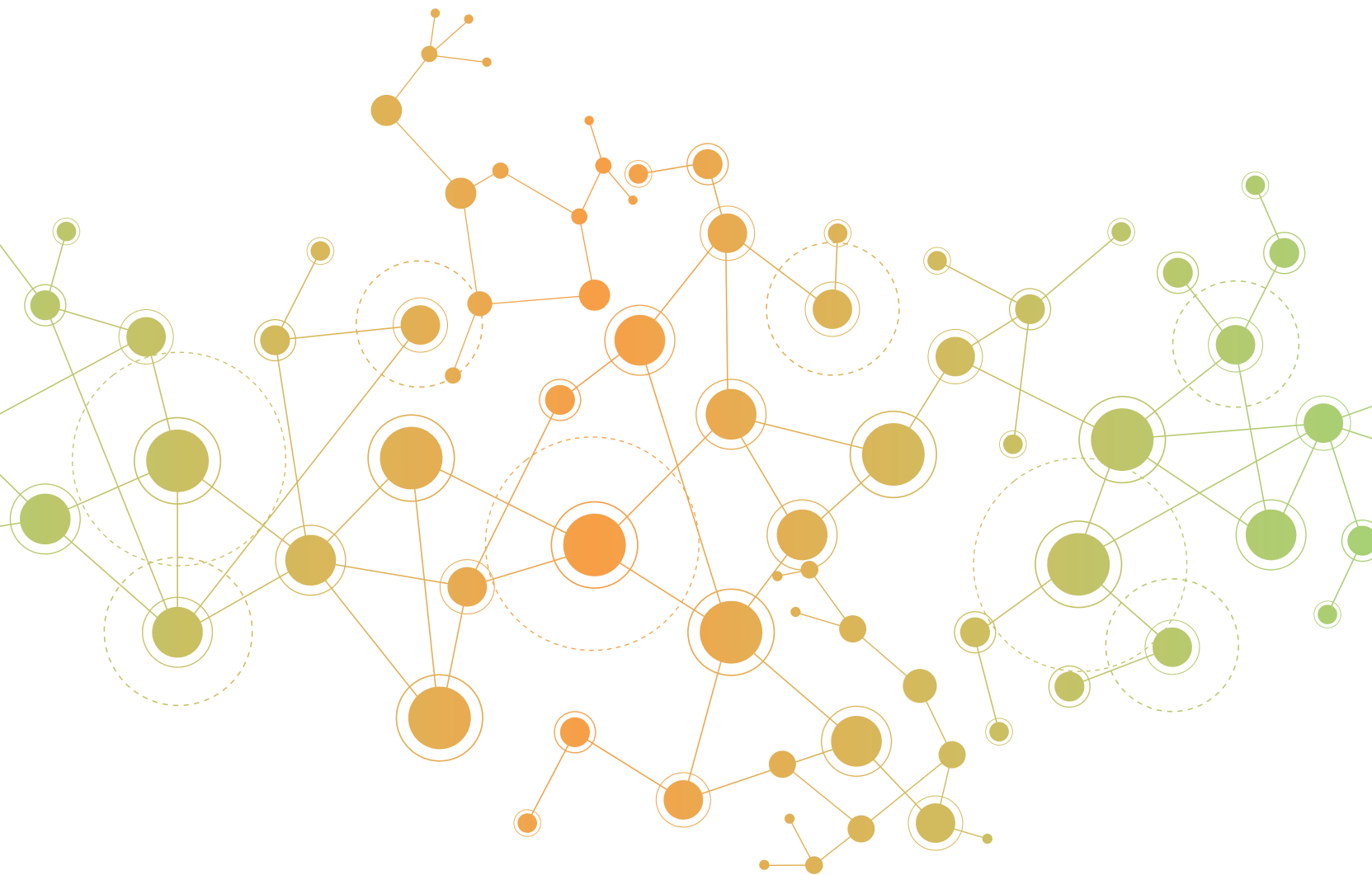


An International Framework For
Eco-Industrial Parks
Version 2.0

January 2021



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION



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The Rationale for Version 2.0

Since publication of the first edition of this Framework in December 2017, many industrial park practitioners have used it as the definitive reference for Eco-Industrial Park development. The World Bank Group, UNIDO and GIZ had opportunities to implement the Framework in countries in which they work, either to retrofit conventional industrial parks or to support governments to move towards Eco-Industrial Parks.

In August 2019, The World Bank Group, GIZ, and UNIDO convened to share their experience in implementing the first edition of the International EIP Framework.

The three organizations confirmed a high level of interest in working with the Eco-Industrial Park framework. However, they also identified a need to increase the practicality of the Framework, and to fine tune the EIP performance requirements and indicators.

The purpose of this second edition is to increase the applicability of the International EIP Framework and to bridge the data availability and knowledge gap in the first edition for introducing EIP performance requirements at national and industrial park levels. The second edition also introduces new indicators to address gaps that were identified over the last few years. Further, a more consistent use of terminology and the addition of examples from country-level EIP Program implementation were introduced as improvements to the second

Foreword

Over the past few decades, the creation of industrial parks has been recognized as an efficient way to bring together industrial activities with commercial and infrastructure services. However, it is now understood that industrial parks can have positive and negative impacts. While they contribute to economic growth, they can also concentrate negative environmental and social impacts, including: greenhouse gas (GHG) emissions, pollution, resource depletion, poor labor standards, and grievances from affected communities.

As developing and emerging economies seek to increase industrial output, there is a pressing need to decouple economic growth from environmental and resource inefficiencies in order to meet wider social objectives. There is a real opportunity now to plan and manage industrial parks to achieve the desired economic, social, and environmental targets.

As a result, the concept of Eco-Industrial Parks (EIPs) has increasingly been recognized as an effective tool to overcome the challenges of inclusive and sustainable industrial development within the scope of Sustainable Development Goals (SDGs).

The concept has been further developed, and this updated publication outlines a common framework for EIP implementation. In this context, the United Nations Industrial Development Organization (UNIDO), the World Bank Group and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH intend to use this framework as a baseline across all of their initiatives in partner countries.

The International Framework for Eco-Industrial Parks will guide policymakers and practitioners on the critical elements needed for governments and the private sector to work together to establish economically, socially and environmentally sustainable Eco-Industrial Parks.

An important element of the EIP approach is to create a more sustainable operating environment for firms, and to promote competitiveness and job creation. These Eco-Industrial Parks should be designed to use resources more efficiently and improve productivity. They should provide investors with environments specifically adapted to support the achievement of their social responsibility goals. They should also increase market access to sustainable products, and lower exposure to climate change risks. Additionally, Eco-Industrial Parks will contribute to the attainment of the Paris Climate Change Accord's Nationally Determined Contributions at the country level.

By working together, our three organizations aim to create a common vision for Eco-Industrial Parks which countries can use and modify according to their own needs. The International Framework is a unifying structure for further efforts on country projects. It leverages a wide range of tools and strengths that each organization brings to the effort. We hope that this common framework will fill the current gap in understanding of Eco-Industrial Parks, and encourage their development on a global scale.



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Acronyms

A-GRIP	The Association of Lady Entrepreneurs of India Green Industrial Park
ALEAP	The Association of Lady Entrepreneurs of India
OIZ	Organized Industrial Zone
IISD	International Institute for Sustainable Development
CCA	Climate Change Adaptation
CE	Circular Economy
DGNB	German Sustainable Building Council
ECE	Economic Commission for Europe
EDGE	Excellence in Design for Greater Efficiencies
EIA	Environmental Impact Assessment
EIP	Eco-Industrial Park
EMS	Environmental Management System
EnMS	Energy Management System
FAO	United Nations Food and Agriculture Organization
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
IFC	International Finance Corporation (private sector arm of World Bank Group)
ILO	International Labor Organization
IP	Industrial Park
ISO	International Organization for Standardization
IZ	Industrial Zone
LEED	Leadership in Energy and Environmental Design
NDC	Nationally-Determined Contributions
NGO	Non-Governmental Organization
OECD	Organization for Economic Co-operation and Development
OH&S	Occupational Health and Safety
OIZ	Organized Industrial Zone
RECP	Resource Efficient and Cleaner Production
SDG	Sustainable Development Goal
SEPA	China State Environmental Protection Administration
SEZ	Special Economic Zone
SIA	Sustainable Industrial Area
SME	Small and Medium-Sized Enterprise
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme (now UN Environment)
UNIDO	United Nations Industrial Development Organization



Executive Summary

The aim of this publication is to provide an international framework (the “framework”) which defines the basic requirements and performance criteria needed for an industrial park to qualify as an Eco-Industrial Park (EIP). It summarizes the areas in which the international organizations that have authored this framework — the United Nations Industrial Development Organisation (UNIDO), the World Bank Group, and the *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ) GmbH — have aligned to define an Eco-Industrial Park (EIP).

The purpose of this publication is three-fold, namely: (i) to assist stakeholders to develop and transition to EIPs; (ii) to consistently engage with, encourage, and recognize EIPs; and (iii) to improve the performance, sustainability and inclusiveness of the industrial sector and move toward an international standard on EIPs.

UNIDO, the World Bank Group, and GIZ are supporting governments and industrial park practitioners to develop EIPs in different countries and contexts. EIPs can be defined as industrial areas that promote cross-industry and community collaboration for common benefits related to economic, social and environmental performance. These goals are incorporated into the siting, planning, management, and operations of EIPs.

Industrial parks are known by different names, including: industrial areas, industrial zones, industrial investment regions, special economic zones, and industrial corridors, and they are planned and developed for industrial activities and associated commercial and infrastructure services. The concentration of economic activities in industrial parks require that they are sustainable.

There are currently a number of tools and processes which assist governments and industrial park stakeholders to implement inclusive and sustainable industrial development. However, a consolidated and targeted framework for EIPs is largely lacking at the international level. Increasingly, countries and industrial park stakeholders request ‘standards’ or benchmarks for pursuing sustainability as envisioned by EIPs. An innovative approach to such requests is to set “prerequisites” or “sustainability performance requirements”¹ for industrial parks, covering regulatory compliance and socio-economic, environmental, and management standards. These standards provide benchmarks for assessing existing industrial parks, retrofitting existing parks, or planning new EIPs.

The EIP Framework presented in this document contains these prerequisites and performance requirements, which are outlined in tables in Section 4. These are international and inclusive in scope, and are relevant to all industrial parks, irrespective of what they are called. They are also relevant to stakeholders in the private and public sectors in which these industrial parks are located. The EIP Framework can inform stakeholder networks, and be used by UNIDO, the World Bank Group and GIZ to promote EIPs globally. Legislation by national governments of the regulations, activities and structures governing industrial parks varies considerably across the world, and so the framework recognizes the need to consider local contexts and sensitivities when applying these requirements. The EIP framework adopts the position that relevant policies and regulations must be complied with, but sets specific, additional requirements for management, environmental, social, and economic arenas in order to accommodate the wide range of different contexts in which the framework is used.

UNIDO, the World Bank Group, and GIZ are committed to using the EIP framework in future projects and programs. We encourage partners and stakeholders to adopt the framework’s recommendations for planning, development, management, operations and monitoring in EIPs. By adopting a common international EIP framework, the development community can systematize its efforts towards a more inclusive and sustainable industrialization.

1 The Sustainable Development Goals (SDGs), particularly SDG 9, make reference to inclusive and sustainable industrialization. For the sake of brevity, references to sustainability of industrial parks are meant to also cover inclusivity in this publication.





