

*Nemes Zsófia*²⁶

Eco-industrial parks: global standardization and institutionalization of the concept

The present paper aims to give an overview of the role of international organizations in the development of eco-industrial parks (EIP) worldwide. The study introduces the term of EIP and explains why and how an international framework and an institutionalized background could contribute to the harmonization of the currently present diverse logic and thinking behind the concept. The author reviewed the publications of the selected international organizations which are actively seeking ways to improve the existing eco-industrial parks, as well as trying to spread the practice globally.

Keywords: eco-industrial parks, UNIDO, international framework, GEIPP

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Introduction

The term 'eco-industrial' park has been known roughly since the 1990s. This term refers to a facility that is created and operates based on novel, innovative environmental solutions and concepts, thereby contributing to the renewal of traditional industrial sectors, and with sustainability in mind, is able to create high added value in both the economic and social dimensions. In case of the eco-industrial parks, choosing a location is a complex process: in addition to the obvious consideration of good accessibility and transport infrastructure, aspects such as environmental and resource management or the protection of ecosystems also appear. Based on all of this, it can be stated that the concept of eco-industrial parks can essentially be interpreted as part of sustainable spatial planning (or as a response to it), and that it carries the most important objectives of the circular economic model in all its elements. The paper is going to review the main dynamics of the recent years' EIP development, with a special focus on the international framework and standards created by UNIDO (United Nations Industrial Development Organization) and its partners, the World Bank and GIZ (the German International Development Agency). The author aims to present what is the role of these actors in developing, institutionalizing, standardizing and mainstreaming eco-industrial parks globally, in which form they have contributed to a more sophisticated and solid theoretical and practical foundation of EIP development.

Theoretical background of EIPs

Organizing industrial activities and industrial parks can be considered as a spatial planning intervention. Following circular models has become a current ambition of planning (Németh et al. 2023), however, integrating sustainability into spatial planning and development activities has a longer tradition. Sustainability considerations have got into the focus of spatial planning and territorial development at European (Sütő et al. 2010; Péti 2011) and also global level (e.g. Benedek 2021) in the last decades. The same can be experienced in the case of urban development (New Leipzig Charter 2020; Salamin 2022), with special emphasis on new ideas of smart and climate friendly cities which are becoming leading issues in urban development worldwide (Salamin 2021).

²⁶ Assistant lecturer, PhD candidate, Corvinus University of Budapest, Institute of Sustainable Development

In the new, EU dominated approaches of local urban and territorial development strategies, the themes of sustainability significantly increased during the last two decades (Salamin 2018), while the application of eco-oriented solutions enhance the attractiveness of localities especially for skilled and young individuals (Varga et al 2020). Not only direct planning and development interventions but also social innovation potential of a region (Kocziszky et al. 2015) can be the drivers of applying sustainability-oriented organizing and management solutions in industrial parks.

Industrial parks can serve as key platforms for planning and managing industrial activities in a territorial way or in a regional dimension. Therefore, industrial parks can have a crucial role in achieving territorial sustainability. Territorial sustainability-related development intentions try to keep the flows of materials, energy, income and knowledge inside of a region as long as it is possible (Péti 2012).

Another theoretical approach of the development of eco-industrial parks can be found in the science and literature of industrial ecology: the efforts to exchange raw materials and resources between companies, increase efficiency, and minimize waste emissions create forms of organizations that the literature describes as industrial symbiosis (Gertler 1995; Ayres – Ayres 2002; Allenby – Graedel 1993; Ehrenfeld 2004). At the same time, the transition between theory and practice is rather difficult, and researchers dealing with industrial ecology and symbiosis are often criticized for the fact that their work is almost exclusively descriptive, about hypothetical models and material flows, but does not provide enough concrete proposals and practical ideas for traditional industries, how to make their linear approach and production models more sustainable, to promote transformation (Gibbs – Deutz 2007). It is important to state that two companies that cooperate in some way are not enough to realize industrial symbiosis, e.g. in the exchange and reuse of waste or by-products, but according to the definition used by Chertow (2000), this requires at least three different actors and the sharing and exchange of at least two different types of resources. Roberts (2004) talks about the clustering of companies with similar waste and material flows, which can contribute, e.g. for the spatial concentration of waste management, to achieve synergistic effects, and to create individual and collective business benefits. This is the guiding principle behind the creation of eco-industrial parks, where economic, environmental and social benefits can arise from the collaboration of participating actors.

The idea that industrial production can only function sustainably if the sector tries to realize the cyclicity and optimized flow of materials known from nature and organic systems (ecosystems) is of course not new, but at the same time it only received great international attention after the UN summit in Johannesburg in 1992, both among politicians and business actors. The science of industrial ecology began to develop by leaps and bounds from the 90s, and set itself the goal of reinterpreting the operation of industrial infrastructures and facilities in a sustainable, circular system (Caroli et al. 2015).

