

The Role of Higher Education Institutions in the Development of Eco-Industrial Parks in Terms of Sustainable Development

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Summary

The article examines the role of higher education institutions in the development of eco-industrial parks in terms of sustainable development. It is substantiated that the concept of sustainable development sets conditions for the development of infrastructure of eco-industrial parks, which should be built using environmental materials, optimization of water supply and energy supply, environmental safety of industrial effluents and waste, the formation of a closed cycle of resource use in accordance with the circular economy. It is determined that in order to develop an effective national policy for the development of eco-industrial parks, it is necessary to use such tools as: management of national policy towards the creation of eco-industrial parks, mandatory requirements for regulation of eco-industrial parks, local levels and information tools. Universities play a particularly important role in these processes. It is proved that the information tools that can be implemented in the educational activities of higher education institutions on the example of universities include: inclusion in the variable part of educational programs within the formation of individual educational trajectory of students; conducting advanced training courses for employees of various enterprises and industries, stakeholders on the functioning and creation of eco-industrial parks; providing consulting services to companies involved in park management; scientific and innovative work in the direction of development of technologies and processes of activity of eco-industrial parks.

Key words:

Eco-industrial parks, sustainable development, circular economy, higher education institutions, industrial enterprises.

1. Introduction

The new global challenges of the COVID-19 pandemic have revolutionized many sustainable development processes. In 2020, more than half of the world's high-tech companies in the European Union experienced problems and delays in supply due to disruption of its chain. This has led to diversification of the supply of necessary resources and changes in their chains.

Many companies have revised the regional aspects of suppliers towards abandoning Chinese partners. This, in turn, becomes a powerful impetus for participation in new supply chains for Ukraine. It is through the development of eco-industrial parks that Ukraine can compete for the placement on the territory of the state of production facilities of large foreign companies that are reviewing opportunities and diversifying their risks in the supply of resources. According to the paradigm of sustainable development, the general concept of industrial development is to ensure the production of competitive products on the world market using innovative and "green" technologies. This and other issues raise the issue of building eco-industrial parks.

The aim of the article is to study the role of higher education institutions in the development of eco-industrial parks in terms of sustainable development. To achieve this goal, the following tasks were identified and solved:

- the concept of sustainable development for the development of eco-industrial parks is clarified;
- features of eco-industrial parks are determined;
- the features of universities as drivers of higher education institutions are singled out;
- directions of development of effective national policy on development of eco-industrial parks;
- the role of involving universities in the global development of knowledge in the direction of the functioning of eco-industrial parks is substantiated;
- directions of measures for the formation of awareness and knowledge about the importance of development and functioning of eco-industrial parks.

The basis of the research methodology is a systematic approach to substantiate the role of higher education institutions in the development of eco-industrial parks in terms of sustainable development.

2. Literature review

Many scientific studies of domestic and foreign scientists are devoted to the study of important aspects of

sustainable development of regions, intensification of their innovative activity, development of eco-industrial parks and the role of higher education institutions in these processes, including: Abraham E.J., Ramadan F., Al-Mohannadi D.M. (2021) [1]; Arefieva O. (2021) [2]; Bazhenkov I., Shaposhnykova I., Sheremet O. (2021) [3]; Chin, H.H. Varbanov P.S. (2021) [4]; Cruz-Avilés D.J., Munguía-López A. del C. (2021) [5]; Dergaliuk M., Pakhota N. (2021) [6]; Dubyna M. V. (2017) [7]; Foong S.Z.Y., Ng D.K.S. (2021) [8]; Fouladi J., AlNouss A., Al-Ansari T. (2021) [9]; Gonta I. (2016) [10]; Grosu V., Safonov Yu. (2021) [11]; Hu Q., Huang H., Kung C.-C. (2021) [12]; Hu W., Tian J., Chen L. (2021) [13]; Jia X., Sh L., Yang Y. (2021) [14]; Khanin S. (2021) [15]; Kholiavko N., Djakona A. (2020) [16]; Nuhu S.K., Manan Z.A. (2021) [17]; Pohrebniak A., Kravchyk Yu. (2021) [18]; Popelo O., Tulchynckiy R. (2021) [19]; Samiilenko H., Khudolei V. (2021) [20]; Shkarlet S., Zhuk O. (2019) [21]; Song L., Zhou X. (2021) [22]; Teh K.C., Lim S.C. (2021) [23]; Tseng M.-L., Negash Y.T. (2021) [24]; Uusikartano J., Väyrynen H. (2021) [25]; Vu T.T., Phan T.S.T., Phan K.D. (2021) [26]; Yuan Z., He B., Wu X. (2021) [27]; Zeng D.Z., Cheng L. (2021) [28]; Zhang S., Wang H., Bi X., Clift R. (2021) [29]; Zhavoronok A., Morozova L. (2021) [30] and others.