Introduction

1.1 Context

Industrial parks are known by different names and cover industrial areas, industrial zones, industrial investment regions, special economic zones and industrial corridors, among others. They exist for the purposes of industrial and associated commercial, infrastructure, and service activities.

Industrial parks have both potentially positive and negative impacts. While they contribute to economic growth and social development, they can also cause negative environmental and social impacts, including: climate change, pollution, resource depletion, labor issues, and negative impacts on communities. Thus, sensitive planning and management are needed to mitigate negative outcomes and to optimise economic, social, and environmental gains.

Interest in industrial parks has grown substantially in recent decades.² The grouping of firms in defined locations offers potential collaborative and efficiency gains, for instance by implementing circular economy practices. As developing and emerging economies seek increased industrial output, there is a pressing need to balance economic growth with environmental and social objectives.

International efforts strive to make industrial development inclusive and sustainable: The idea of EIPs was first presented at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992. At the time at which the term was presented, other countries (Africa, Asia, Europe, South America, and the United States) had initiated various Eco-Industrial development planning processes which were viewed as viable frameworks for transitioning to sustainable production and circular economy practices. These included eco-design, reuse of parts, components and by-products, remanufacturing, and recycling. As a result, EIP was adopted as a common reference term.

The EIP concept has evolved to address additional, interrelated concerns, including, for example: resource efficient and cleaner production; industrial symbiosis; climate change; pollution; social standards; shared infrastructure; and improved management of risks and shared resources, including land and other ecosystem services. It has become clear that an interdisciplinary approach is required to overcome barriers and promote the desired operation of EIPs.

UNIDO, the World Bank Group, and GIZ are supporting governments and industrial park practitioners to develop EIPs. GIZ is providing technical cooperation based on the concept of “Sustainable Industrial Areas” to countries worldwide. Similarly, UNIDO has been promoting EIPs, green industry, resource efficiency and cleaner production through its projects and its Global Eco-Industrial Parks Program. The World Bank Group is financing and providing technical assistance to climate competitive industry projects, including EIPs and low-carbon zones, in many countries.

Countries and industrial park stakeholders are increasingly requesting ‘standards’ or benchmarks to guide their efforts towards sustainability, and partner organizations in these efforts have collaborated to establish performance requirements for an EIP framework. The framework will be used to guide development cooperation projects and the promotion of EIPs around the world.

Eco-Industrial Parks: There are a number of definitions for EIPs. Broadly, an EIP may be defined as a dedicated area for industrial use at a suitable site that supports sustainability through the integration of social, economic, and environmental quality aspects into its siting, planning, management and operations.

² Preliminary World Bank Group research in 2016 identified over 250 operating or planned self-declared EIPs globally, although these vary widely in status. This represents significant growth over 1990 levels (World Bank Group 2016).

Setting international benchmarks and performance requirements for EIPs: There are many tools and processes to assist governments and industrial park stakeholders to move towards sustainable industrial development. However, EIP guidelines are largely lacking at the international level. An innovative approach is to set “performance requirements” for industrial parks which cover compliance, socio-economic, environmental, and management aspects. Such standards provide benchmarks for assessing existing industrial parks, and planning retrofits and new parks.

Sustainable Development Goals (SDGs) are drivers for inclusive and sustainable industry: The 2030 SDGs include targets and actions for industry, innovation and infrastructure, as well as measures for decent work, economic growth, gender equality, and climate action. For instance, SDG 9 aims to significantly raise industry’s contribution to employment and gross domestic product by 2030. The means for achieving this goal may include retrofitting industries to make them sustainable, increasing resource-use efficiency, and increased adoption of clean and environmentally sound technologies and industrial processes. SDG 7 aims, among other things, to double the rate of energy efficiency improvement and significantly increase the share of renewable energy by 2030. SDG 8 targets sustained per capita economic growth at seven percent per year, and SDG 13 focuses on climate actions. SDG 12 aims to substantially reduce waste generation through prevention, reduction, recycling and reuse in the public and private sectors by 2030 . It will also require firms, especially large and multinational enterprises, to adopt sustainable practices and to report sustainability performance accordingly. SDG 5 addresses issues of gender equality. These SDGs are applicable to EIPs and the development of an international framework for their use.



1.2 Aims and Objectives

This publication aims to provide an international framework of prerequisites and performance requirements needed for industrial parks to qualify as EIPs.

This publication further aims to:

- (i) Assist stakeholders to develop and transition to EIPs;
- (ii) Engage, encourage, and recognize EIPs in a consistent manner; and
- (iii) Provide benchmarks to improve the performance, sustainability, and inclusiveness of the industrial sector, and progress toward an international standard for EIPs.

As the need for sustainability in all its dimensions has grown, so too have ideas about what constitutes an EIP. The metrics for EIPs outlined in this publication aim to complement, rather than replace, existing tools and standards, and seek to guide best practice for EIPs internationally. This will allow a broad range of stakeholders to use the framework as a reference point in their efforts to set expectations and improve performance.

The requirements for EIPs aim to:

- **Increase park management performance**, specifically with regard to management and monitoring. This includes investing in better infrastructure; applying national/international standards; organizing and managing services (including disaster preparedness and risk management), and marketing.
- **Enhance environmental performance** by minimizing the footprints of parks, by providing sustainable means to manage water, wastewater, waste, and resources. It also involves addressing climate change issues and effects on local and global environments.
- **Improve social performance** by addressing the needs of the community and employees, including in relation to labor rights and working conditions, gender, community dialogue, land acquisition and social infrastructure.
- **Increase economic performance** by maximizing returns for park managers and business owners. Economic benefits from an industrial park include revenue and profit, job creation, and competitiveness, as well as access to additional investment for resident industries.

1.3 Scope of the International Framework for EIPs

This framework adopts an inclusive approach, and provides a common understanding of EIPs. Given the diversity of industrial parks, and the regulatory regimes under which they operate, sensitivity in the application of this framework is required.

This framework is intended to be applied to:

- Industrial parks in developed, transition, and developing countries;
- Existing industrial parks (brownfield) and planned industrial parks (greenfield);
- All parks irrespective of their differences (for example, area, level of technological development, and extent of existing collaborations); and
- All industrial sectors, with the understanding that different sectors (e.g., leather, textile, chemicals manufacturing) will each have specific, national compliance requirements.

The aim of this framework is to encourage industrial parks to exceed compliance with local and national regulations with respect to environmental and social issues (“Compliance Plus”). An EIP should comply with local and national regulations,³ but should strive to meet international good practice if national requirements fall short. In situations in which local or national regulations exceed these performance requirements, then it is expected that local and national regulations would take precedence.

3 While the emphasis in this publication is on environmental and socio-economic aspects, industrial parks should by default comply with all applicable rules and regulations, including those pertaining to the environment, social aspects, intellectual property, technology, labor, physical planning, consumer safety etc. “Compliance Plus”, in effect, equates to the performance levels proposed in this International EIP Framework.

The framework focuses on four key categories: park management performance, environmental performance, social performance, and economic performance. The requirements for each category are divided into “prerequisites” and “performance indicators” that can be measured in qualitative and/or quantitative terms. Using the framework’s prerequisites and indicators as benchmarks, national governments set country-specific values for these indicators. Thus, in a given country, an Industrial Park is expected to comply with these country-specific standards in order to be deemed an EIP. Common EIP components include: a sustainable park management structure; park- and where applicable, firm-level resource efficiency and cleaner production; industrial symbiosis and synergies; interactions with the local community and natural environment; spatial planning and zoning; socially acceptable working and living conditions; and collective use of park-level infrastructure, such as utility services and facilities management.

The framework’s reference to “industrial park management” is limited to the role and leverage of park managers, sometimes called park operators, regarding the planning, development, management and operations of the park — and not to higher-level park governance structures and institutions. The park manager is defined as the entity that deals with management and day-to-day operations, services to resident firms, park infrastructure and facilities, promotion and marketing, and interactions with authorities and the community on behalf of the park’s resident firms. These tasks are to be performed in line with existing higher-level park governance structures, institutions, and regulating bodies. By focusing on the park management level, the framework aims to allow for comparisons between defined areas within countries and economies. This demarcated system consists of the industrial park and facilities on its premises, the park management entity, resident park firms, and the community and relevant authorities.

This framework constitutes a natural progression, and builds on the work of UNIDO, the World Bank Group, GIZ and the wider international community. Over the past two decades, several local and national initiatives and certification programs have been established to formulate best practices, standards and benchmarks, which are directly and indirectly related to the concept of EIPs. These include:

- *United Nations’ indicators for sustainable development* (United Nations Department of Economic and Social Affairs 2007);
- *Green Growth Indicators* (Organisation for Economic Co-operation and Development 2017);
- *Guidelines for Sustainable Industrial Areas* (GIZ, Version 1.0, 2015)⁴;
- *Chinese Eco-Industrial Park Standards and Certifications*⁵;
- *Indicators of Kaiserslautern University of Technology*;
- *Certification System of the German Sustainable Building Council* (DGNB);
- *Green Special Economic Zone (SEZ) Rating System of the Indian Green Building Council* (IGBC);
- *Guidelines for Multinational Enterprises: Responsible Business Conduct Matters* (OECD 2013);
- *The Implementation of Industrial Parks: Some Lessons Learned in India* (World Bank 2014);
- *Low-carbon Zones: A Practitioner’s Handbook* (World Bank 2014);
- *Global Assessment of Eco-Industrial Parks in Developing and Emerging Economies* (UNIDO 2016);
- *Implementation Handbook for Eco-Industrial Parks* (UNIDO 2017);
- *Mainstreaming Eco-Industrial Parks* (World Bank 2016);
- *Greening Industrial Parks: A Case Study on South Korea’s Eco-Industrial Park Programme* (Global Green Growth Institute 2017);
- *Guide to Corporate Sustainability* (United Nations Global Compact 2017);
- *An International Framework for Eco-Industrial Parks* (UNIDO, World Bank Group, GIZ 2017)⁶;
- *A Practitioner’s Handbook for Eco-Industrial Parks: Implementing the International EIP Framework*⁷ (UNIDO, World Bank Group, GIZ 2018).

4 This is Version 2.0.

5 These include: The EIP Demonstration Program; The Circular Transformation of Industrial Parks; and The Low-Carbon Industrial Park Program as explored by the International Institute for Sustainable Development (IISD 2015).

6 <https://openknowledge.worldbank.org/handle/10986/29110>

7 <https://openknowledge.worldbank.org/handle/10986/30458>

1.4 Framework Application and Target Audience

A diverse range of stakeholders are involved in the development and operation of industrial parks, and the framework's parameters inform them of performance requirements recommended for EIPs. This publication aims to serve as a reference for a broad group of stakeholders involved in the development and implementation of EIPs. It will help them to report on the status and achievements of an EIP in a comprehensive and transparent manner. It should be noted that this publication does not provide actual implementation advice, as this responsibility rests with national governments and EIP decision makers. UNIDO, the World Bank Group, and GIZ will advise and assist in the application of the performance requirements in their respective projects and programs, and encourage other collaborators to also apply these requirements in industrial park planning, development, management and monitoring.

The target audience for the framework includes a broad range of industrial park stakeholders. They comprise both government institutions looking to inform industrial park-related policies to incentivize green and circular manufacturing activities, and private sector actors who are involved in the development and operation of EIPs. They also include, but are not limited to the following:

- Industrial park planners and developers;
- Industrial park operators and managers;
- Firms located in industrial parks;
- Industrial associations and chambers of commerce;
- Governments at the national, provincial and local levels, and regulators;
- Financial sector, funding agencies and donors;
- International development agencies and non-governmental organizations (NGOs); and
- Scientific research institutions.