The practical areas of the principles of industrial ecology are the so-called eco-industrial parks. These facilities create a higher added value for the stakeholders and provide more economic, environmental and social benefits than if they were to perform their activities independently (Lowe – Evans 1995). Compared to traditional industrial parks, eco-industrial parks have collective advantages from which, in addition to the businesses operating there, many other actors can benefit, e.g. other partners, institutions and companies involved at the regional level, which contribute to the maintenance of the ecosystem (Bellantuono et al. 2017; Barrera Saavedra et al. 2017). Figure 1 summarizes the major characteristics of eco-industrial parks in terms of environmental impacts, however, it is important to highlight the socio-economic interdependencies of the below mentioned specifics as well, as each of them are related to a various set of social and economic aspects and potential benefits too.

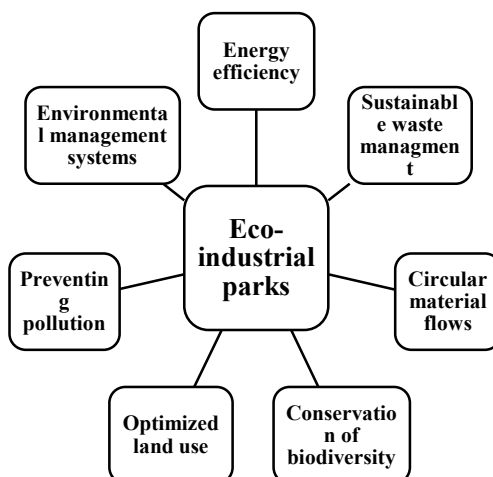


Figure 1: The main characteristics of eco-industrial parks, source: the author's own work based on Massard et al. (2014) and Conticelli & Tondelli (2014)

Evaluation of the practice of eco-industrial parks based on the international EIP framework

Analytical evaluation of the development of eco-industrial parks through green- or brownfield investments, as well as of international good practices and experiences, is at least as much the task of practical experts, policy-making bodies and institutions as it is of representatives of theoretical science. Whether we look at the countries of the developed or the developing world, with very few exceptions, we can everywhere find research, reports, documents prepared by government institutions and international organizations that analyze the connections between the circular economy and the sustainable development of industry, formulate goals, plans, and a vision for the future. The UN is no exception among international organizations which have been intensively dealing with the issue for years. UNIDO (United Nations Industrial Development Organization) is a specialized organization of the UN that supports sustainable, inclusive industrial development worldwide, in accordance with the Sustainable Development Goals (SDGs) of the UN. UNIDO's activities can be aligned with each of the 17 sustainable development goals, but the most direct connection is with goal number 9, which is about the creation of adaptive and sustainable industry, innovation and infrastructure (United Nations Information Service n.d.). UNIDO supports the complex sustainability reform of the industrial sectors of emerging countries with both financial and non-financial resources, with particular regard to the application of the principle of circularity and the CE²⁷-compliant development of industrial parks and similar facilities (unido.org; n.d.)

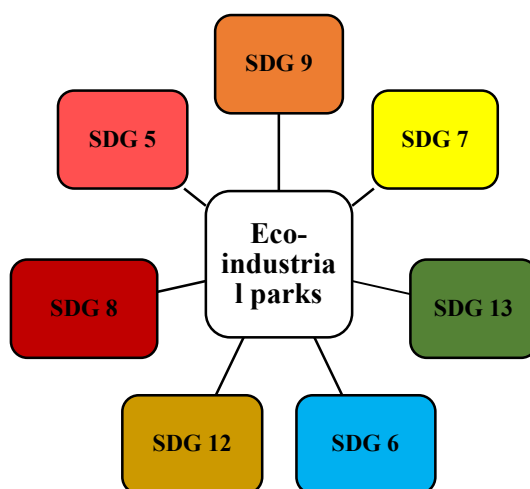
On behalf of the UN, UNIDO (United Nations Development Organization), carried out an international comparative research in 2020, involving about 50 industrial parks from 8 different developing countries (Colombia, Egypt, Indonesia, Nigeria, Peru, South Africa, Ukraine, Vietnam) (van Beers et al. 2020). The organization supports eco-industrial park projects in many parts of the world, which are managed in an integrated manner and are seen as particularly important sites for cooperation networks between cities and industry, government actors, the civil and corporate spheres and local communities.