The aim of the study [4] is to create an eco-industrial park to design water symbiosis networks on an industrial site, which will be aimed at solving the problem of water quality and safety by minimizing the consumption of fresh water or pollutants. The proposed structure demonstrates the potential benefits and guidelines for each industrial enterprise, as well as the government, to develop possible cooperation policies to achieve the goal of reducing emissions into the environment, and can be used to analyze such a symbiosis.

The scientists' article [29] evaluates the biogas-centric agricultural eco-industrial park in British Columbia. The authors investigate the potential benefits of applying the industrial symbiosis approach in agriculture and horticulture. Scientists have presented a detailed case study of a potential Eco-Industrial Park, which includes three activities: dairy farming, greenhouse vegetable growing and mushroom growing.

Researchers argue [5] that eco-industrial parks have recently become an interesting alternative for reducing and optimizing water consumption through reuse and recycling networks. The authors propose a new approach to the optimal design of water supply networks in eco-industrial parks, which for the first time considers fair distribution schemes between different involved users.

The authors' research [24] will help to create valid sets of attributes for the transition to hierarchical eco-industrial parks with quality information, as previous research has not explored the attributes of the transition to eco-industrial parks in Hungary. The assessment involves the analysis of the principles of industrial symbiosis using

language preferences. The results of the researchers' research show that the policy and regulatory framework promote the cooperation of firms in the model of transition to an eco-industrial park.

The authors of the article [17] proved the need to use technology for on-site research of spatial and non-spatial factors of industrial parks, especially the new ecological-industrial park. The aim of the article is to assess the global application, capabilities and acceptability of geographic information system tools and multi-criteria decision-making tools in the selection and planning of sites of eco-industrial parks.

The authors [1] argue that the circular economy is used to minimize the consumption of fresh resources and maximize reuse of materials. The potential of the study is demonstrated by the example of a specific case, which shows that an eco-industrial park can be profitable, subject to strict limits on emissions and materials.

The study [22] proves that the regional environmental industrial policy, the construction of national eco-industrial parks is of great importance for the implementation of industrial green transformation. The authors have shown that the creation of a national eco-industrial park has significantly reduced industrial emissions of sulfur dioxide, and the effect of reducing emissions has the effect of lagging and long-term impact.

Despite the large amount of research on the functioning of eco-industrial parks, the role of higher education institutions in these processes requires further study and analysis.

3. Results

Eco-industrial parks differ from industrial ones by a clear model of increasing resource efficiency and improving not only economic but also environmental and social performance of their participants, which ensures the achievement of sustainable development goals. Industrial development aimed at environmental friendliness and high efficiency of resource use corresponds not only to the concept of sustainable development, but also to the paradigm of the circular economy.

Taking into account the vector of sustainable development of European countries, the policy of strategic development of EU industry in the direction of achieving leading positions in world industry and ensuring competitive advantages in "green" technologies and innovations has been updated. This actualizes the direction of industrial development in the vector of development of eco-industrial parks.

The use of production capacity of former large industrial enterprises, their revitalization with the use of production and human resources and direction in accordance with the goals of sustainable development in

environmentally friendly and resource-efficient use is possible through the development of eco-industrial parks.

The concept of sustainable development sets conditions for the development of infrastructure of eco-industrial parks, which should be built using environmentally friendly materials, optimization of water supply and energy supply using renewable energy sources, environmental safety of industrial effluents and waste, formation of closed cycle resources and waste management, active communication with the community and provision of social services.

To develop an effective national policy for the development of eco-industrial parks in Ukraine, it is necessary to use tools such as: firstly, the management of national policy towards the creation of eco-industrial parks, this task is entrusted to institutions with certain responsibilities and functions to ensure necessary

regulatory reforms and further support for their implementation.