1.5 Rationale for a Consolidated Eco-Industrial Park Framework

International experience demonstrates that the EIP concept is a valid and sustainable approach to increasing resource efficient and cleaner production (RECP), and promoting environmental protection and socially fair and responsible business practices in existing and new industrial parks. However, to date, different parties, practitioners, and researchers have defined EIPs in different ways. As a result, generally accepted guidance on what constitutes an EIP is unclear, and the following issues require clarification (UNIDO 2016):

- ***Divergence in name and understanding:*** The EIP concept can mean different things to different parties. While similarities exist in the literature, stakeholders require clear and consistent messaging from the international community;
- ***Practice does not yet match ambition:*** Some parks describe themselves as EIPs, but fall short in performance. For instance, they may not be continuously implementing environmental and social improvements;
- ***There is potential to leverage best-in-class examples:*** Many best practices exist, but these need to be brought together and implemented routinely;
- ***Barriers and market failures still exist:*** Lack of experience, awareness, supporting regulations, and enforcement slow the development and implementation of EIPs.

Consolidated EIP assessment frameworks and performance criteria are important because they assist stakeholders with the following decisions and actions:

- ***Private sector decision making:*** Businesses often require assistance to decide whether to locate within an industrial park, or to invest in clean production technologies and processes. The framework can complement existing decision-making tools, thus supporting better decision-making among firms.
- ***Public-sector decision making:*** The framework presented in this report can also provide guidance and incentives for stakeholders to encourage the transition toward EIPs. Governments will find the framework useful to prioritize industrial areas for support based on a common set of qualifications and understanding of what constitutes an EIP. In addition, the framework may help to clarify the vision for a specific park, or mandate for an industrial development program.

- **Performance improvement:** The framework can assist stakeholders to assess the performance of industrial parks via priority topics and indicators which flag whether an industrial park meets EIP requirements. In addition, a clear and commonly agreed understanding of EIPs and their characteristics can help bring together park operators, park owners, and stakeholders as they seek to improve their processes and operations.
- **Allocating funding:** The framework can help the financial sector, funding agencies and donors to allocate financial support to industrial parks that meet certain performance requirements. In addition, the standardization of EIP performance expectations has the potential to unlock new funding streams such as green bonds, and other products supporting sustainability.
- **Reputational benefits:** Standardized criteria allow for comparisons between EIPs, offering reputational benefits to high performing parks, and thereby incentivizing other parks to match these requirements. In turn, this may enhance the status of certain EIPs as a desired location for sustainability conscious companies.
- **Awareness raising:** A common framework raises awareness of the benefits of EIPs, including alignment with international priorities such as the SDGs, climate change mitigation, sustainable industrial development, and corporate social responsibility.
- **Marketing advantages:** Industrial areas compete for investors worldwide, and the high Eco-Industrial performance and corporate social responsibility profiles of EIPs can provide marketing benefits.
- **Better allocation and use of resources:** A well-designed park will also optimise the use of resources such as land, water, and/or energy by creating synergies (for example, by using waste heat), or better economies of scale (for example, through joint use of infrastructure).
- **Retrofitting of existing industrial areas:** The framework will help assess the performance of an industrial park, identify gaps, and plan further development.

Limitations of the framework: It should be noted that this framework, in its current format, aims to provide strategic and operational direction regarding expectations for EIPs. It does not translate these expectations into a formal international EIP labelling and certification scheme, as this responsibility rests with national governments.

1.6 Publication Structure

This publication is divided into five sections (see figure 1). The first section details the context, aims and objectives of the EIP performance requirements framework, along with the scope and intended audience. Section 2 provides a common understanding of EIPs, and highlights the associated benefits, drivers and barriers. Section 3 outlines the approach followed to develop the framework for EIP requirements. Section 4 provides the EIP performance requirements across park management, as well as environmental, social, and economic categories. Finally, Section 5 provides closing remarks from the three authoring organizations.

Figure 1: Publication Structure





2 A Common Understanding of Eco-Industrial Parks

2.1 Defining Eco-Industrial Parks

Different terminologies and definitions are used by organizations to refer to EIPs, or to similar concepts related to them. Figure 2 presents combinations of commonly used terms relating to EIPs. This publication does not stipulate the use of particular terms, but highlights areas of alignment that provide a practical way to move forward, whichever terminology is used.

Figure 2: Examples of Combinations of Terms Used Internationally in Relation to Eco-Industrial Parks



Broadly, EIPs can be defined as managed industrial areas that promote cross-industry and community collaboration for common benefits related to economic, social and environmental performance. The EIP concept has evolved to address additional, interrelated aspects, including, for example: resource efficient and cleaner production, industrial symbiosis, climate change, pollution, social standards, shared infrastructure, improved management of risks and shared resources, including land and ecosystem services. An interdisciplinary approach is required to optimally realise the EIP concept.

2.2 Drivers and Benefits of Eco-Industrial Parks

Industrial parks are an important driver of industrialization. By grouping businesses in a dedicated co-location, they offer important efficiency and collaborative opportunities. However, industry can also harm the environment through air and water pollution, land contamination, degradation of resources, and in many other ways. Furthermore, industrial parks which are not properly managed can also harm employees and the communities in which they operate.

An EIP framework helps to manage these risks, and maximize sustainable development opportunities.

With the growth of industrial output in developing and emerging economies alike, there is significant scope for EIPs to drive efficiency and contribute positively to socio-economic development at local and national levels. Mitigating and managing the adverse impacts of industrial parks is crucial. Indeed, it is increasingly important to maximize sustainable development opportunities, particularly in those economies in which legislation and risk management are weak.

Key drivers for EIPs include: reducing environmental footprints; promoting efficiency gains and cost-effectiveness; enabling community cohesion; resilience to various types of risks, providing better access to finance and technical support; and enhancing competitiveness. International industry practice and experience demonstrate a wide range of economic, environmental, and social benefits from EIPs. Indeed, these may go beyond conventional business case benefits. In this context, EIP benefits are not just commercial. They are also strategic in that they reduce exposure to resource and licensing risks. They also increase competitiveness, promote business development, and build reputations with stakeholders. Benefits such as access to finance, technical support, and policy, economic and community gains were frequently cited in EIP case studies by UNIDO in 2016.

Industry competitiveness, a significant driver of EIPs, is the ability to increase business performance and sustainable growth. For an EIP to be economically successful, the concept must be attractive to investors and industries, and offer resources and human capital. A key goal for EIP developers is to attract strategic investors and incentivize domestic and foreign direct investment. Support to help EIPs meet these goals can be offered by providing economically-, environmentally-, and socially-aligned services, and plans to meet sustainability agendas of industrial areas. The clustering of businesses at the park level enables added-value services to be offered at lower prices, and efficient management structures which minimize administrative overhead costs. Firms in well-designed and -managed EIPs are better positioned to take advantage of resource efficiencies, risk-mitigating measures, value-addition to their products, and services at both firm and park levels.

From an industry competitiveness perspective, the main drivers for EIPs are:

- Improved and dynamic business environment;
- Reduced operating costs and improved process efficiency and productivity;
- Increased stakeholder demand for improved efficiency and growth;
- Less risk of exposure to natural resource scarcity;
- Assurance to stakeholders regarding environmental and social concerns relevant to consumers, local communities, governments and investors;
- Meeting corporate social responsibility goals;
- High-quality infrastructure, and
- Collective representation of business interests.

The imperatives of environmental protection, climate change mitigation and resource use efficiency are making the case for EIPs stronger. Industry accounts for a significant portion of global emissions, and has wide-reaching environmental and community impacts. EIPs can make a significant contribution to reducing greenhouse gas emissions, thereby contributing toward the implementation of the UN Framework Convention on Climate Change. Reaching these targets will require significant and long-lasting changes in energy and industrial greenhouse gas emissions. In this context, EIPs have the potential to play an important role.

Key environmental drivers of EIPs include:

- Climate change commitments at the national level;
- Policy mechanisms (e.g., tax holidays and market mechanisms, such as carbon pricing);
- Greening the supply chain through circular economy practices,⁸ which can lead to improved resource management, resource conservation and reduced climate impacts;
- Cost-effective infrastructure which adapts to climate change;
- Responding to environmental and social concerns from consumers and neighbouring communities; and
- Impetus to improve efficiency and growth.

With increasing industrial output in developing and emerging economies alike, an EIP framework can help to maintain social standards, and protection of employees and the wider community. Integrating social quality standards within industrial parks is becoming increasingly important. Evidence suggests that friction between communities and industrial parks can occur due to poor preparedness for dealing with emergencies, concerns about operational standards, and increasing encroachment of industrial developments into residential areas. In addition, industrial parks often depend on local labor, resources from surrounding communities, social infrastructure, and in some cases housing and wider social services. Thus, careful planning is needed to address social concerns.

8 Circular economy practices aim to design waste and pollution out of production systems and consumption habits; keep products and materials in use for as long as possible through innovative business models; and regenerate natural systems. They consist of practices such as eco-design of products to ensure durability, reusability, upgradability and reparability, addressing hazardous chemicals, and enhanced energy and resource efficiency in a systemic way. Circular economy practices also include reuse of parts, components, and materials, repairs, refurbishments and remanufacturing to keep products in use, recycling to extract materials for reuse, selling a product as a service and recovering energy from non-recyclables.

Key social drivers of EIPs include:

- Better working conditions;
- Creation of local employment;
- Improvement of gender equality within the park;
- Better security and crime prevention;
- Provision of social infrastructure to workers and community;
- Support for local community well-being and community outreach;
- Provision of vocational training;
- Improved occupational health and safety; and
- Transition to more sustainable land use.

EIPs can provide a wide range of economic benefits, in particular, employment creation. EIPs often involve the creation of an enhanced social infrastructure, which is particularly important for developing countries. Indirect benefits may be difficult to quantify, but are increasingly important for the long-term economic sustainability of parks and firms.

Key economic drivers of EIPs include:

- Direct and indirect employment creation;
- Skills-upgrading of the labor force;
- Linkages between industrial park firms, small and medium sized enterprises (SMEs), and communities outside the industrial park;
- Technology and knowledge transfer through foreign direct investment; and
- Demonstrable benefits following the application of good international industry practices and regional development approaches.

Managing reputational risk is increasingly important to firms, and such risks can be mitigated through an EIP framework. Government authorities, industrial park developers, and industrial landowners are conscious of the negative reputations that industrial parks may acquire because of weakly managed operations. An EIP framework allows them to create a more responsible image through sustainable industrial operations that provide environmental protection, climate change mitigation, resource efficiency, and higher social quality standards. These factors play an important role in driving the development of EIPs (World Bank 2016).

2.3 Barriers to the Implementation of Eco-Industrial Parks

EIP implementation faces a number of difficulties, some of which can be tackled through the provision of an EIP framework and strategic planning. Although industrial parks have taken steps towards sustainability in many parts of the world, few fully developed EIPs exist today. Barriers faced by park owners, operators, and firms are both internal and external, and cover a range of aspects from technology to managerial deficiencies.

International examples demonstrate that the success of an EIP is dependent on its ability to compete, and to offer cost-effective and non-disruptive solutions to resident firms. For example, the lack of competitively priced water, energy, and raw materials; and even the disruptions attending the introduction of innovations and improvements may prevent firms from establishing and operating in EIPs.