The theoretical and methodological basis of the empirical study was provided by the international framework developed by UNIDO, with the cooperation of the World Bank and GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit), the German International Development Agency. The first version of the document was published in 2017, followed by version 2.0 in 2021, reflecting the very significant international interest and demand for a single, coordinated EIP

²⁷ Circular economy

framework (World Bank 2021). The international framework responds to the environmental, economic and social sustainability challenges of the industrial activities of developing countries, and defines the planned development of eco-industrial parks as a normative goal, for which it intends to provide a practice-oriented reference base, especially considering that the countries named and examined in the document are also partners of all three organizations (UNIDO, WB, GIZ) in many significant international development projects. The publication emphasizes that the development of eco-industrial parks at international level can be clearly integrated into the context of the UN Sustainable Development Goals (SDGs) and the objectives of the Paris Climate Agreement. Figure 2 shows the connections between the Sustainable Development Goals and eco-industrial parks. Besides the obvious relevance of SDG 9 (Industry, Innovation and Infrastructure), the complex system of the value added created by eco-industrial parks can be related to affordable and clean energy (SDG 7), gender equality (SDG 5), decent work and economic growth (SDG 8), as well as climate action (SDG 13), responsible consumption (SDG 12) or clean water and sanitation (SDG 6).

Figure 2: Connections between EIPs and the UN SDGs; Source: the author's own work based on World Bank (2021)



The goal of the above-mentioned three international organizations was to create a common conceptual framework along which cooperation related to EIPs can be promoted and to develop the idea of a uniformly defined reference framework for all parties involved (national governments, civil organizations, companies, etc.), to be created based on international standards which did not exist before. In addition to uniform international conceptual frameworks, from a practical point of view, an indicator system is primarily needed that makes the individual EIP developments and initiatives comparable and creates the opportunity for a comprehensive performance evaluation (benchmarking) based on predetermined aspects, environmental, social and economic criteria. Among these conditions, compatibility with existing, internationally accepted legislation and standards appears with great emphasis, among them e.g. international agreements on environmental or social issues (see e.g.: international environmental protection conventions adopted by the UN and its specialized organizations, human, minority and labor law agreements) (Kechichian – Jeong 2016, UNIDO 2019).

The 2021 study published by UNIDO, the World Bank and GIZ defines four main pillars through which international EIP practices and specific case studies can be examined in a standardized performance evaluation framework. The four dimensions are park management, environmental, social and economic performance, and the indicators were defined grouped around them.

The purpose of the document and framework – which is of course not legally binding – is to

harmonize and coordinate the very diverse thinking, theoretical-methodological and policy-oriented considerations on eco-industrial park developments, start more effective cooperation projects than before, with the participation of all actors involved, in order to create circularity, energy-efficient industrial production and sustainability.

Van Beers and his co-authors (2020) reflected on the first, 2017 edition of the study jointly published by UNIDO, the World Bank and GIZ, and drew attention to the generally experienced performance gaps that characterize the EIP initiatives of all the countries examined, either from a management or environmental perspective. It is important to mention the strengthening of the business approach in case of those parks that are managed purely by the public sector (local or central government body), as well as the 'customized' development concept that takes the country-specific characteristics into account as much as possible. Another defining aspect is that, based on the framework and benchmarking system linked to UNIDO, the parks with the greatest development potential should be supported most significantly, namely in the area where the given facility is the most outstanding and provides performance that best meets the evaluation criteria. Figure 3 presents the general steps and concrete actions required in order to create an international EIP framework, from ensuring commitment to the operational level.

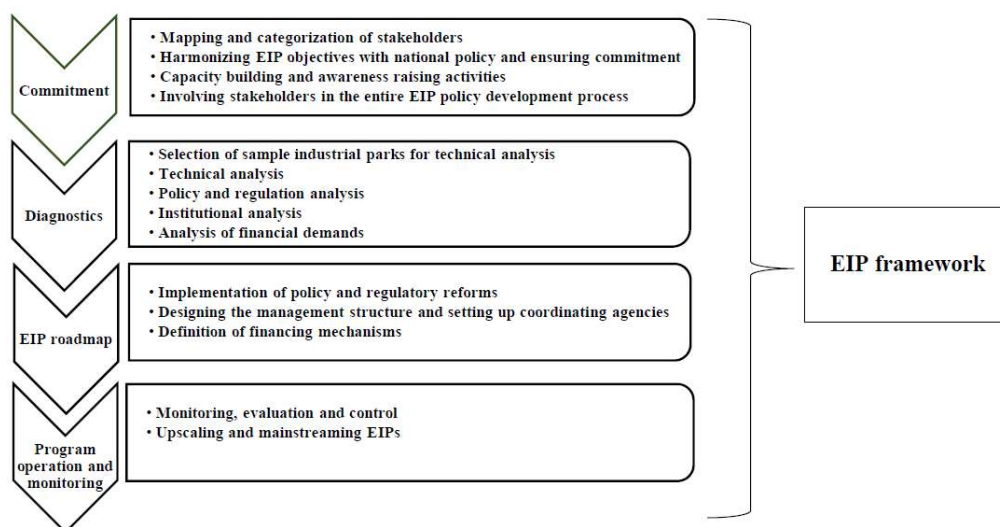


Figure 3: The steps of creating an international EIP framework; source: the author's own work based on UNIDO (2018) and Massard et al. (2014)