Secondly, there are mandatory requirements for the regulation of eco-industrial parks, which provides for the development of regulations relating to national planning, requirements for the functioning of parks, environmental responsibility, monitoring, control and enforcement.

Thirdly, economic instruments that provide for the development and implementation of incentive and support for eco-industrial parks at the national and local levels.

Fourthly, information tools, ie raising public awareness of the benefits of clean production, relevant environmental aspects such as environmental or harmful behavior, the effects of pollution and the benefits of conservation, to attract investment in clean technologies, etc. (Fig. 1).

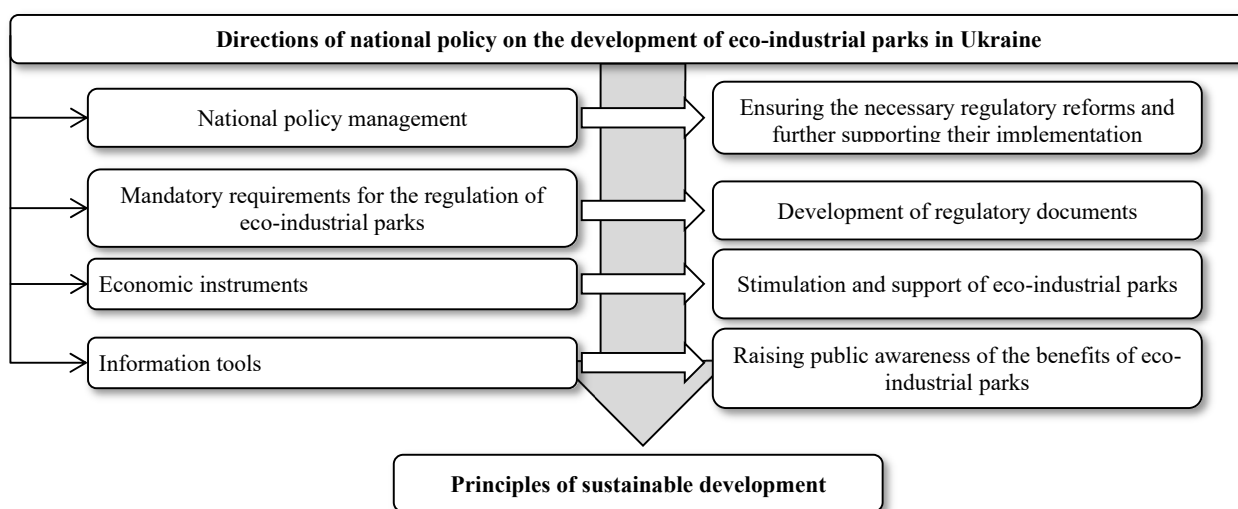


Fig. 1 Directions of national policy on the development of eco-industrial parks in Ukraine.
(Source: developed by the authors.)

Eco-industrial parks around the world are developing under the influence of global knowledge development, this and other things focus on the involvement of higher education institutions in this process. Higher education institutions in the system of global knowledge development are able to provide not only specific specialists with certain competencies who can act directly as employees of eco-industrial parks, but also to form awareness and knowledge of the population about the need to build eco-industrial parks and their advantages over industrial parks. And also to direct efforts on dissemination of knowledge on the international experience of functioning of eco-industrial parks, to carry out research and innovation activity in the direction of possibility of use by eco-industrial parks of new innovative projects.

The development of eco-industrial parks has many positive features not only for the members of such associations, but also for the regions, as they increase tax revenues of local budgets, increase social protection due to rising incomes and employment, and so on.

Improving the efficiency of industrial and eco-industrial parks involves intensifying research and innovation activities, including in higher education institutions, and especially in universities. Universities can analyze and evaluate the innovation and environmental potential of parks, develop and implement mechanisms and procedures to support and promote their activities, taking into account the specific regional characteristics of their operation and market needs. The formation of knowledge in higher education about eco-industrial parks in the future will increase the innovation culture and

increase the competence and awareness of future employees in production, finance, entrepreneurship and other areas, promote the commercialization of innovative ideas and the introduction of environmentally friendly business.