In addition, although crucial to long-term sustainability, the short-term investment costs of ‘eco-efficient’ industrial processes can be prohibitive for parks in developing countries. For example, expensive wastewater treatment plants which recover waste heat and can treat complex chemicals — such as dyes and pharmaceutical by-products — require significant investment, and have long financial return periods. Depreciating these investments and recovering additional costs through EIP management fees can be difficult to negotiate with resident businesses. In addition, the realization of efficiency gains depends on skilled management of process improvements, which often requires additional capacity building. This highlights the need for effective planning and strong internal support. External assistance for the implementation of an EIP framework may also be required.

Barriers exist in designing and building new EIPs, as well as in retrofitting existing parks. The type and severity of barriers differs across industrial parks. It is often argued that transitions to sustainability are particularly difficult for existing parks. That is, retrofitting for sustainability requires the integration of complex processes into existing infrastructure, which can present technical, design, installation, and operational challenges. Stakeholders need to consider phased, park-specific approaches in order to address these difficulties. Establishing new EIPs also entails planning, design, and licensing challenges. However, these may be mitigated through detailed front-end engineering design phases which allow for the integration of efficient and cost-effective designs and adoption of eco-efficient processes.

The lack of clear guidance, indicators, and international benchmarks presents difficulties for prospective developers, while also making it harder to quantify and communicate the benefits that EIPs offer. As a result, differentiating true EIP leaders from conventional industrial parks is difficult (Zhang 2012). A commonly agreed framework and set of indicators are needed to design and measure management and governance practices, social benefits, knowledge sharing efforts and results, and collaboration for resilience and competitiveness (Geng and others 2009; Lombardi and Laybourn 2012). Table 1 provides an overview of some of the key barriers faced by industrial parks as they seek to make their operations more sustainable. It also contains some high-level solutions to overcome these barriers.

Table 1: Key Barriers for EIPs, and Potential Solutions

Key barriers for EIPs and potential solutions	
Regulatory barriers	
Description: The lack of sufficient, appropriate regulations, and their enforcement. Lack of incentives for conventional industrial parks and their resident firms to prioritise sustainability.	
Barriers: Potential regulatory barriers include: <ul style="list-style-type: none"> • Lack of suitable policies to encourage EIP development (both command and control, and fiscal incentives). • Lack of policies to encourage clean technology development and adoption. • Lack of transparency surrounding industrial regulations and enforcement. • Regulations not applied universally, leading to competitive disadvantages. • Limited capacity of stakeholders to engage with more favorable regulatory frameworks. 	Sample Solutions: Policy makers can: <ul style="list-style-type: none"> • Seek to understand the key national and local barriers to the adoption of environmental and social standards in industrial operations. • Set hard and soft targets for the development of EIPs. • Develop command and control, and fiscal incentives that encourage EIPs. • Develop regulations that are conducive to the development of an enabling environment for EIPs. • Engage in national, regional, and international dialogue to source best practices, rather than duplicate existing practices.
Technological and socio-economic barriers	
Description: Certain high impact and innovative technological solutions are not advanced enough, and/or are too expensive to implement, especially in low margin environments and developing contexts. Competition concerns can arise for firms in parks having to bear higher costs (due to higher environmental and social performance requirements) than those that do not, when both compete in the same markets.	
Barriers: <ul style="list-style-type: none"> • Park management entity and firms lack finance to implement pollution prevention mechanisms. • High upfront capital costs with longer term returns on investments limit implementation. • Limited financial support for innovative processes and environmental measures to improve park infrastructure for the benefit of firms. • Park management is not entrusted with mandates and budgets by tenant firms. • Long lead times and disruptions when installing new technologies. • Limited understanding of the benefits of socially responsible business practices. • Lack of research funding. 	Sample Solutions: Policy makers can: <ul style="list-style-type: none"> • Provide capital subsidies and support to implement new technologies. • Encourage technological cooperation programs. • Encourage standardization. • Promote socially responsible business practices. EIPs can: <ul style="list-style-type: none"> • Engage in park-level dialogue and enterprise training to improve awareness of cost effective and advanced technology solutions and socially responsible business practices and associated benefits. • Deploy outsourced, technically sound infrastructure and services through viable business models.
Institutional and organizational capacity	
Description: There are potentially a large number of internal barriers, one of the most important being technical capacity.	
Barriers: <ul style="list-style-type: none"> • Lack of internal resources and technical workforce. • Lack of motivation for continuous improvements in moving toward an EIP. • Lack of experience in dealing with developers and authorities. • Lack of capacity for energy conservation and pollution prevention, or awareness of their cost saving potential. • Lack of stakeholder communication channels. • Lack of management resources. • Lack of indicators and guidelines. • Lack of external support from owners, value chains, communities and international organizations. 	Example Solutions: Policy makers can: <ul style="list-style-type: none"> • Prepare national guidelines and standards for EIPs. The performance standards suggested here can help inform frameworks and serve as benchmarks. • Fund training programs. EIPs can: <ul style="list-style-type: none"> • Examine sector-specific international best practices and adhere to them. • Develop internal training programs to build human resource capacities, which in turn can provide a competitive advantage. • Engage with national and regional stakeholders to build confidence in EIPs. • Engage professionals and/or firms to undertake EIP assessments, site master planning, and so on.



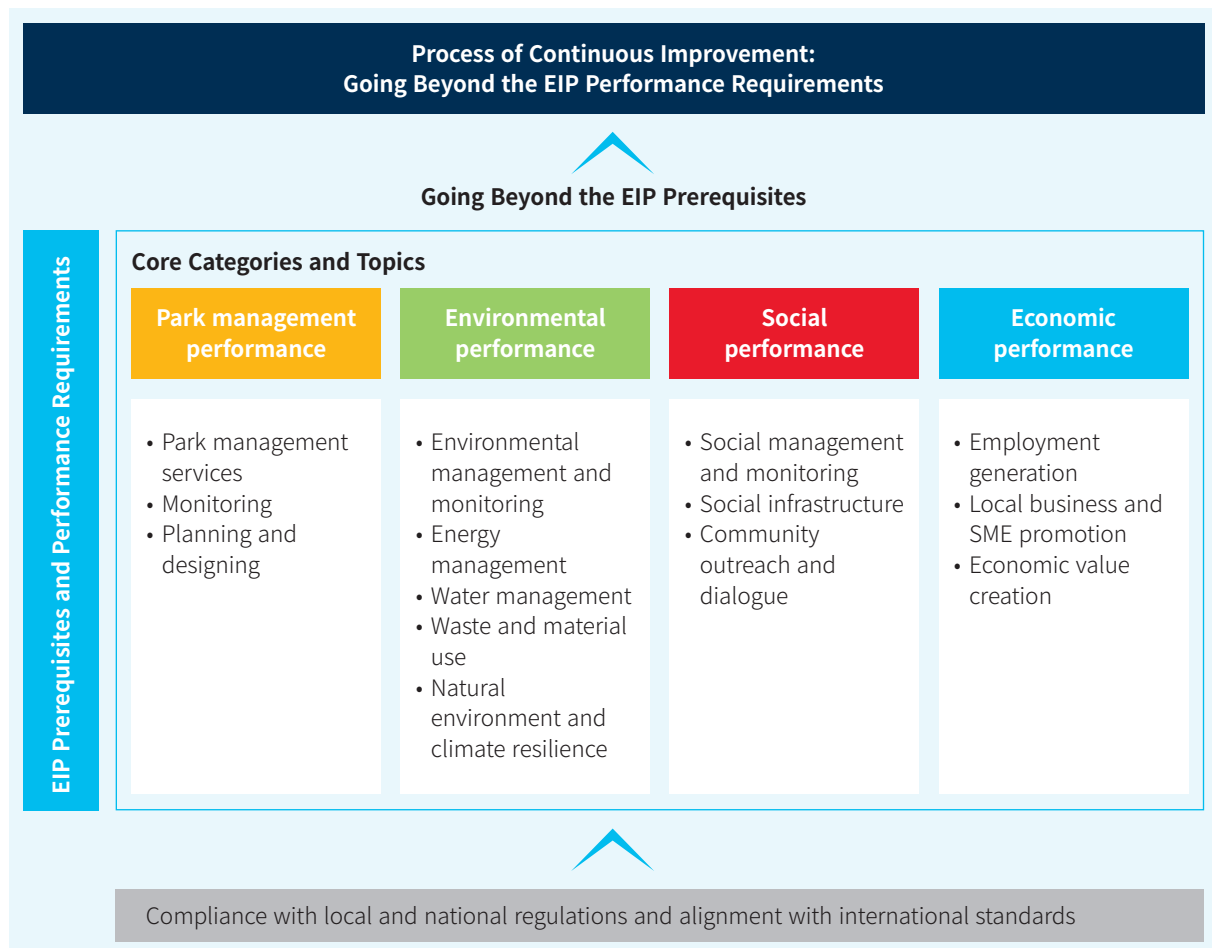
3

Approach to Defining Performance Requirements for Eco-Industrial Parks

3.1 Framework for Eco-Industrial Parks

The EIP framework describes performance **requirements for EIPs for four key categories: park management performance, environmental performance, social performance, and economic performance.** Figure 3 presents the overarching framework. This framework provides the basis for defining and setting prerequisites and performance requirements for EIPs (see Section 4). As a baseline, EIPs must comply with all applicable local and national regulations. They must also meet the broader requirements set out within this framework. The performance requirements for EIPs are defined so that environmental and social commitments go beyond prevailing regulatory requirements in the country.

Figure 3: Overall Framework for Describing Eco-Industrial Parks



Regulatory Compliance at the Park and Firm Levels

Compliance with national and local regulations is mandatory for all industrial parks, regardless of their location and characteristics. An EIP, as a collective entity of resident firms, must comply with all applicable national and local laws, regulations, and standards. When applying this framework to a specific park, stakeholders (typically local authorities and the EIP management team, and where relevant, investors) will be required to check for regulatory compliance.

When national regulations fall short of internationally expected compliance requirements, EIPs would be expected to align with standards based on international good practice. It is recognized that the stringency of national and local regulations will differ from country to country. Therefore, in countries in which regulatory frameworks do not match international standards, compliance can also refer to fundamental international standards applicable to the park and its resident firms. Compliance with local/national regulations and good international business practice applies to both the industrial park level (for example, the park management entity, property owners) and the firm level (for example, individual small, medium, and large enterprises operating in the park).

EIP Performance Requirements (Pre-requisites Plus)

The EIP framework provides performance requirements for EIPs. These international requirements for environmental, social, economic and park management performance have been primarily developed to inform EIP stakeholders about inclusive and sustainable industrial development. The requirements in the framework are not prescriptive. Given differences in the type, function, and regulatory setting of parks globally — and wide range of industrial sectors covered — sensitivity to local norms and standards should guide the framework's implementation.

Going Beyond EIP Performance Requirements (see annex 1)

Good industry practice for EIPs will recognize the importance of ongoing improvements at the park and firm levels, and the goal of exceeding minimum requirements. Compliance with EIP requirements is a primary step in integrating sustainability criteria within industrial parks. Where technically, socially, and economically possible, EIPs must strive to go beyond the performance requirements set out in this publication. Industrial parks differ in context and stage of development,⁹ and this presents opportunities for EIPs to act as models within given areas, for example on environmental sustainability. Annex 1 highlights the opportunities attending more ambitious criteria for industrial parks — going beyond the suggested performance requirements, and ultimately leading to more inclusive and sustainable industrial development.

3.2 Defining Performance Requirements for Eco-Industrial Parks

This section outlines the considerations necessary to develop performance requirements for EIPs.

