

The relevance of an eco-industrial cluster in promoting Ukraine's post-war reconstruction and sustainable development

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Abstract

The study explores the relevance of eco-industrial clusters in promoting Ukraine's post-war reconstruction and sustainable development. To this aim, the paper carries out a comprehensive literature review of academic articles, reports, and case studies on eco-industrial clusters and sustainable development, collect data on Ukraine's post-war reconstruction efforts and the current state of its industrial sector, and analyze relevant legislation and policies. The results show that the success of eco-industrial clusters can be attributed to several critical factors, including robust collaboration between companies, a supportive regulatory framework, and a long-term vision for sustainable development. In the context of Ukraine's post-war reconstruction, an eco-industrial cluster offers an opportunity to build back better by creating new jobs, promoting sustainable economic growth, and enhancing environmental protection. This suggests that an effective eco-industrial cluster in Ukraine should align with the country's long-term vision for sustainable development, identify industries and companies that can benefit from collaboration and resource sharing, and prioritize stakeholder engagement and public awareness. The involvement of research institutions, a supportive regulatory framework, and financial resources from international donors and investors are also critical for the success of an eco-industrial cluster in Ukraine. By adopting a collaborative, innovative, and sustainable approach to economic development, Ukraine can build a more resilient, inclusive, and prosperous future for its people.

Keywords: eco-industrial cluster (EIC), post-war reconstruction, Ukraine, sustainable development

Introduction

Industrial clusters (IC) are a relatively new form of economic organization. In many developed countries, they have proven their significant role in shaping and ensuring the economic security of the country and its territories, improving the welfare and safety of people (Behrendt and Nguyen, 2018; Bashynska *et al.*, 2021; Bashynska *et al.*, 2024). Effective long-term functioning of industrial clusters is possible only if the strategy is based on the principles of sustainable development, namely

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greening, circular economy, resource management, renewable resources, smartization of business processes and more (Bashynska, 2020; Kurbatova *et al.*, 2023; Sala *et al.*, 2023).

However, amidst the undeniable economic benefits, the trajectory of industrialization and urbanization often interconnects, posing challenges to global sustainability. In the case of Ukraine, the Russia's war has not only inflicted devastating consequences on the nation but has also exacerbated environmental concerns due to various disruptions and damages caused by the conflict.

Green industrial growth is one of the most critical issues for sustainable development (Bashynska *et al.*, 2024); in particular, industrialization and urbanization usually interact. It is well known that the industrial sector is the engine of the growth of the national economy. At the same time, it also contributes to most global environmental impacts, such as carbon and resource emissions, as well as emissions of critical pollutants (Hu *et al.*, 2005). It is essential that neglecting preventive means of ecological safety management of individual entrepreneurs can lead to irreparable damage to human health and life. Thus, given the increasing environmental challenges faced globally, the contemporary scenario demands a shift towards a new economic model that prioritizes sustainability and environmental conservation - an ecological industrial cluster (EIS).

The main goal of this research is to examine the relevance of eco-industrial clusters in promoting Ukraine's post-war reconstruction and sustainable development. The study aims to provide insights into how eco-industrial clusters can be leveraged to promote economic growth, improve environmental sustainability, and foster social development after the war.

The central hypothesis is that the eco-industrial cluster is an effective tool for sustainable development and prosperity of the country and people. The results (Zheng and Peng, 2019) show that the eco-efficiency of energy-intensive industry, energy-intensive industry chains, and energy-intensive industrial clusters are all on the rise. Eco-industrial parks, serving as catalysts for industrial ecology development, promote sustainable practices, resource optimization, and symbiotic inter-industrial relationships (Negesa *et al.*, 2023). It provides companies with significant benefits from participating in it, namely the synergy effect, saving resources, primarily financial (Park *et al.*, 2016). The formation and development of clusters is an effective mechanism for attracting foreign direct investment and intensifying the process of integration into global value chains. Inclusion in such chains allows companies to increase their technological level, expand innovation to gain more significant competitive advantages, and increase the depth of product processing and added value. Such factors facilitate this as acquiring and implementing the latest equipment and technologies, gaining access to modern methods of management and organization of production and special knowledge, and gaining adequate opportunities to enter international markets. The study (Hu *et al.*,

2005) demonstrate that overall eco-efficiency of the cluster following eco-industrialization could result in increases of up to 30~40% over the pre-eco-industrialized level.