Today, higher education institutions are not only institutions that provide only specialized educational services, but are active participants in the global development of knowledge and centers of research. Universities play a particularly important role in these processes. Universities differ from other institutions of higher education in that universities (Fig. 2):

- a larger number and high level of representation of applicants for higher education who receive a second master's degree, educational and scientific level of PhD and doctoral degree;
- high degree of involvement of faculties, departments and scientific and pedagogical staff in research activities, international projects and grants;
- high level of employment and training of graduates;
- close interconnection of educational and research activities in all parts of the educational process;
- established close relations with external contractors, namely regional and local authorities, business, stakeholders;
- active international research, international mobility of teachers and students of higher education, integration with the global scientific community;
- high degree of influence of the university on the level of development of regional and national economy;
- ensure the integration of education, science and industry.

These and other features of universities make it possible to note that the introduction of elective disciplines in the educational process for eco-industrial parks will form the knowledge and experience of higher education students in terms of their priority, importance, functional focus, features of activities and more.

Involvement of higher education institutions in the process of global knowledge development does not contradict institutional norms, as the Law of Ukraine "On Higher Education" provides for the formation of an individual educational trajectory of students, according to which elective courses should not be less than 25% of total ECTS credits, the total volume of the educational program. Thus, the introduction of elective courses, which will be aimed at the implementation of international experience and the need for students to understand the functioning of eco-industrial parks in universities, at the educational level will contribute to the formation of knowledge and experience.

After studying the course, students will gain an understanding of the integration of cost-effective, energy efficient and "green" technologies, closed cycle production and recycling in accordance with the paradigm of circular

economy, management processes to ensure competitive advantage and the ability to use this experience in any industry and other industries processes.

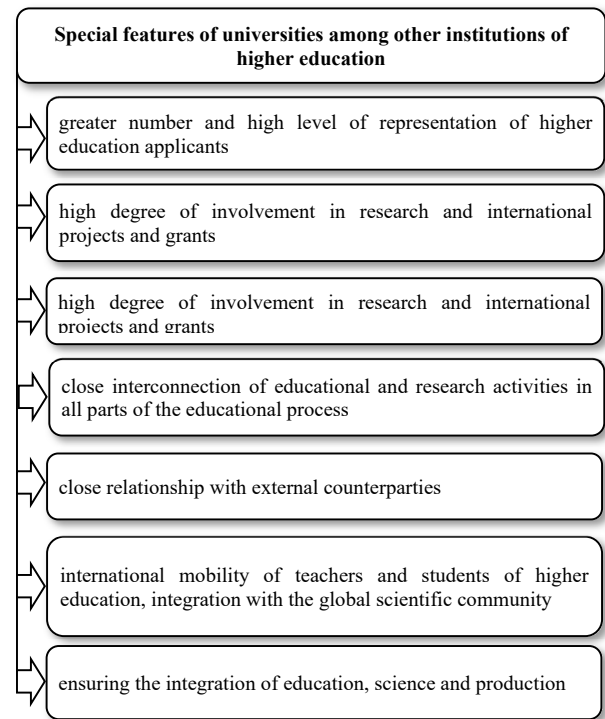


Fig. 2 Special features of universities among other institutions of higher education. (Source: developed by the authors.)

Applicants for higher education in universities will understand the importance of the interaction between the processes of resource and energy efficiency, as well as socially relevant practices. The knowledge gained in the study of disciplines "Eco-industrial parks" will help to ensure economic benefits and competitive advantages of enterprises in the future, as well as increase their competitiveness. International best practice demonstrates that cleaner production and implementation of energy efficiency measures with low capital costs, minimal disruptions and favorable payback periods can provide important economic benefits. The development of eco-industrial parks will also offer important job creation opportunities, added industrial value and links with local businesses.

Among the areas of developing an effective national policy for the development of eco-industrial parks, it was determined that information tools can be implemented in the educational activities of higher education institutions on the example of universities. This will raise awareness of the benefits of clean production, relevant environmental aspects such as environmental or harmful behavior, the

effects of pollution and the benefits of conservation, and attracting investment in clean technologies.

Educational activities can be carried out on the basis of higher education institutions, in another aspect - it is training courses for employees of various enterprises and industries, stakeholders on the functioning and creation of eco-industrial parks in Ukraine (Fig. 3).