A balance between ambition and achievability is important for implementation in developing countries and transition economies. The framework aims to achieve a balance between performance requirements so that they are meaningful, but also achievable (i.e. realistic), by the parks concerned. The requirements are classified by category, topics, and sub-topics. The relevance of (sub-) topics may depend on the geographical location and type of EIP. As such, sensitivity is required when applying these standards. However, all (sub-) topics are important and should be considered when determining whether a park can be considered an EIP.

The EIP framework requirements include both prerequisites and performance requirements. The prerequisites establish the basic conditions for industrial parks to start transitioning towards EIPs, and the performance requirements specify the indicators that an EIP should meet. These requirements cover both qualitative and quantitative indicators. The approach offers flexibility, and can be applied to different kinds of industrial parks.

⁹ For example, the macroeconomic and policy environment, the sector focus, process configuration, existing infrastructure, local development priorities and stakeholder commitments.

In setting the indicators for EIPs, careful consideration was given to the following:

- **Exceeding national compliance standards:** Performance metrics were set for industrial parks aspiring to exceed local and national regulations for environmental and social requirements (“compliance plus”).
- **Addressing key environmental and social requirements:** The framework focuses on important environmental, social, and economic impacts, rather than on detailed requirements, which may differ by industrial park. It also aims to achieve a balance of qualitative and quantitative indicators.
- **Focus on impact areas that can be controlled or influenced by the park’s management:** The topics, and associated sub-topics, need to address significant environmental, social, or economic impacts or benefits, which can be influenced at the park and/or firm level. They should include indicators that can be monitored, managed or influenced by the park management entity or resident firms.
- **Practicality of features and feasibility of implementation:** It is important to align with real-life practices, as opposed to what is desirable under optimum conditions. In some countries, it is already challenging for firms to comply with local and national regulations. Data availability, measurability, and confidentiality are also all-important considerations. In addition, indicators should not extensively burden the park management/operator entity or firms. Preferably, indicators should be easily monitored, measured, and reported. As such, they would leverage existing or available metrics and data, where possible, and this would increase the chances of their uptake and use.
- **Globally applicable:** Features that are unique, or limited to specific situations, have not been included in this framework. The indicators should be applicable to all countries, and relevant to new (“greenfield”) and existing (“brownfield”) industrial parks.
- **Align with competitiveness requirements:** There are many measures that can assist park management and firms to be more competitive, and to have better designed and managed industrial parks. Such measures may include: increasing resource efficiency (and thereby reducing costs) and circular economy practices; encouraging collaborative business opportunities (for example, through supply, utility, by-product, and service synergies); reducing risks (for example, environmental, social and business risks); ensuring the long-term license-to-operate and viability of the park; and collectively addressing government and community requirements. It is also a given that a park should be solvent.



4

Performance Requirements for Eco-Industrial Parks

4.1 Introduction

This section outlines the performance requirements for an industrial park to be considered an EIP.

These requirements are based on the framework outlined in Section 3, and focus on the key components and management of EIPs. Specifically, they focus on environmental, social and economic performance. As such, the framework moves from a common understanding of EIPs (Section 2) to a higher-level criteria and assessment approach (Section 3) to specific requirements within this section.

When applying this framework to a current or prospective industrial park development the following should be noted:

- The EIP framework and corresponding performance requirements provide a useful guideline toward the mainstreaming of EIPs. Additionally, they serve as a tool to build capacity and sound institutional frameworks. On an operational level, the EIP framework assists practitioners and park managers to identify areas in which further strengthening is required in line with international good practices.
- The EIP performance requirements set the expectations for EIPs globally. Sensitivity to local norms and standards is required in their application (for example, when setting thresholds for fuel and industrial electricity mix, energy intensity, waste disposal, as well as requirements of the higher-level governance structures, institutions, regulating bodies, and so on).
- The performance requirements within each category are divided into prerequisites and performance indicators. To be deemed an EIP, a park is expected to comply with all prerequisites and performance expectations (target values) as set by national governments for the countries concerned.
- Where currency values are specified, these should be converted to the local currency. Quantitative performance targets should be aligned against ambitious, but feasible national industry performance, norms and standards.
- Compliance with national and local regulations is necessary for all industrial parks, irrespective of their location and specific characteristics.
- The performance requirements for EIPs in this framework aim to go beyond compliance with national environmental and social regulations and requirements (“Compliance Plus”).
- EIPs are encouraged to exceed these requirements and performance expectations where it is technically, socially, and financially feasible and cost effective to do so.

4.2 Compliance with National and Local Regulations

EIPs and resident firms need to comply with all applicable national and local laws, regulations, and standards. This includes, but is not limited to, compliance with: national employment regulations; discharge limits; national air emission limits; waste disposal techniques; waste transportation requirements; hazardous waste handling restrictions; and noise limits during operations. In this context, the park management entity should have a monitoring system in place to report on the performance of firms, such as the International Organization for Standardization (ISO) 19600, which provides guidance on establishing, developing, implementing, evaluating, maintaining, and improving a compliance management program.¹⁰

In applying the EIP performance requirements to a specific park, stakeholders, particularly governments, authorities and park managers, will be required to monitor national and local compliance. EIPs should seek to align with international good practices when national regulations fall short of EIP expectations.

¹⁰ For more information see: [http://www.ey.com/Publication/vwLUAssets/EY-iso-19600-international-standard-for-compliance-management/\\$FILE/EY-iso-19600-international-standard-for-compliance-management.pdf](http://www.ey.com/Publication/vwLUAssets/EY-iso-19600-international-standard-for-compliance-management/$FILE/EY-iso-19600-international-standard-for-compliance-management.pdf)

The following regulatory compliance topics are considered most relevant to EIPs, and are based on the experiences of UNIDO, the World Bank Group, and GIZ worldwide. They aim to inform stakeholders of the relevant regulatory considerations. The following listing is not an all-inclusive record because regulations vary by country, and their relevance to specific industrial parks will differ.

Park Management Compliance: The park management entity should instil a culture of compliance in its own functions and activities, and extend this culture across its tenant firms. At a minimum, the park management entity should maintain compliance with:

- National regulations on OH&S and emergency requirements (for example, protective clothing and equipment, safety features of machines and work posts, regular medical inspections, and preventative measures);
- National regulations on anti-corruption (for example, access to information, accountability, bribery, and conflict of interest);
- National regulations on violence and crime prevention (such as cybercrime, theft, violence against women, and protection of children and the elderly);
- National regulations on land use planning, zoning, licensing and permits;
- National regulations on intellectual property, trade and fiscal measures;
- National regulations on emergency awareness and preparedness (including disaster risk management);
- National regulations on environmental and social aspects (as listed below); and
- By-laws related to national regulations.

Environmental Compliance: EIPs and tenant firms are expected to comply with all local and national environmental regulations. These include, but are not limited to the following:

- National regulations on air emission limits (for example, sulfur oxides (SO_x), nitrogen oxides (NO_x), heavy metals, particulate matter, GHGs and odors);
- National regulations on water extraction, watershed management and water discharge limits;
- National regulations on waste disposal (including contaminants, treatment requirements and recycling) and waste transportation (including labelling, maximum volumes, storage);
- National regulations on hazardous waste handling restrictions (including labelling, containment, and use of qualified contractors);
- National regulations on noise limits during operations (for example, maximum and ambient noise levels);
- National regulations on energy and resource efficiency, as well as other regulations related to efficiency (for example, on circular economy practices);
- National regulations on soil and ground water contamination (including effluent/waste discharges);
- National regulations on protection of the natural environment and biodiversity (for example, sensitive marine environments, inland water bodies, native forests, and protected flora and fauna);
- National regulations related to climate change mitigation and adaptation; and
- By-laws related to the national regulations listed above.

Social Compliance: EIPs and tenant firms are expected to comply with local and national regulations. These include, but are not limited to the following:

- National regulations on human rights (for example, gender equality and women and children's rights);
- National regulations for protection of indigenous people, and employment, vocational training and social security;
- National regulations on addressing discrimination (for example, discrimination based on color, race, religion, gender, age, and disability);
- National labor laws/regulations (including working hours, OH&S, prevention of child and forced labor, and maternity leave);
- National laws on land acquisition and compensation of affected people;
- National laws on protection of cultural heritage;
- By-laws related to the national regulations listed above.

Economic Compliance: EIPs and their tenants are expected to comply with local and national financial and economic regulations. These include, but are not limited to the following:

- National regulations on the reporting of financial performance and disclosure;
- Regulations on the promotion of SMEs and local business development;
- Regulations on technology transfer and protection of intellectual property;
- Regulations on skills development and vocational training; and
- Business regulations, including registration and licensing, financial, trade and fiscal regulations.

EIPs also need to conform with international standards and protocols, as outlined in Box 1.

Box 1: EIP Conformance with International Standards and Protocols

When local and national requirements are not well developed, where a park has an important international transboundary impact, or in cases in which a country has not yet adopted the international conventions and codes of conduct listed below, it is expected that an EIP would adhere to international standards, conventions and protocols. These may include, among others, the following:

Environmental:

- [Stockholm Convention on Persistent Organic Pollutants](#);
- [Basel Convention on the Control of Transboundary Movements of Hazardous Wastes](#);
- [Vienna Convention for the Protection of the Ozone Layer](#);
- [Emission Thresholds from the World Health Organisation](#);
- [International Convention for the Prevention of Pollution from Ships](#);
- [IFC Environmental, Health and Safety \(EHS\) Guidelines and Performance Standards](#);
- [Montreal Protocol on Substances that Deplete the Ozone Layer](#);
- [Economic Commission for Europe \(ECE\) Water Convention on the Protection and Use of Transboundary Water Courses and Internal Lakes](#);
- [Ramsar Convention of Wetlands](#);
- [Food and Agriculture Organization \(FAO\) International Code of Conduct on the Distribution and Use of Pesticides](#);
- [World Health Organization \(WHO\) Recommended Classifications of Pesticides by Hazard Class Ia/Ib](#);
- [World Bank Environmental and Social Framework](#);
- [Espoo Convention on Environmental Impact Assessment in the Transboundary Context](#).

Social:

- [United Nations Guiding Principles for Business and Human Rights](#);
- [The International Bill of Human Rights](#);
- [International Covenant on Economic, Social and Cultural Rights](#);
- [Declaration on Social Progress and Development](#);
- [Freedom of Association and Protection of the Right to Organize Convention](#);
- [Convention on the Rights of the Child](#);
- [Declaration on Fundamental Principles and Rights at Work \(International Labour Organization\)](#);
- [International Labour Standards on Child Labour \(International Labour Organization\)](#);
- [Standard Rules on the Equalization of Opportunities for Persons with Disabilities](#);
- [Declaration on the Rights of Indigenous Peoples](#);
- [International Convention on the Elimination of all Forms of Racial Discrimination](#);
- [Convention on the Elimination of All Forms of Discrimination against Women](#);
- [International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families](#);
- [Convention on the rights of Persons with Disability](#);
- [The Ten Principles of the UN Global Compact](#);
- [Women's Empowerment Principles](#);
- [OECD Guidelines for Multinational Enterprises](#);
- [Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy \(ILO\)](#).



Photo Credit: © Michael Gaida.

4.3 Park Management Performance Requirements

Introduction

The management entity of an industrial park plays a pivotal role in daily operations, ensuring the continuous implementation of an EIP framework, and engaging with the park's stakeholders, including resident firms, communities, and regulatory authorities. The management entity needs to be empowered to carry out these tasks, and the framework's performance requirements support this empowerment in the interests of overall sustainability.