While ample methodological resources exist for decision-making under uncertainty and risk, emerging scenarios present distinct patterns that necessitate understanding decision-making amidst less-explored conditions – specifically, decision-making in conflict situations. These conditions demand further study and analysis to develop comprehensive frameworks for effective decision-making. Thus, the study is dedicated to developing the concept of eco-industrial cluster and provide practical recommendations for managing the companies' participation in EIC based on the principles of risk resilience, sustainable development, cooperation and smartization, as well as the principles of synergy, reasonable sufficiency, conservation, recirculation, lean manufacturing, economics and science.

1. Literature review

Clusters are a relatively new form of economic organization. The increased interest of scientists was formed after the publication of the works of Michael Porter (Porter, 1998) and which is given a leading role of clusters in shaping the competitiveness of states and regions.

Sufficiently in-depth IC studies are available from foreign scientists. A group of authors from Japan (Tsujimotoa *et al.*, 2018) reviewed 90 previous studies using the ecosystem concept and identified four main research approaches, through which researchers and influential groups are examining and studying industrial clusters. The first approach is the perspective of industrial ecology, which is based on industrial ecosystems. The second approach is considered in terms of business ecosystems. This approach is based on the theory of organizational boundaries. Some other influential scientists are paying attention to platform management, which is the third approach. The fourth approach is a multi-stakeholder network that facilitates dynamic analysis of behavioural relationships based on social media theory. A publication (World Bank, 2021a), which is the result of cooperation between the United Nations Industrial Development Organization (UNIDO), the World Bank Group and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, outlines a rethinking of industrial eco-parks based on the experience gained since the start of the framework project in 2017, as the creation of industrial smart eco-parks has proven to be an effective way to combine industrial activity with commercial and infrastructure services.

A group of scientists from Finland (Halonen and Seppänen, 2019) define the industrial eco-park as a business community of enterprises in the real economy sector and services that seek to improve environmental and economic performance through cooperation in solving ecological and

resource problems. Emphasis is placed on the pursuit of collective benefits, which outweigh the number of individual benefits, which each realizes only by optimizing the activities of each participant. Recent studies are increasingly concerned with greening eco-clusters as a tool for introducing a circular economy (Li and Xiangyun, 2022) or developing eco-industrial parks (Genc *et al.*, 2019; Ong *et al.*, 2021). In turn, such issues as the participation of companies in the IC and the calculation of the feasibility of making management decisions are not paid attention to, except in terms of the impact of COVID-19 (Mengistu *et al.*, 2020).

It is essential to distinguish clusters from other business associations, particularly from industry business associations. Most industry business associations aim to lobby for the common business interests of their members, such as fiscal and other industry preferences. With rare exceptions, they do not have on the agenda and strategies provisions for increasing competitiveness through better production cooperation, international cooperation, exports, innovation and digitalization. All of the above distinguishes clusters from other business associations. However, effective long-term functioning of industrial clusters is possible only if the strategy is based on the principles of sustainable development, namely greening, circular economy, resource management, renewable resources, smartization of business processes and more (Dudek *et al.*, 2023; Bashynska *et al.*, 2023). Green industrial growth is one of the most critical issues for sustainable development; in particular, industrialization and urbanization usually interact. It is well known that the industrial sector is the engine of the growth of the national economy. At the same time, it also contributes to most global environmental impacts, such as carbon and resource emissions, as well as emissions of critical pollutants. It is essential that neglecting the preventive means of ecological safety management of individual entrepreneurs can lead to irreparable damage to human health and life. Thus, creating a new economic system - an ecological industrial cluster – would be helpful.

2. Materials and Methods

This article explores the relevance of eco-industrial clusters in promoting Ukraine's post-war reconstruction and sustainable development. To achieve this objective, the following materials will be utilized: academic articles and reports on eco-industrial clusters and sustainable development; official statistics; Reports and data on Ukraine's post-war reconstruction efforts; national and regional laws, regulations, and policies; case studies of successful eco-industrial clusters in other countries.

