

## Case Report

# Eco-Industrial Parks: Experiences from Turkey

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## Abstract

The development of Eco-Industrial Parks (EIPs) is an emerging concept that is being spread in Turkey as a sustainable development model. This study analyzes the improvement of EIPs in Turkey and discusses prevailing problems on transferring Organized Industrial Zones (OIZ) to EIPs. In the study, EIP projects completed by the Ministry of Science, Industry and Technology (MoSIT) and other institutions such as Regional Development Agencies, Technology Development Foundation of Turkey (TTGV), Universities, etc. are reviewed. The findings have shown that the potential for the application of EIPs is high in Turkey; however, there are various constraints on implementation. Some of these barriers are organizational and institutional setups, lack of interest of companies, deficiencies on financial sources, inadequate sharing of the good practices and absence of internationally accepted standards. The project titled as "Green OIZ Framework Development for Turkey" was customized to identify a comprehensive Green OIZ criterion, supported by MoSIT and assisted by the World Bank Group (WBG). This project evaluated the existing regulatory framework to create a roadmap for Green OIZs in Turkey. The performance requirements were considered in four key categories, namely, park management performance; environmental performance; social performance; and economic performance. Then, the sustainability criteria for the Turkish OIZs were proposed; however, further work is needed to tailor it and set the targets for the OIZs.

## Introduction

Eco-Industrial Parks (EIPs) contribute to environmental and social sustainability as well as economically sound industrial development. The idea of EIPs was first described at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro 1992 [1] and has become popular in many countries in the last two decades. Since eco-industrial parks encourage resource efficiency and circular economy practices, it is a promising strategy to support sustainable industrial development and to improve the industries' environmental performance in terms of materials, energy and waste. Therefore, number of the EIPs has recently spread worldwide both in developed and developing countries.

One of the most famous examples of Industrial Symbiosis (IS) is the Kalundborg industrial cluster in Denmark and it has often been used as a reference case in literature. The Kalundborg network arose spontaneously from a self-organizing initiative between companies to address water scarcity and over the years has increased not only in terms of the number of symbioses but also the number of participants and remains a successful case

to this day [2]. However, industrial symbiosis is not limited to the Kalundborg case. There have been various examples of synergistic networks reported in the countries in North and South America, Australia, Southeast Asia, and Europe [3].

In Turkey, the number of the Organized Industrial Zones (OIZs) has also been growing rapidly. Currently, there are more than 300 OIZs in Turkey, 75% of which are located in four regions: namely, the Marmara, the Aegean, Central Anatolia and the Black Sea. OIZs consume high amounts of resources (e.g. raw materials, water, electricity, natural gas, coal, etc.) and generate significant volumes of solid, liquid, and gaseous wastes. Therefore, attempts on development of new Eco-Industrial Parks (EIP) and/or transformation of conventional OIZs to green OIZs has become an important issue in the last decade.

### Development of Eco-industrial parks in turkey

Turkey has been encouraging industries with the green growth perspective and has supported this strategy via several national and international projects. In order to ensure the efficient use of resources, various projects have been



implemented since 2010. The list of the projects performed in OIZs is summarized in Table 1. As can be seen from the Table 1, the IS applications in Turkey started with Iskenderun Bay Project (Baku-Tbilisi-Ceyhan Pipeline Project) in 2010. The project was financed by BTC Crude Oil Pipeline Company and implemented by the Technology Development Foundation of Turkey (TTGV). The objective of the project was to introduce IS approach into the area of Iskenderun Bay as a mechanism to increase the collaboration and solidarity between companies for the purpose of achieving both environmental and economical improvement in the region, as well as creating a background for a national program. As a result of analyses and follow-up studies, around 420 potential synergies were identified within the IS network of 51 member companies from 28 sectors. As shown in the following table, particularly waste reductions, water and energy savings, and decreases in CO<sub>2</sub> emissions, etc. were listed among the major benefits of the project.

Using the experiences especially gained from this project, many others have been put into practice across the country in the last decade. These projects were generally performed in the existing industrial parks by the regional development agencies such as IZKA, TRAKYAKA, BEBKA and The Ministry of Science, Industry and Technology (MoSIT). The feasibility studies were also prepared to reveal IS potential in their region. For example, as part of IS program conducted by BEBKA in cooperation with TTGV, synergy workshops were performed; and potential synergies between the food, mineral products, furniture, textile and mining industries were exposed. Trakya Industrial Symbiosis Program was initiated at 2014 by TRAKYAKA in cooperation with TTGV. The analysis of the structure of industrial sectors in the region (i.e. Edirne, Kırklareli, Tekirdağ provinces) was carried out and then IS opportunities were identified. Biogas and electricity production