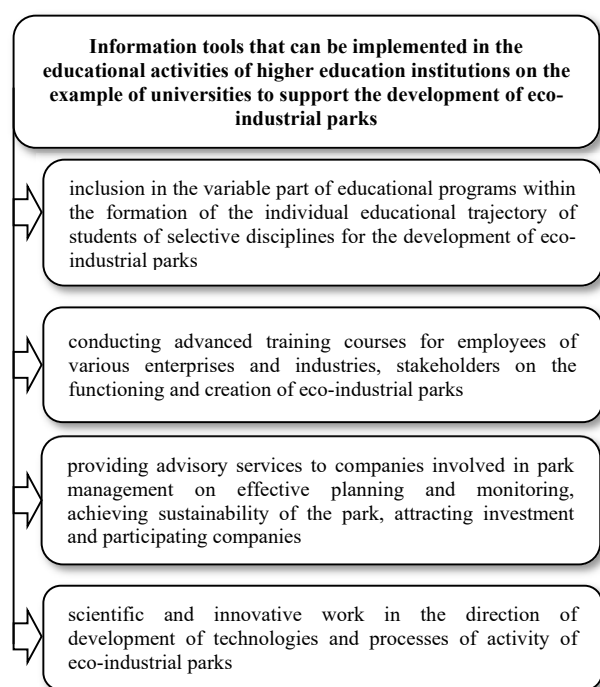


Fig. 2 Information tools that can be implemented in the educational activities of higher education institutions on the example of universities to support the development of eco-industrial parks. (Source: developed by the authors.)

In such courses, applicants will have the opportunity to learn about the international experience, viability and benefits of eco-industrial park approaches in increasing resource productivity and improving economic, environmental and social business performance, influencing all stakeholder groups in strengthening their capacity and ability to implement and maintain environmental policies. parks in the long run without external support.

Higher education institutions, namely universities, can also provide advisory services to park management companies on effective planning and monitoring, achieving sustainability of the park, attracting investment and participating companies.

Also, an important aspect of the role of higher education institutions, and especially universities in the development of eco-industrial parks is scientific and innovative work in the direction of development of technologies and processes of eco-industrial parks. This

ensures the efficient and rational use of existing scientific potential, material and technical base for the commercialization of research results and their implementation in the activities of eco-industrial parks. Such activities provide synergy of interaction of all participants of educational, scientific and innovative activities. Contributes to the creation of an eco-environment in accordance with the goals of sustainable development for the comfortable activities of all stakeholders involved in science, business and entrepreneurship.

3. Conclusions

Thus, today there is a lack of experience and awareness of national and local authorities, representatives of enterprises, industries and businesses on the benefits of industrial production in accordance with the principles of eco-industrial parks, and lack of motivation and experience of enterprises for continuous improvement towards the transition to eco-industrial parks.

At the national level, there is a lack of targeted information support related to the initiation, creation of industrial and eco-industrial parks, algorithm of actions, incentives, location planning. Such information is branched out in a number of legislative acts, in decisions of local authorities, construction and other norms. There is a lack of knowledge at the national and local levels on tools to attract funding for the development of industrial and eco-industrial parks, finding investors. There is a lack of information for investors about potential investment objects within industrial and eco-industrial parks. This is due, in particular, to the lack of resources for such activities, as well as the low level of self-regulation in this area (due to the low interest of industrial parks in the interaction and joint representation of their interests). Therefore, knowledge gained in higher education institutions is very important, raising awareness of educators about eco-industrial parks, industrial symbiosis, attracting participants to eco-industrial parks, attracting investment, will improve environmental, economic and social indicators in Ukraine.

It is proved that the information tools that can be implemented in the educational activities of higher education institutions on the example of universities include:

- firstly, the introduction into the variable part of educational programs within the formation of the individual educational trajectory of students of selective disciplines for the development of eco-industrial parks;

- secondly, conducting advanced training courses for employees of various enterprises and industries, stakeholders on the functioning and creation of eco-industrial parks;

- thirdly, the provision of advisory services to companies involved in park management on effective

planning and monitoring, achieving sustainability of the park, attracting investment and participating companies;

- fourthly, scientific and innovative work in the direction of development of technologies and processes of eco-industrial parks.

Further research is required to develop programs to enhance the development of eco-industrial parks in terms of sustainable development and the paradigm of the circular economy.

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