Upscaling and mainstreaming EIPs

Economic production and development based on the circular principle, comprehensive innovations affecting the industrial sector, and the inclusion of eco-industrial parks in the policy mainstream appear in local, regional and national level initiatives and projects, but at the same time they are also taking on an increasingly dominant role in thinking and acting at the global level. This process is well illustrated and supported by the GEIPP, or Global Eco-Industrial Parks Programme, which was launched in 2018 under the auspices of the United Nations Industrial Development Organization (UNIDO), specifically to make the economies and industrial sectors of developing countries more sustainable and competitive (UNIDO 2018).

The goal of the GEIPP, which was launched under the coordination and leadership of UNIDO, is dual: concrete development assistance appears with the same emphasis on projects supporting industrial sustainability in some developing economies, as does the development of knowledge on a global level, the promotion of the unification of conceptual frameworks and indicators, and an

international dialogue on eco-industrial parks. The project, planned for a period of 5 years, involves industrial parks, small and medium enterprises, as well as business and professional organizations in the partnership, and its geographical target areas are Colombia, Peru, Egypt, Indonesia, South Africa, Ukraine and Vietnam (UNIDO 2018).

When reviewing the history of the development of eco-industrial parks on a global level, we can conclude that the foundations of the concept are by no means brand new (as, of course, neither is the circular economic model itself, since these cyclical processes have been operating in the nature for millions of years), but we can talk about an evolution which originates from the the EIPs and industrial symbioses established in the Scandinavian countries, starting from the 1960s and 70s – see, for example, Kalundborg Symbiosis of Denmark, one of the most commonly cited case studies in the literature (Schwarz – Steininger 1997; Valentine 2016). In the next stage of development, in the 1990s, the concept continued to spread to other European states with a less developed commitment to sustainability than the Scandinavian ones, as well as to the USA, Canada and Japan, among others – so it is important to highlight here that we are talking about a group of the most developed economies. The 21st century has brought a change which still clearly dominates the global trends of EIP development even nowadays: from that time, dynamically developing economies began to embrace the concept, especially the newly industrialized Asian countries (Kechichian – Jeong 2016).

Kechichian and Jeong (2016) draw attention to the significant change that took place from early 2000s to the present times in terms of the geographical distribution of eco-industrial parks: while in 2000 only 10% of all EIPs were in non-OECD member states, by 2016, this ratio was already over 30% and shows dynamic growth. It is also important to point out that the majority of the EIP development models are brownfield investments (i.e. converting an existing facility), with 59%, while new, greenfield developments account for 34% of all projects. In international practice, we can also encounter spontaneous, unplanned development, but only in 7% of the registered cases (in 2016, there were 254 EIPs registered globally, including the planned ones and those currently being developed).

The available statistical data on the increase in the number of eco-industrial parks and their geographical coverage shed light on the clear trend that can be seen in this field among the group of developing and emerging countries since the 2010s. In connection with the topic, the concept of 'mainstreaming' (Kechichian – Jeong 2016), mentioned many times in the literature, best expresses what the global, normative goal can be in the development of EIPs: they should not be merely an alternative to traditional, linear production and consumption systems, but represent the mainstream of development policy. The prerequisite and key to 'mainstreaming' is a unified international conceptual/interpretive framework, the construction of the eco-industrial park as a brand, as van Beers et al. (2020) emphasized.

Conclusions

The purpose of the brief presentation of the above-discussed literature, policy documents and initiatives was to highlight the dynamically growing importance of the topic of eco-industrial parks in the institutional system of international development policy. Based on the last 7-8 years period, we can clearly see the enhanced demand on globally standardized schemes, tutorials, guidelines and benchmarks in the field of eco-industrial park development. Theoreticians, decision makers and practical experts may find a common point in the normative aim to establish an international system which can create the frames of mainstreaming industrial symbiosis as the most sustainable and beneficial concept of industrial production and development. The major players in this process are UNIDO, GIZ and the World Bank which have been engaged in promoting the idea primarily – but not exclusively – in their developing partner countries.

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