Based on the materials available, the following methods will be utilized: Literature Review (conduct a comprehensive literature review of academic articles, reports, and case studies on eco-

industrial clusters and sustainable development. The review will provide an understanding of the key concepts, principles, and benefits of eco-industrial clusters in promoting sustainable development); Data Collection (collect data on Ukraine's post-war reconstruction efforts and the current state of its industrial sector. The data will include economic indicators, environmental impact assessments, and government policies related to sustainable development); Relevant Legislation and Policies (this review will focus on identifying the legal and regulatory framework for the implementation of eco-industrial clusters in Ukraine, including environmental regulations, tax incentives, and government policies that support sustainable development and post-war reconstruction. The analysis of legislation and policies will provide insights into the opportunities and challenges of implementing eco-industrial clusters in Ukraine, as well as potential barriers that may need to be addressed to facilitate their successful implementation) and Case Study Analysis: Analyze successful eco-industrial cluster case studies from other countries to identify best practices and lessons learned. This analysis will inform the design and implementation of an eco-industrial cluster in Ukraine. Data Analysis (analyze the collected data and expert insights to assess an eco-industrial cluster's feasibility and potential impact in promoting Ukraine's post-war reconstruction and sustainable development).

3. Data Collection, Legislation Analysis and Case Study Analysis

3.1. Clusters and industrial parks overview

There are about 2,950 clusters in Europe, i.e. defined as regional concentrations of participants in the relevant industries. Economic activities related to European clusters cover up to 39% of jobs and up to 55% of EU wage funds. In contrast to the relationship of industrial cooperation in traditional industries, which was practised long before the emergence of clusters, clusters are much more innovative – 87% of all EU patents are produced by companies that are members of clusters. In addition, the contribution of clusters to foreign economic activity is significant - 50% of export industries also belong to clusters (Merkelbach and Hollanders, 2020). According to the European Cluster Panorama 2021 (Franco *et al.*, 2021), for the period 2010-2013, in some sectors and regions of the EU, 33.3% of cluster firms showed employment growth of more than 10%, while outside the clusters, such results were achieved only in 18.2% of firms.

In China, the first industrial parks were established in the 1980s (United Nations Industrial Development Organization, 2020). There are currently 375 of them, and about 25% of all foreign direct investment accumulates there. In turn, parks provide China with about 15% of merchandise exports and more than 4 million jobs.

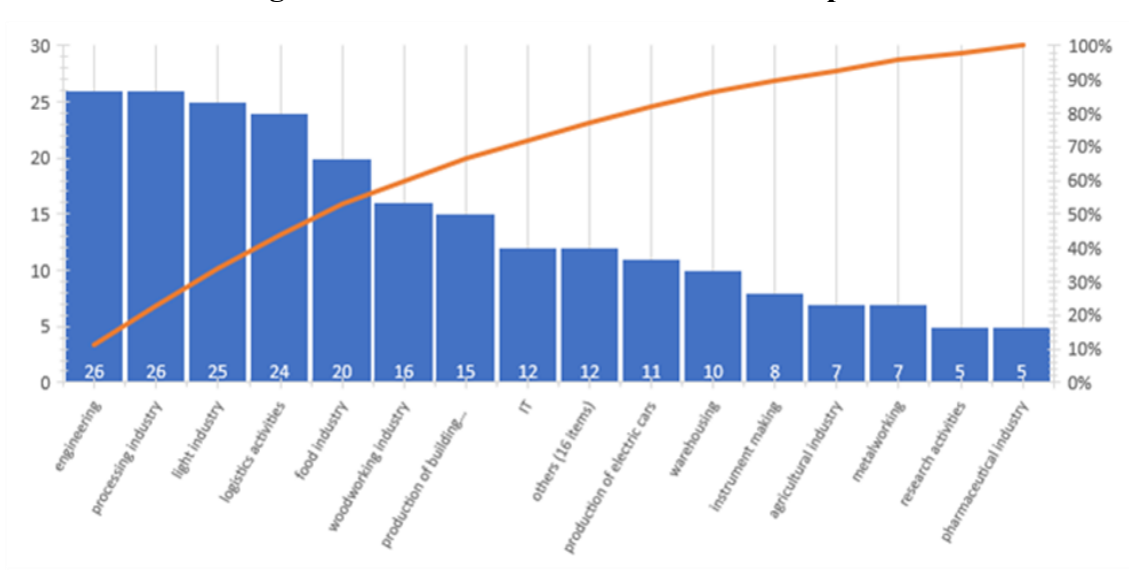
There are 1,200 industrial parks in South Korea. They provide 80% of national exports, 70% of industrial production and 50% of employment in the industry (Park *et al.*, 2008).