from organic wastes; reusing slag and ashes in cement, concrete and road construction; recycling of casting wastes; and recycling of metal and plastic wastes in household appliances were proposed as potential synergies in the Trakya Industrial Symbiosis Program. In order to ensure the efficient use of resources by industrial/non-industrial companies located in Antalya Organized Industrial Zone (Antalya OIZ) and to protect the sustainability of regional development, the project titled as “The Industrial Symbiosis and Eco-efficiency” was launched in 2015. The project was carried out jointly by Directorate of Antalya OIZ and TTGV. It was aimed to decrease resource consumption and to apply more productive and eco-friendly production and service processes through preventing the wastes in their sources or reducing them. The IS opportunities among various sectors in Gaziantep OIZ were also explored in Gaziantep project. In this context, 2012 companies from 166 different sectors were analyzed to identify the IS opportunities. An industrial symbiosis match-making platform was used to screen the opportunities. The results covered a range of benefits, such as energy and material recovery/reuse, waste recycling/reuse, which all addressed to considerable reduction in GHG emissions in a regional industrial zone. Additionally, the MoSIT of Turkey, with the assistance of the World Bank Group (WBG), initiated a project, Green OIZ Framework Development for Turkey, to set “minimum requirements” or “sustainability performance standards” for industrial parks [4]. The environmental, economic, social criteria were proposed in the project as well as the indicators for OIZ management. On this context, the comprehensive technical, financial and regulatory analyses were carried out to identify the most viable opportunities in resource efficiency, green infrastructures (renewable energy, waste water treatment/recycling, etc.) and circularity (e.g. industrial symbiosis). As it mentioned before, regional development agencies have played

**Table 1:** The list of the projects on eco-parks and/or industrial symbiosis in Turkey.

Project Title	Project Partners	Major Outputs
Iskenderun Bay Industrial Symbiosis (2010-2014)	-Technology Development Foundation of Turkey (TTGV) -BTC Crude Oil Pipeline Company -International Synergies	Water saving: 6,500 m <sup>3</sup> /year Energy saving: 33,581,155 kWh/year CO <sub>2</sub> reduction: 36,680 tCO <sub>2</sub> /year Raw material substitution: 276,253 tons/year
Trakya Industrial Symbiosis Program (2014-2016)	-Trakya Development Agency (TRAKYAKA) -Technology Development Foundation of Turkey (TTGV)	Feasibility report
Bursa-Eskişehir-Bilecik Industrial Symbiosis Program (2014-2015)	-Bursa Eskişehir Bilecik Development Agency (BEBKA) -Technology Development Foundation of Turkey (TTGV)	Feasibility report
Industrial Symbiosis and Eco-efficiency Project in Antalya Organized Industrial Zone (2015-2017)	-Directorate of Antalya Organized Industrial Zone -Technology Development Foundation of Turkey (TTGV)	Water saving: 75,000 m <sup>3</sup> /year CO <sub>2</sub> reduction: 3,800 tCO <sub>2</sub> /year Raw material substitution: 91,600 tons/year
Gaziantep Industrial Symbiosis Project (2015-2016)	Gaziantep Industrial Chamber Ipekyolu Development Agency (IKA)	104 Industrial Symbiosis opportunities have been identified.
Green OIZ Framework Development for Turkey (2016-2018)	-The Ministry of Science, Industry and Technology (MoSIT) of Turkey -World Bank Group (WBG)	National Framework on Green OIZs for Turkey.
Eco-Industrial Park Transformation in Izmir: Green IAOSB (2019)	-Directorate of Izmir Atatürk Organized Industrial Zone -Izmir Development Agency (IZKA)	Water saving: 1,152,032 m <sup>3</sup> /year CO <sub>2</sub> reduction: 63,892 tCO <sub>2</sub> /year Energy Saving/ Production: 151,840 MWh/year Solid Waste Reduction: 16,000 tons/year
Eco-Industrial Park Transformation Project in Tire Organized Industrial Zone (TOSBI) (2019-2020)	-Directorate of Tire Organized Industrial Zone -Izmir Development Agency (IZKA) -Dokuz Eylul University	Feasibility report



an important role in the development and/or transforming of eco-industrial parks in Turkey. Their efforts are focused on to raise awareness on industrial symbiosis and eco-efficiency (clean production) practices, specifying the current potential, performing feasibility studies, executing communication activities, and building the infrastructure required for the sustainability and extension of industrial symbiosis practices. In this framework, the feasibility projects for Izmir Atatürk OIZ (IAOSB) and Tire OIZ (TOSBI) were recently supported by Izmir Development Agency (IZKA) to transform the OIZs to EIPs. The technical analysis of the industries was carried out as first; and then green OIZ opportunities, e.g. resource efficiency, industrial symbiosis and green infrastructure alternatives were identified [5].

## Results and conclusion

Although the industrial symbiosis and eco-industrial growth are new concepts for Turkey, various successful projects have been conducted since 2010. The experiences have shown that the potential for the application of IS projects is high, however, there are number of constraints on the implementation. The limiting factors are organizational and institutional setups, lack of company interest, insufficient policy and regulatory framework, financial deficiencies, insufficient knowledge and unawareness, and technical factors.

Our experiences revealed that it is vitally important both the awareness and engagement of stakeholders and OIZ Directorate to EIP concept. Although the sustainability criteria for the Turkish OIZs are proposed in the developed framework,

further work is needed to tailor it for TOSBI and to set the targets. Besides, in order to determine the criteria and/or indicators described with various units, data collection system (i.e. type, frequency, measurement, etc.) has to be revised and/or upgraded by firms and OIZ management considering the sustainability criteria. A Green OIZ Development Unit (GDU) has to be established under the OIZ in order to implement and manage green-related programs among the existing firms and other institutions; and to organize the data collection and evaluation. Finally, financial supports (grants, loan, etc.) which have to be provided to tenants and/or OIZ Directorate are another important factor to stimulate the green transition of the industries in the implementation of the projects.

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