development.

Moreover, in the context of Ukraine's current challenging circumstances, it is particularly relevant to highlight the prevailing advantages of establishing residential clusters adjacent to industrial parks:

- Enhanced attractiveness for park residents and attraction of international companies.
- Reduced risk of employee outflow from park enterprises.
- Park residents form a stable solvent demand for housing and infrastructure.
- Creation of a multifunctional location provides a competitive advantage for attracting new industrial park residents.
- Development of a residential cluster allows to earn on housing development and facility management in the future.
- Implementation of sustainable development technologies increases the investment attractiveness of the industrial park.
- The opportunity to sell housing in the future at prices higher than the regional average due to the existence of comfortable houses and well-developed new commercial and social infrastructure.
- Development of a residential cluster in synergy with an industrial park reduces initial investments in engineering communications and roads infrastructure.

The concept of a residential cluster can be used to attract additional grants and preferential financing programs for IDPs and other categories.

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**Обушний Сергій Миколайович**

кандидат економічних наук, доцент  
Київський столичний університет імені Бориса Грінченка  
Київ, Україна  
ORCID ID: 0000-0001-6936-955X  
e-mail: s.obushnyi@kubg.edu.ua

**Новіков Артем Вікторович**

аспірант  
Київський столичний університет імені Бориса Грінченка  
Київ, Україна  
ORCID ID: 0009-0004-7245-4535  
e-mail: a.novikov.asp@kubg.edu.ua

**ДОСЛІДЖЕННЯ ДЕВЕЛОПМЕНТУ ЖИТЛОВОЇ ЗАБУДОВИ ПОРУЧ З  
ІНДУСТРІАЛЬНИМИ ПАРКАМИ: СИНЕРГІЯ ТА ПРАКТИКИ**

**Анотація.** У статті проводиться дослідження потреб українських внутрішньо переміщених осіб, які виникли внаслідок воєнних дій на території держави у 2022–2024 роках. Основна увага приділяється перспективам створення нових комфортних зон проживання та місць працевлаштування для ВПО. З цією метою визначено ключові вимоги до розвитку індустріальних парків, аналізу історичного контексту їх становлення та еволюції, а також перспектив їх використання для створення симбіозу між житловими поселеннями та зонами промислового виробництва. Стаття розглядає приклади з таких країн, як Німеччина, Ізраїль, Італія та Китай, для демонстрації поточних переваг і недоліків індустріальних парків, а також їх ролі у забезпеченні збалансованого розвитку регіонів. У ході дослідження проводиться порівняльний аналіз міжнародних практик, спрямованих на інтеграцію житлової та промислової інфраструктури, що дозволяє виявити найбільш ефективні моделі для застосування в українських реаліях. Особлива увага приділяється потенціалу індустріальних парків в Україні для вирішення актуальних соціальних та економічних проблем, пов'язаних з внутрішнім переміщенням населення. У статті представлені рекомендації щодо розробки стратегій, спрямованих на сталий розвиток житлових зон у безпосередній близькості до промислових об'єктів, що може сприяти створенню нових робочих місць і покращенню якості життя населення.

**Ключові слова:** нерухомість; девелопмент; розумні міста; інвестиційна привабливість; сталий розвиток; внутрішньо переміщені особи; індустріальні парки; синергія; житлові зони; кібуц; індустріальні зони; ESG принципи; стратегічні перспективи девелопменту.

*Стаття надійшла до редакції 13.05.24*

*Рецензовано 28.05.24*

*Опубліковано 12.06.2024 р.*



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