The park management entity needs to have measures in place to manage risks and accidents, catalyze stakeholder dialogue, provide platforms for knowledge sharing, and operate and maintain park-level infrastructure. Furthermore, it is expected to formulate environmental- and social sustainability-related strategies for the park, including collaboration with regulators, resident firms and surrounding communities. It should also set performance targets at the park level. In addition, the park management entity needs to be knowledgeable about resident firm operations (for instance, resource demands, labor requirements, waste and wastewater generation and management, administration, and so on). With this knowledge, it can guide the EIP strategy, supply shared services and promote industrial synergies.

Although the park management entity is instrumental in driving sustainability, its influence should not be overestimated. While park managers can influence industrial operations, they are not mandated to police compliance with EIP framework regulations in most cases. Charters, codes of conduct, and service contracts signed by prospective tenants can drive sustainable park practices. In addition, attention should be given to potential conflicts of interest with regard to the roles and functions of regulators, inspectors, and the park management entity. Typically, these are not aggregated into one entity, and appropriate checks and balances are required.

A formalized, well-functioning and financially¹¹ sustainable park management entity can deliver a range of benefits, including the following:

- Having a single management entity to interface with resident firms, provide customer-oriented services, and engage with stakeholders will result in efficiency gains;
- Having a single entity to drive the overall strategy for resource efficient and clean production, circular economy practices and social standards, will help to meet national and international expectations in attracting local and international investment. The management entity should market the park as a sustainable business location adhering to international environmental and social standards;
- An environmentally- and socially-orientated management team can identify synergies and opportunities for collaborative approaches among park firms, and help achieve mutual environmental and social goals and targets; and
- A dedicated entity is better able to disseminate knowledge and inform stakeholders about new technologies and successful interventions available to EIP firms.

Beyond regulatory compliance, there are important considerations and performance requirements that the EIP park management entity must fulfil. Key considerations for a well-managed EIP include the following:

Park management services:

- ***An empowered park management entity is in place:*** A dedicated entity exists and acts as the park manager.¹² A park management entity is required for all industrial parks, including EIPs. The entity's role is to manage and maintain infrastructure and utilities, and organize and implement collective measures and services for resident firms and their employees. It will also manage risks, accidents and incidents

11 Financial sustainability of a park management entity may be achieved through a combination of incomes: rents, service fees and charges paid by resident firms, grants received from governments, commercial income such as revenues from operation of warehouses, on-site hotel, restaurants, shopping centers, etc., and other ad-hoc incomes such as those received from donors, and donations, etc.

12 In the framework, the park manager, sometimes also called the park operator, is defined as the entity that deals with management. This includes day-to-day operations, tenant services, infrastructure and facilities in the park, promotion and marketing of the park, and interactions with authorities and the community on behalf of tenants and itself in line with its mandate from higher level park governance structures, institutions, and regulating bodies that may exist in a country or economy.

at the park. In addition, it markets the park to new customers, preferably firms that will have synergetic operations with existing tenants.

- **All resident firms have signed a residency contract with the park management entity:** The park management entity needs to have a clear mandate to generate and/or secure sufficient financial resources to undertake its responsibilities and tasks. The residency contract should specify the responsibilities and tasks of the park management entity with respect to all park operations and services. It should also outline the responsibilities and tasks of tenant firms in detail, including provisions for payments and the collection of user fees. In a greenfield EIP, residency contracts should include the minimum environmental and social performance requirements expected of resident firms.
- **Park management facilitates continuous provision of shared park infrastructure and utility services:** EIPs provide integrated and collective infrastructure and utilities to avoid isolated, inefficient, and ineffective systems. The park management needs to provide infrastructure, along with risk, accident, and incident management. It also needs to maintain these facilities, and collect user fees for this purpose.
- **Engagement with the park's stakeholders, and business representation:** The park management within an EIP is expected to carry out periodic stakeholder consultations with relevant parties (for example, local citizens, municipal and government officials, workers and firm representatives). It also promotes, supports, and facilitates knowledge sharing and collaboration between firms in the industrial park. Where appropriate, it explores and promotes opportunities for firm-level resource efficiency and sharing of wider benefits. Park management and engagement should also involve the creation of a forum for tenants to cooperate and collaborate to identify common interests, synergies, and funding opportunities to achieve environmental and social performance requirements. The park management should also represent the interests and objectives of the park in handling local or regional disputes and in holding stakeholder meetings.
- **Engagement with local community and the public:** The park management maintains good relations with the local community, is dedicated to an open-information policy, and strives for community participation in all steps of park development and operation.

Monitoring: Monitoring is an important mechanism to track progress against EIP environmental, social and economic performance targets in a transparent and accountable manner. Residency contracts of park firms should include provisions for sharing information with the park management entity regarding compliance declarations to regulators and inspection bodies. This should be done with respect for issues of confidentiality and intellectual property rights.

Park Management should monitor general park environmental conditions (air quality, wastewater discharge), and operate an emergency response system in case of fire, air and water contamination, etc.

In both existing and new industrial parks, firms should seek to reach a documented agreement regarding the implementation and enforcement of additional measures (“compliance plus”) related to EIP performance targets at the firm level and collectively — but without imposing disproportionate burdens on firms. Upon such agreement, the park management entity should undertake EIP performance monitoring regularly. In some cases, the park management entity may enforce selected regulatory compliance issues. The entity would monitor compliance to the extent of the powers given to it by park regulatory and other relevant inspection entities, including requisite financial resources for related monitoring and enforcement activities. If some statutory compliance monitoring and enforcement is delegated to a park management entity, then regulators, inspectors and park managers should be alert to conflicts of interest, and have mechanisms to address them.

Planning and designing: A thorough planning and design process, including selection of the most appropriate location/site is a key component of an EIP, particularly for greenfield EIPs. This should include a master plan to consider economic, environmental, and social aspects through multi-stakeholder processes with government agencies, the private sector, and the local community, among others. With regard to climate change adaptation and disaster risk management, the design and planning can have significant implications for firms in the EIP, as outlined in box 2.

Box 2: Climate Change Adaptation (CCA) and Disaster Risk Management in Eco-Industrial Parks

Climate change is a growing threat to industrial development. Some industrial parks are located in vulnerable areas, which may pose long-term risks to their economic activities and operations. Impacts of a changing climate — particularly due to increasing temperatures, heat waves, droughts, excessive or reduced rainfall, flooding, and so on — are becoming a significant concern for vulnerable industrial parks. Indeed, climate change can lead to infrastructure damage, environmental degradation, risks to human health, and considerable economic losses. In some developing countries, there is insufficient awareness of the need to adapt to climate change, as well as a lack of technical expertise in park management to provide climate-resilient measures in industrial areas.

Climate change adaptation requires anticipating local impacts and acting to prevent or minimize possible damage. EIPs that are vulnerable to climate change should seek to reduce environmental, social and economic damages caused by heat waves, droughts, heavy rainfall, cyclones and floods. In this context, they should implement adaptation measures for infrastructure and services. For example, this can be achieved through the integration of CCA measures into site selection, planning, implementation, and risk management within new parks, as well as in the retrofitting of existing industrial parks.

To successfully integrate climate change adaptation measures, the park management should create awareness through capacity development and sensitization. This enables resident firms to analyze and prioritize their climate change-related risks, and develop suitable adaptation strategies — which could ultimately lead to investment in climate-resilient development of industrial areas. Adaptation measures and disaster preparedness for industrial parks and their firms could increase their resilience. Through these actions, the costs of losses and damages, as well as negative socio-economic impacts caused by extreme weather events can be reduced.

Park Management: EIP Performance Requirements

The park management requirements for EIPs are outlined in table 2, which details EIP prerequisites and performance indicators. These can be used to set international EIP expectations, but may require adaptation to local norms and industry benchmarks.

Table 2: Park Management - Performance Requirements for Eco-Industrial Parks

EIP Prerequisites for Park Management				
Topic	Sub-topic	Description/Requirement	Prerequisites/Evidence	Checklist
Park management services	Park management entity	A park management entity (or alternative agency, where applicable) exists to handle park planning, operations and monitoring.	A distinct park management entity (or agency, where applicable) exists to handle park planning, operations, management, and monitoring.	Available [Yes / No]
	Park property, common infrastructure and services	The park management entity provides and facilitates common services and infrastructure to resident firms to ensure smooth operations.	<p>Park management entity to manage and maintain the industrial park property, common infrastructure, and services as prescribed in the tenant contract. This should include at least the following:</p> <ul style="list-style-type: none"> • Property management, including plot allotments, re-allotments, development, land use monitoring. • Utilities, roads, security (including IT security) and emergency response services/facilities and wastewater treatment plants and operations, including waste heat/energy recovery and distribution networks • Environmental monitoring and advisory activities • Common landscaping, buffer zones, street lighting, security surveillance and street cleaning. • Provide facilitating services to and between tenant firms (for example, networking, collaboration and training opportunities). • Engagement with the park's stakeholders and business representatives. • PR and community participation center/platform/activities. 	Available [Yes / No]
Monitoring and risk management	Monitoring performance and risks	The park management entity has established and maintains a system for monitoring achievement of threshold EIP performance targets and management of critical risk factors within the park.	<p>Park management entity maintains an EIP framework monitoring system in place, tracking and reporting:</p> <ul style="list-style-type: none"> • Progress on environmental, social and economic performance at the park level annually. • Critical risk factors and related responses, at least for: <ul style="list-style-type: none"> ◦ Risk points for the accidental release of hazardous solid, liquid and gaseous effluents, including during transportation and disposal when fire hazards are possible; and ◦ Applicable natural disaster risks (for example, earthquakes); ◦ Environmental performance; ◦ Social performance; ◦ Economic performance; and ◦ Critical risk management at the level of the park. • Acts as monitoring and pre-clearing institution for environmental issues on behalf of the regulatory bodies, as delegated. • May operate a central environment control unit with an emergency alert system for environmental and other hazards. 	Available [Yes / No]
		The park management establishes measures to deal with climate change adaptation and disaster preparedness.	Park management has a plan, to be updated every seven years, in place to react to possible negative impacts due to climate change (heat waves and droughts, storms and floodwater events). All adaption needs for infrastructure and services are identified and in place for the industrial park to protect against climate change and potential damages. Park management entity and resident firms have plans and measures to ensure continued operation of critical infrastructure systems within the park (e.g., wastewater treatment plants, power plants, recycling facilities, etc.) that can be activated even in emergencies.	Available [Yes / No]
	Climate risk assessment	The park management entity collects, assesses, and reviews comprehensive climate risk information specific to the location of the park.	Park management entity investigates risks due to climate change and updates this information on a regular basis.	Available [Yes / No]
	Information on applicable regulations and standards	Park management has a good understanding of regulations and international standards applicable to industrial park compliance and enforces them in the park.	Park management entity has a system to collect, register and comply with local/national regulations and international standards applicable to the industrial park. Park management enforces compliance by resident firms and requests and collects compliance information that firms share with the park management entity.	Available [Yes / No]
Planning and park design ¹³	Master plan	A master plan for the EIP is developed by park developers and is applicable to both planning and operations by park managers.	<p>A master plan (or equivalent planning document) for any new and existing industrial park has been developed and is reviewed periodically (minimum every seven years) and updated if required, including the following core elements:</p> <ul style="list-style-type: none"> • Based on various risk analyses; essential and efficient infrastructure (onsite and offsite, in particular ensuring access to decent housing), utilities, transportation network; environmental and social issues; buffer zone around the park; procedure to safely locate high risk industries; and cluster synergistic industries and similar. • Integration into master plan of relevant requirements specified in this EIP framework. 	Available [Yes / No]
Performance indicators for Park Management				
Topic	Sub-topic	Description/Requirement	Performance indicator	Unit [Target value]
Park management services	Park management empowerment	Distinct park management entity is empowered to provide and charge fees through a legally binding instrument.	Proportion of firms in the industrial park to have signed a residency contract/park charter/code of conduct (depending on what is legally binding on park firms according to the existing legislation in the country ¹⁴) and additional legally binding arrangements that empower the park management entity to perform its responsibilities and tasks, and charge fees (sometimes absorbed in rental fees) for common services. This may include transparent fees for services pertaining to the achievement of EIP performance targets.	Percentage of firms [100%]
	Park management entity property and common infrastructure operations	The park management entity provides and facilitates efficient common services and infrastructure to resident firms.	Proportion of satisfied resident firms with regard to the provision of services and common infrastructure by the park management's entity (or agency, where applicable) out of total respondents.	Percentage of firms [75%]

¹³ While planning and design processes of an industrial park are most relevant for greenfield initiatives, the original, industrial park masterplan remains useful as a guide to park management regarding future expectations and plans.