In Turkey, 346 industrial parks have been established in the last 30 years, and more than 80% of foreign direct investment is concentrated in them. The *development of Smart Eco-Industrial Parks is an emerging concept that is being spread in Turkey as a sustainable development model* (Dolgen and Alpaslan, 2020). There are more than 50,000 resident companies in Turkey's industrial parks. According to expert estimates, they created more than 1 million jobs and provided GDP growth and exports more than 3 times for the last few years. As a result, in 2013, Turkey, which had been a debt to the IMF for decades, returned the last tranche to the organization, fully repaying its debt.

Poland also has 77 industrial and technology parks in 14 special economic zones. Almost all of them were founded in the second half of the 1990s (KPMG, 2009). Over the next 10 years, the country's real GDP grew by 50%, and exports almost tripled. The total number of jobs created in the SEZ reached 186 thousand. At the same time, more than 20 billion euros were invested in parks.

According to the European Observatory for Clusters and Industrial Change (World Bank, 2021a) on cluster support in 29 European countries, which includes an in-depth analysis of 30 national and 55 regional programs, tailor-made cluster support policies and strategies are widespread worldwide.

Figure 1. Branch distribution of industrial parks

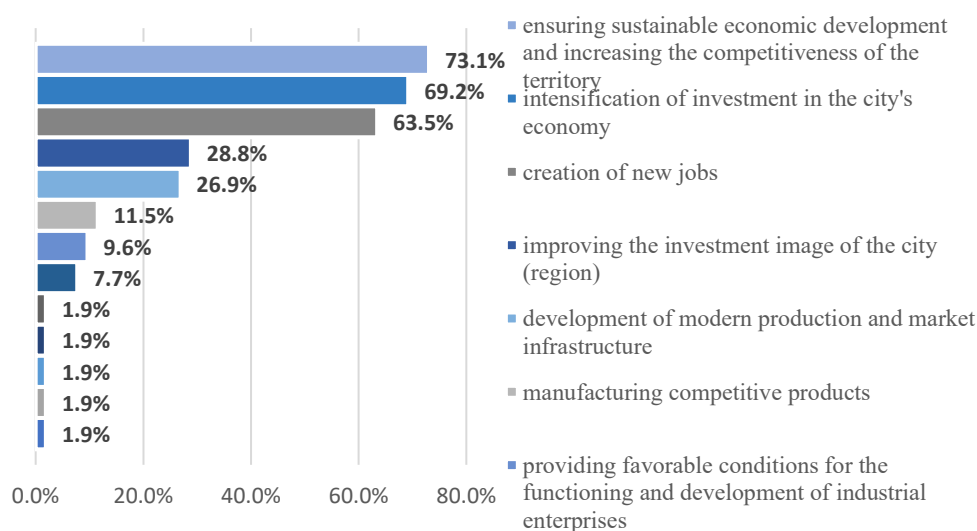


Source: compiled by the authors according to the data of the Ministry of Economics of Ukraine, 2023

Despite the economic feasibility of clustering the economy, clusters have not yet become widespread in many countries, in contrast to highly developed countries. As of April 2023, there are 61 industrial parks in Ukraine (Ministry of Economics of Ukraine, 2023), and up to 10 in Kazakhstan, but there is not a single industrial park or cluster that would be, in total, functioning to some extent the way that such leading clusters work. In 2012, Ukraine adopted the law "On Industrial Parks", and in September 2021, it adopted amendments to it. Their predominant activities are engineering, processing, and light (Figure 1). Statistical and analytical research showed that Ukrainian industrial parks do not ensure the region's sustainable development.

However, ensuring sustainable economic growth and increasing the territory's competitiveness was one of the goals of creating more than 70% of industrial clusters (Figure 2).

Figure 2. The goals of creating industrial parks



Source: compiled by the authors according to the data of the Ministry of Economics of Ukraine, 2023

However, only four high-quality infrastructure facilities with residents with operating plants are fully operational:

- Bila Tserkva Industrial Park (Kyiv region);
- Vinnytsia Industrial Park (Vinnytsia region);
- Solomonovo Industrial Park (Zakarpattia region);
- Korosten Industrial Park (Zhytomyr Region).

There are many reasons explaining the low operational rate, but the main one is the lack of total funding. According to the Ministry of Economics (2023), from 2016 to 2019, the State Fund for

Regional Development financed only four projects related to creating an infrastructure of industrial parks, for a total of 7.2 million UAH (210 thousand EUR).

In geographical terms, most of Ukraine's border industrial parks are located in the Lviv region, which borders Poland, whose economic structure is similar to Ukraine's. At the same time, the experience of development and efficiency of Polish industrial parks is much higher than in Ukraine.

3.2. Legislation, Policies, and Operational Challenges

Unlike Ukrainian legislation, no single law in Poland regulates industrial parks' activities. For the first time at the legislative level, support for the development of industrial parks was included in the program of the Council of Ministers of July 11, 2000, "On strengthening the innovative economy in Poland until 2006." However, this was preceded by the Law of May 12 2000, "On Principles of Support for Regional Development" (Internetowy System Aktów Prawnych, 2000), which provides local governments with the opportunity to develop an active spatial development policy (strategic planning and financial support at the local level, etc.), which promotes investment in their territory. The law outlines the basic principles and forms of support for regional development and defines the interaction mechanisms between executive bodies and local governments.

In particular, Art. 3 identifies the main priorities of regional development:

- development of each region, improving the quality and living conditions of residents and the level of satisfaction of the needs of territorial units;
- creating conditions for increasing the level of competitiveness of territorial units;
- reduction of asymmetry between regions.

To do this, local governments can create preferential conditions on the territory of a particular administrative unit. For example, reduce local taxes and rents, organize training for entrepreneurs, reimburse the cost of employment of the unemployed, facilitate entrepreneurs' access to technical infrastructure, and so on. One of the tools that local governments can use is the exemption from the real estate tax, which is subject to land tax, residential buildings or parts thereof, and buildings or parts thereof related to economic activities. They acquired this right by adopting the Law "On Taxes and Local Taxation" of January 12, 1991, which allowed local councils to set tax rates and establish certain benefits. The community council may, through a resolution, exempt entrepreneurs from paying real estate tax, using this as a form of state aid. Such assistance is equivalent to a tax benefit and must be provided following the conditions set out in Polish law (Polska Agencja Inwestycji i Handlu, 2018).

The Concept of the Regional Industrial Park (2002) once again emphasizes the possibility of local governments creating preferential conditions for enterprises. It outlines the role of the industrial park as a tool for strengthening regional development and creating quality conditions for entrepreneurship (Krawczyk, 2007). In addition, the placement of new investments within industrial or technology parks is one of the conditions for providing public financial support to enterprises, as stated in the said law № 1537 (Article 3). However, enterprises applying for public investment must meet at least two other criteria specified in Art. 2 item 1 of the law "On financial investment support" from 20.03.2002:

- investments will affect the economic development of the region;
- investments will be located in the support zone;
- investments focused on technological innovations;
- investments will promote the development of cooperation with the national research base;
- investments will affect the local labour market. At the same time, the company's share in investment costs should be at least 25%.

Later, the partnership agreement "Programming the Financial Perspective for 2014-2020" defined a strategy for attracting funds from the European Structural Funds under the three EU policies (cohesion, standard agricultural, and common fisheries policy). It focuses on the need to support small and medium-sized businesses to increase their competitiveness and innovation, as well as industrial and science parks to reorient, expand and better adapt to the needs of entrepreneurs in the services they provide. However, it is noted that to increase the efficiency of public spending; aid should cover those projects that would not have been implemented without public support or where state support would help increase or accelerate the project (European Funds Portal, 2014). The Strategy for Responsible Development until 2020 (with a perspective until 2030), adopted by the Council of Ministers on February 14, 2017, already emphasizes the development of innovations. To this end, support is provided to business environment institutions that increase the efficiency of the "innovators" service system and professionalize their services (Ministry of Funds and Regional Policy, 2022).

The Industrial Development Agency, established in 1991, also plays a vital role in supporting industrial and innovative activities. Its main goal is to keep the restructuring of Polish economic entities and their adaptation to the conditions of international competition. The Agency initiates the creation of technology incubators and industrial technology parks; provides access to high-quality services provided by business institutions, public online services and external sources of funding; contributes to the creation of a modern infrastructure for doing business, strengthening the links between the research sector and enterprises, as well as improving the efficiency of implementation

and commercialization of innovations. Another factor contributing to developing industrial parks and attracting significant investments in infrastructure is access to European funds.