¹⁴ In most developing countries, a park's charter or code of conduct may not be a legally binding instrument. Therefore, it would not provide the park management entity with the necessary authority.

4.4 Environmental Performance Requirements

Introduction

Environmental performance encompasses both the management and mitigation of potential adverse environmental impacts. It entails the introduction of low/zero carbon energy generation and resource-efficient production processes.

Typically, key environmental themes in the context of Eco-Industrial Parks include pollution prevention, resource efficiency and cleaner production, industrial symbiosis and synergies, and water, waste and energy management.

Pollution control systems are needed to mitigate the hazardous nature of industrial production and operation. Indeed, pollution prevention is an important consideration for all EIPs. If technically possible, pollution should be avoided in the first place through circular economy practices. When process emissions and by-products cannot be avoided, they should be mitigated at the source.

Resource Efficient and Cleaner Production (RECP) refers to the integrated and continued application of preventive environmental practices and total productivity techniques. These practices and techniques are aimed at increasing the efficiency of industrial processes, products and services, while reducing risks to people and the environment (UNIDO and UNEP 2010). RECP also includes the implementation of low carbon inputs (resources and energy) to avoid negative environmental externalities.

The concepts of industrial cooperation and synergies are attracting increasing interest as an approach to fostering greater environmental, social, and economic benefits. Industrial symbiosis, a circular economy practice, entails the exchange of by-products, energy, and process wastes among closely situated firms. The keys to industrial symbiosis are collaboration and taking advantage of the synergistic possibilities offered by firms situated close to one another (Chertow 2000).

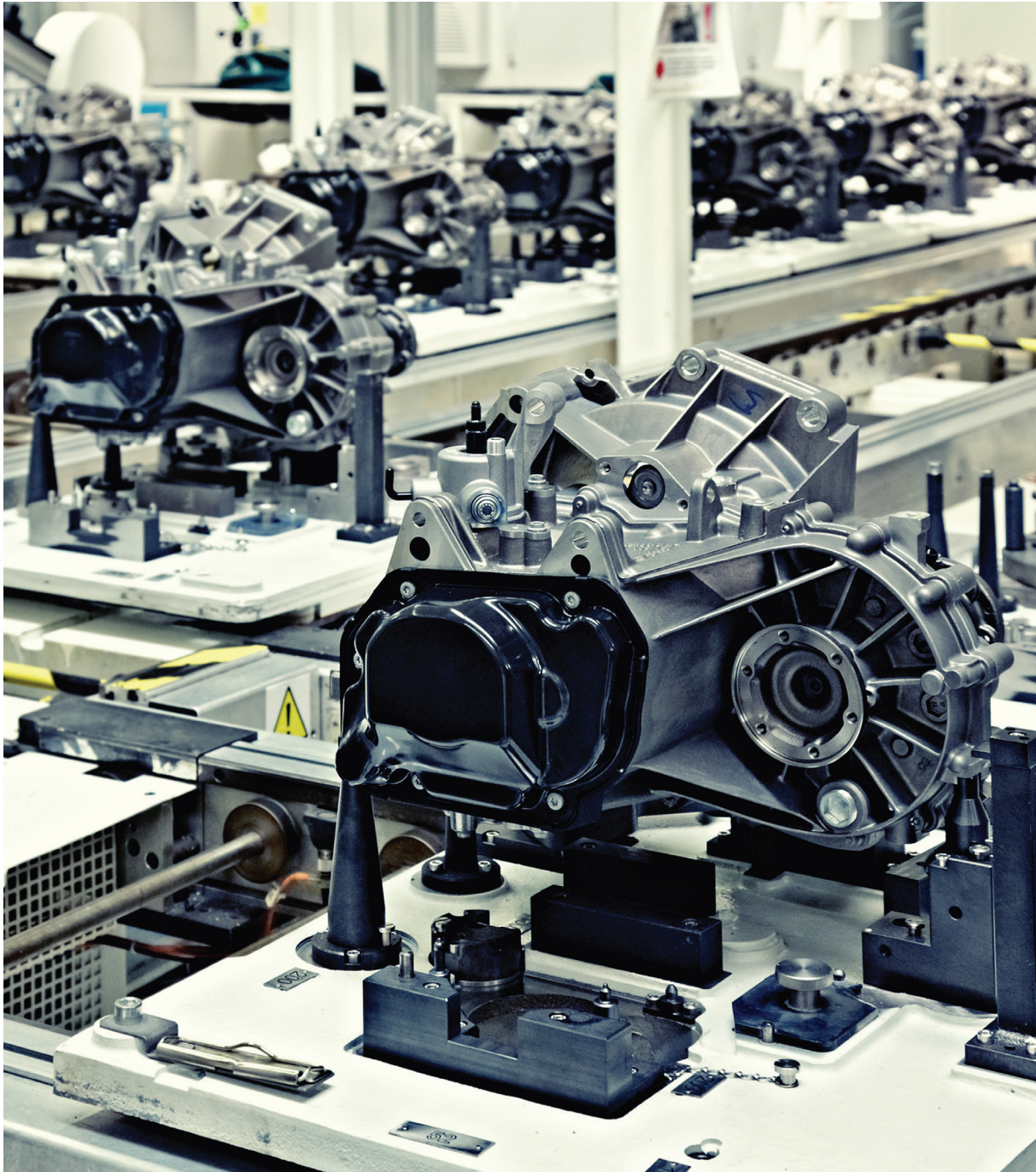
Waste, water and energy management are key factors in circularity at the industrial park level. Management may also entail using large waste streams for material exchanges to make industrial parks greener. Combining energy and heat networks enables the exchange of waste energy and heat, thereby providing potentially lower-cost energy to resident firms. Circularity can also help firms to minimize operational expenses by designing out or reducing the quantity of waste and effluents to be treated and discharged. In addition, renewable energy and energy efficiency measures can partly displace the use of fossil fuels across key park infrastructure and tenant businesses.

The strategic tackling of environmental considerations within EIPs can deliver a range of benefits, including:

- Helping EIPs avoid or minimize adverse impacts on the climate, human health, and the natural environment. Promoting the sustainable use of resources and circularity within EIP physical boundaries and surrounding areas;
- Assisting EIPs to reduce costs, increase competitiveness, and enhance investor attractiveness; and
- Enabling EIPs to show environmental leadership with a view to promoting and improving environmental performance in their respective sectors, regions and countries.

Beyond regulatory compliance, there are a number of important environmental considerations and requirements that an EIP must fulfil. Important considerations for increasing environmental performance are summarized as follows:

Management and monitoring: An EIP needs to have dedicated personnel within the park management entity for operating both environmental management systems (EMS) and energy management systems (EnMS). These systems should adhere to internationally certified standards. In addition, they should enable users to monitor park performance, and support resident firms to do the same. Where appropriate, firm level data should be aggregated and reported confidentially at the park level.



Energy: An EIP supports resident firms to improve the efficiency of industrial processes and buildings. It seeks a high level of energy efficiency in common services under the control of the park management entity. Where technically possible and cost effective, EIPs must replace fossil fuels through the integration of low or zero carbon/renewable electricity generation across key park infrastructure, and promote its implementation to resident businesses. Common networks for waste heat/energy distribution and utilization need to be in place based on an agreed rewards system for waste heat/energy provision. The formation of energy efficiency networks among resident firms needs to be encouraged by park management. EIPs should also take stock of their carbon footprint (greenhouse gas emissions). In addition, reduction targets should be set annually. Parks also need strategies to avoid or minimize GHG emissions through extended energy efficiency measures, industrial symbiosis, circular economy practices and the use of renewable energy sources encouraged by a rewards system for CO₂ emissions savings.

Water supply and wastewater: An EIP should prioritize sustainable water management, use, efficiency and treatment. EIPs are expected to use water responsibly, taking into account local water scarcity issues, sensitive water reservoirs and non-climatic uncertainties that can shock or stress the water allocation system as a result of land use changes, demographics, or shifts in demand. An EIP should also plan to increase water efficiency for resident firms and the park as a whole. Wastewater must be treated, and water circularity promoted. Water recycling should have priority over zero liquid discharge (ZLD) systems.

Waste and material use: An EIP needs a waste management plan which also covers reduction and reuse at park and firm levels. Resource conservation through circular economy practices should be encouraged. The park should also facilitate industrial symbiosis between industries, both within the park and outside it, and municipalities (urban industrial symbiosis). The park manager, or a designated entity, monitors and accounts for waste disposal, and ensures environmentally sound disposal. A hazardous waste monitoring system is needed to track the storage and disposal of toxic materials. On-site solutions for hazardous waste management might be considered before releasing waste into an insecure public disposal system.

Climate change and the natural environment: Climate change requires anticipating local and global effects of climate breakdown, and preventing or minimizing potential damage. Thus, the management entity needs to be aware of these impacts, and act to mitigate risks to the park. In this context, the EIP should seek to reduce emissions of GHG gases, as well as air and point-source pollution. Monitoring the carbon footprints of park activities, and reducing CO₂ emissions should be incorporated in the park's code of conduct and made compulsory for all resident firms.

EIP Environmental Performance Requirements

The environmental performance requirements for EIPs are outlined in table 3 in the form of EIP prerequisites and performance indicators. These can be used to set international EIP expectations, but may require adaptation to local norms and industry benchmarks.