Today in Poland, industrial parks are finding more effective tools for their activities, mainly through the Golden Triad (cooperation between government, business and research centres), operational programs 2014-2020 and 2021-2027, and international projects (Prawo.pl, 2016). International collaboration is necessary for developing industrial parks, which provides the exchange of knowledge in the effective management of parks and their operation, as well as helps attract foreign investors and find foreign partners.

3.3. Case Studies of Eco-Industrial Clusters

At the EU level supporting and encouraging the development of industrial parks is stated in the opinion of the European Socio-Economic Committee, “The role of technology parks in the industrial transformation of new member states” of 11.02.2006. provide a comprehensive structure and tools to promote, stimulate and develop innovation and regional development”. In addition, it is noted that in legal texts and terminology, such organizations are referred to differently in different EU member states. However, *the basic idea remains the same: to promote synergies between science, technology and economic development and to create synergies through cooperation between business and research institutions, thus facilitating market access* (Bashynska et al., 2021; 2022). *At the same time, the creation and development of industrial parks in EU member states should be based on compliance with environmental principles and standards* (European Investment Bank, 2018; United Nations Industrial Development Organization, 2019; The World Bank, 2021b).

Thus, the analysis showed that Poland is one of the European leaders in the effectiveness of industrial parks and can be the basis for the development of an industrial reference cluster. Still, compliance with environmental principles and standards is not fully implemented by law, in addition, to European and Ukrainian experience, parks will develop the concept of a smart eco-industrial cluster and management of participation of enterprises in it.

To understand the potential benefits and challenges of eco-industrial clusters in promoting sustainable development and post-war reconstruction, this article analyzes successful eco-industrial cluster case studies from around the world. The following case studies were selected based on their relevance to the Ukrainian context and their success in achieving sustainable development and post-war reconstruction goals.

Kalundborg Symbiosis (Denmark). The Kalundborg Symbiosis is a well-known eco-industrial cluster located in Denmark. The cluster involves a network of companies, utilities, and public organizations that exchange byproducts, waste heat, and energy to minimize waste and reduce the environmental impact of industrial processes. The symbiosis has resulted in significant environmental and economic benefits, including a 20% reduction in water consumption, a 30% reduction in CO₂ emissions, and a 50% reduction in sulfur dioxide emissions.

Industry Park of Sweden – Green Cluster. The Helsingborg Industrial Park (HIP) in Sweden is a network of 22 companies that collaborate to reduce waste and increase resource efficiency. The companies exchange waste products, heat, and electricity to optimize their operations and minimize environmental impacts. The HIP has resulted in significant environmental and economic benefits, including a 30% reduction in water consumption, a 50% reduction in energy consumption, and a 70% reduction in CO₂ emissions.

Kwinana Industrial Area (Western Australia). Kwinana Industrial Area is an industrial park located in Western Australia, where companies collaborate to create a sustainable industrial ecosystem. The park is home to over 200 companies, including petrochemical, chemical, and manufacturing companies. The Kwinana Industrial Area has achieved significant environmental benefits, such as reduced greenhouse gas emissions and water consumption, and economic benefits, such as cost savings and increased competitiveness. For example, the park has reduced its greenhouse gas emissions by 60% since 2005, and companies have saved over \$100 million per year through collaborative resource use. The Kwinana Industrial Area has been successful due to strong collaboration between the companies, a supportive regulatory framework, and a long-term vision for sustainable development. The park has also benefited from the involvement of research institutions, which have provided technical support and facilitated innovation.

Masdar City (United Arab Emirates). There are also negative examples of greening and the creation of new clusters. Masdar City is a planned eco-city located in the United Arab Emirates, which aims to be a carbon-neutral and zero-waste city. The city is designed to incorporate sustainable technologies, such as renewable energy, green buildings, and sustainable transportation. Masdar City has achieved significant environmental benefits, such as reduced greenhouse gas emissions and water consumption, and economic benefits, such as job creation and increased competitiveness. For example, the city has reduced its greenhouse gas emissions by 50%, and the city's industries have created over 3,000 jobs. Masdar City has been successful due to a strong vision for sustainable development, a supportive regulatory framework, and a long-term commitment to innovation. The city has also benefited from the involvement of research institutions, which have provided technical support and facilitated innovation. The global economic crisis in 2008 significantly impacted the

progress of Masdar City's ambitious projects, resulting in many of them either stalling or failing to meet expectations. As of 2020, the city only has a small cluster of low-carbon buildings housing 1,300 residents, which is far below the planned initial 50,000 residents. Additionally, approximately 4,000 people now commute into the city for work.

The above case studies demonstrate that eco-industrial clusters can bring significant environmental and economic benefits, including resource efficiency, waste reduction, and greenhouse gas emissions reduction. These benefits can help to promote sustainable development and post-war reconstruction by creating green jobs, reducing environmental pollution, and improving the quality of life for communities. However, the success of eco-industrial clusters depends on several factors, including supportive policies, effective collaboration among stakeholders, and adequate financing.

3. Results and Discussion

The case studies of successful eco-industrial clusters worldwide provide valuable insights for promoting sustainable development and post-war reconstruction in Ukraine. By adopting the key strategies and lessons learned from these case studies, Ukraine can develop an effective eco-industrial cluster that fosters sustainable economic growth, environmental protection, and social development.

The success of eco-industrial clusters can be attributed to several key factors.

Firstly, strong collaboration between companies is critical for promoting resource efficiency, reducing waste, and creating a circular economy.

Secondly, a supportive regulatory framework that incentivizes companies to adopt sustainable practices and provides funding and technical assistance is necessary for driving innovation and reducing environmental impact.

Thirdly, a long-term vision for sustainable development that prioritizes economic, social, and environmental objectives is crucial for promoting stakeholder engagement and ensuring the viability and resilience of the eco-industrial cluster.

In the context of Ukraine's post-war reconstruction, an eco-industrial cluster offers an opportunity to build back better by creating new jobs, promoting sustainable economic growth, and enhancing environmental protection. Ukraine's vast natural resources, including agricultural land, forests, and minerals, provide a solid foundation for developing sustainable industries such as renewable energy, green building materials, and sustainable agriculture. Moreover, Ukraine's strategic location and access to European and Asian markets make it an attractive destination for investment and trade.

In Ukraine, there is a need for post-war reconstruction and sustainable development, particularly in the eastern regions affected by the conflict. An eco-industrial cluster can be a valuable tool in achieving these goals by promoting sustainable industrial development, creating job opportunities, and reducing environmental impact.

To create an eco-industrial cluster in Ukraine is vital to identify the industries and companies that can benefit from collaboration and resource sharing. The cluster should be developed in a way that aligns with Ukraine's long-term vision for sustainable development and considers the country's specific challenges, such as limited financial resources.

In addition to strong collaboration between companies, a supportive regulatory framework is crucial for the success of an eco-industrial cluster in Ukraine. The government can play a key role in creating policies and incentives encouraging companies to participate in the cluster and promote sustainable industrial practices.

The involvement of research institutions is also critical for the success of an eco-industrial cluster in Ukraine. These institutions can provide technical support, facilitate innovation, and promote knowledge exchange and best practices.

To develop an effective eco-industrial cluster, Ukraine must address several key challenges. These include enhancing institutional capacity and governance, promoting private sector participation, and mobilizing financial resources from international donors and investors. Additionally, Ukraine must prioritize stakeholder engagement and public awareness to ensure that the eco-industrial cluster is aligned with local communities' and stakeholders' needs and priorities.

Overall, the success of eco-industrial clusters in promoting sustainable development and post-war reconstruction in other countries provides valuable lessons for Ukraine. By adopting a collaborative, innovative, and sustainable approach to economic growth, Ukraine can build a more resilient, inclusive, and prosperous future for its people.

The development of an eco-industrial cluster in Ukraine could have a significant impact on the country's post-war reconstruction and sustainable development efforts. The cluster could facilitate collaboration between businesses and organizations in the industrial sector, leading to the development of innovative solutions for sustainable development challenges. The cluster could also help to attract investment and support economic growth in the country.

The analysis of successful eco-industrial cluster case studies and the specific context of Ukraine suggest that an eco-industrial cluster can be a valuable tool in promoting sustainable development and post-war reconstruction. To achieve success, the cluster should be developed with strong collaboration between companies, a supportive regulatory framework, and the involvement of research institutions.

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