Table 3: Environment - Performance Requirements for Eco-Industrial Parks

EIP prerequisites				
Topic	Sub-topic	Description/Requirement	Prerequisites/Evidence	Checklist
Management and monitoring	Environmental and Energy Management Systems (EMS and EnMS, respectively)	The park has appropriate, functioning EMS and EnMS systems (for example, ISO 14001 Environmental Management Standard and ISO 50001 Energy Management Standard) in place to set and achieve targets, and covering key issues (for example, energy waste and material use; water; point-source emissions; carbon footprint; and the natural environment).	<ul style="list-style-type: none"> • Park management entity operates an environmental/energy management system in line with internationally certified standards, monitoring park performance and supporting resident firms in the maintenance of their own firm-level management systems. For this purpose it records all relevant data, preferably managed by a dedicated environmental monitoring and recording unit/group. 	Available [Yes / No]
		The park actively supports and facilitates industrial synergies and symbiosis.	<ul style="list-style-type: none"> • Park management entity keeps updated records on energy, water, waste products, and materials inefficiencies and needs at tenant firms to provide a basis for industrial synergies development. 	Available [Yes / No]
Energy	Energy efficiency	Energy efficiency strategies are in place for the park management infrastructure and major energy-consuming resident firms.	<ul style="list-style-type: none"> • Supporting programs (e.g., energy efficiency networks) are in place to improve the energy efficiency of major energy-consuming businesses in the park. 	Available [Yes / No]
	Energy network and waste heat recovery	A program/mechanism is in place to identify opportunities for common energy and heat exchange networks to be established. The park management will provide the required physical network and offers support programs to assist resident firms with implementation.	<ul style="list-style-type: none"> • An industrial heat recovery strategy is in place to investigate opportunities for heat and energy recovery for the major thermal energy-consuming firms in the park. (Typically, these are firms that individually use at least 10–20 percent of total firm level energy consumption). • Park management provides the physical network for waste heat/energy exchange at park level, and assists firms to connect to the network. A commonly accepted rewards system for waste heat/energy provision/use is in place. 	Available [Yes / No]
Water supply and wastewater	Water efficiency, reuse and recycling	Water-saving and re-use plans are important to reduce total water consumption and manage water use. The industrial park may face challenges related to climate and non-climate related uncertainties that can shock and/or stress a system (land use changes, demographics, shifts in demand, etc). The park and firms should have systems in place to increase water savings and reuse.	<ul style="list-style-type: none"> • Park management entity has operational plans to increase water reuse in next five years. This would be achieved by either reuse of industrial effluents, or by rainwater/storm water collection. 	Available [Yes / No]
			<ul style="list-style-type: none"> • Park management entity provides the physical network for water reuse/cascading of water. 	Available [Yes / No]
Waste and material use	Dangerous and toxic material	Tenant firms are obliged to make as little use as possible of hazardous materials in their production process; to generate as little hazardous waste as possible, and to seek alternative materials.	<ul style="list-style-type: none"> • Obeying the principles of good practices for the management of hazardous materials and waste as part of legally binding agreements. 	Available [Yes / No]
	Resource conservation	The park management and firms are obliged to consider circular economy principles and practices (e.g. circular products, using as little virgin raw material as possible, reuse and remanufacturing of components and parts and making extensive use of secondary/recycled materials generated in the park).	<ul style="list-style-type: none"> • Obeying the principles of circular economy is part of the Park's Code of Conduct, and any legally binding agreement between tenant firms and the park authority. 	Available [Yes / No]
	Treatment of waste	Waste generated in the production process is recovered, as far as possible, through sorting, cleaning, conditioning etc., so that it can be used as raw material for other firms in and outside of the park.	<ul style="list-style-type: none"> • A central park facility or other mechanism is in place to treat waste that cannot be processed by individual firms. 	Available [Yes / No]
	Disposal of waste	Waste/secondary raw materials (including hazardous waste) leaving the park is being monitored to check that the material is either reused or further processed by authorised firms outside of the park, or disposed of according to legal and environmental standards.	<ul style="list-style-type: none"> • A monitoring system is in place that controls and registers origin, type, mode and route of transport, and final destination of waste/secondary raw material leaving the park. 	Available [Yes / No]
Climate change and the natural environment	Air, GHG emissions and pollution prevention	The park seeks to limit and mitigate pollution and GHG emissions, including air, waterway, and ground pollution. A set of measures at the park level is introduced (for instance, low-carbon technologies, energy efficiency measures, circular economy practices, waste heat recovery) to reduce GHG emissions.	<ul style="list-style-type: none"> • A program is established with clear evidence of steps taken to monitor, mitigate and/or minimize GHG emissions such as carbon dioxide (CO₂), methane (CH₄), and nitrogen oxides (NO_x). 	Available [Yes / No]
			<ul style="list-style-type: none"> • Reducing CO₂ emissions is an integral part of the park's code of conduct, which urges firms to reduce their carbon footprint. The park acknowledges actions in this regard through an awards and incentive system. 	Available [Yes / No]
	Environmental assessment and ecosystem services	The industrial park demonstrates an understanding of the potential impact of park activities on priority ecosystem services in and around the vicinity of the park, and takes needed actions.	<ul style="list-style-type: none"> • The park management entity has a plan in place to assess operational environmental impacts, and aims to limit these impacts on prioritized local ecosystem services. • The park management implements measures to protect biodiversity, and protects or creates natural/recreational areas in and surrounding the park. 	Available [Yes / No]

Performance indicators				
Topic	Sub-topic	Description/requirement	Performance indicator	Unit [Target value]
Management and monitoring	Environmental/Energy Management Systems (EMS and EnMS, respectively)	Firms have functioning and fit-for-purpose EMS/EnMS systems. Summary information from these management systems is provided to park management, who aggregate and report on data at the park level.	<ul style="list-style-type: none"> • Proportion of a firm's energy consumption that is covered by an energy management system. 	Percentage of energy consumption by firms to be covered by an energy management system [10%]

Performance indicators				
Topic	Sub-topic	Description/requirement	Performance indicator	Unit [Target value]
Energy	Energy consumption	The industrial park has adequate metering and monitoring systems in place to measure thermal energy and electricity consumption at both the park and firm levels.	• Proportion of the park management and tenant firms that have a metering system in place.	Percentage of park facilities [100%]
			• Proportion of firm-level energy consumption that is monitored.	Percentage firm-level energy consumption monitored [20%]
	Renewable and clean energy	The industrial park leverages available renewable energy with plans to increase its contribution for shared services (for example, solar streetlamps).	• Total renewable energy use for electricity and heat production in the industrial park is equal to or greater than the renewable energy share in the annual national electricity mix in the grid.	National grid emission factor ¹⁵ ≥ the combined CO ₂ emissions intensity ¹⁶ as per unit of produced and purchased heat and electricity for use by EIP firms
	Energy efficiency	Energy efficiency opportunities should be identified at the park and firm levels to reduce energy use and associated greenhouse gas emissions. EIPs should identify and promote technological and process-related interventions in their own and resident business operations.	• The equivalent of at least 10% of the total CO ₂ emissions (Scope 1 and 2) at park level is covered by the percentage of firms that have a qualified energy efficiency certification (LEED, Industry EDGE, DGNB or ISO 50001 or their national equivalent).	Percentage of CO ₂ emissions covered by the firms with energy management certification [10%]
Water supply and wastewater	Water consumption	A mechanism is in place to monitor water consumption across the park, and establish demand management practices in case of water stress. Extraction from water sources (such as rivers and groundwater sources) should take place at sustainable levels. ¹⁷	• Total water demand from firms in industrial park that does not negatively impact local water sources or communities.	Percentage of water demand [100%]
	Wastewater treatment	The industrial park has provisions to treat, recycle and reuse treated wastewater. No effluents significantly impact potable water resources, or the health of local communities or nearby ecosystems.	• Proportion of industrial wastewater generated by industrial park and resident firms which is treated in accordance with appropriate environmental standards.	Percentage of wastewater treated/total wastewater [100%]
	Water efficiency, reuse and recycling	The park and firms have systems in place to increase water savings and reuse.	• Proportion of total industrial wastewater from firms that is reused responsibly within or outside the industrial park.	Percentage of water reused or recycled/total water consumed [25%]
Waste and material use	Waste/by-products re-use and recycling	A waste management plan with a program/mechanism in place to promote and encourage reuse and recycling of materials by firms in the park (for example, raw materials for process and non-process applications).	• Proportion of non-hazardous, solid industrial waste generated by firms that is reused-recycled by other firms, neighbouring communities, or municipalities.	Percentage of solid waste reused/total waste [25%]
	Dangerous and toxic materials	Program/mechanism in place with clear targets to reduce, and avoid the use of, dangerous and hazardous materials by firms in the park.	• Proportion of firms in park which appropriately handle, store, transport and dispose of toxic and hazardous materials.	Percentage of firms with programs for handling and disposing of hazardous materials [100%]
	Resource conservation	Circular economy practices (e.g., Industrial Symbiosis Networks, Exchange Platforms for waste and secondary raw materials, for reuse and recycling, etc.) are in place and used by firms. Circular economy practices consist of a) redesigning products for ease of reuse, remanufacturing, disassembly and recycling; b) reuse of waste and/or by-product within its own operations; c) collecting back and remanufacturing products or parts and components of products.	• Proportion of manufacturing firms adopting circular economy practices, including engagement in Industrial Symbiosis Networks in the park; or actively exchanging secondary raw materials, or waste, or other circular economy practices.	Percentage of tenant firms participating in CE practices [20%]
	Waste disposal	A waste management system with a systematic approach to collection, treatment, recycling and disposal of waste, and which correctly manages unusable waste materials (e.g., disposed of in proper landfills, burned in proper incinerator).	• Waste generated by firms in the industrial park which is safely disposed of. Open burning of waste generated in an EIP is prohibited.	Percentage of industrial waste without re-processing, reuse or recycling options that go to sound disposal [100%]
Climate change and the natural environment	Flora and fauna	Native flora and fauna are important to maintain the proportion of natural areas. They are integrated within the industrial park and natural ecosystem where possible.	• Proportion of open space ¹⁸ in the park for native flora and fauna.	Percentage of open space [5%]
	Air, GHG emissions and pollution prevention	A mechanism is in place to avoid, minimize, and/or mitigate significant point-source pollution and GHG emissions. Covering GHG gases (CO ₂ , methane (CH ₄), nitrous oxide (N ₂ O), and hydrofluorocarbons (HFCs)), local particulate and air pollution emissions such as PM 2.5, heavy metals (Hg, Cd, Pb and other relevant heavy metals), selected unintentional toxic organic pollutants (dioxins, PCDD/Fs). Program for on-site chemical management.	• Proportion of firms in park which have pollution prevention and emission reduction strategies to reduce the intensity and mass flow of pollution/emission releases which exceed national regulations. • Proportion of firms in industrial park which have a risk management framework in place that: (a) identifies activities which have an impact on the environment, and; (b) assigns a level of significance to each activity, and; (c) have appropriate mitigation measures in place.	Percentage of firms [50%] Percentage of firms [30%]

15 National Grid Emission factor is the measure of CO₂ emissions intensity per unit of electricity generation in the national grid (kg CO₂/kWh).

16 This should cover Scope 1 emissions: direct emissions from owned or controlled sources, and Scope 2 emissions: indirect emissions from the generation of purchased energy.

17 Sustainable levels refer to the rights/concessions allocated to incentivize lower water usage as compared to the business-as-usual baseline.

18 Open space refers to natural areas not allocated for industrial use but used to maintain native flora and fauna.

4.5 Social Performance Requirements

Introduction

Eco-Industrial Parks should ensure implementation of good social management practices, including decent work, social and community infrastructure, and good relationships with the local community.

The overarching aim of social performance requirements is to adopt good international practice across the park and resident firms. The social performance of the EIP is an indicator of its inclusiveness, local employee/ community welfare, and equal opportunities.

Historically, industrial parks have faced social challenges, including labor conditions, child labor, treatment of migrant workers, land rights (such as land grabbing, economic displacement, involuntary resettlement), and community cohesion. Some compensation mechanisms have been put in place, including employment contracts, and adequate employee facilities (for example, restrooms, cafeterias, childcare provision, and medical facilities) to address these issues. The severity of these issues differs by country, the nature of the industrial activity, and the stringency and enforcement of local regulations.

An emerging social challenge concerns the implementation of elements of “Industry 4.0” and the “Internet of Things”, including use of artificial intelligence (AI) or fully-automated production processes in industrial parks, particularly in “developing” and “emerging market” countries. While these developments might create additional jobs for educated IT specialists, the number of jobs for un- or low-skilled labor will be reduced. While economic considerations might favour this development, it will have negative impacts on the social environment due to losses of jobs and income, in particular in the low-income sector. EIPs need to reflect on this emerging challenge and to adopt mitigating measures for an undisruptive transformation.

In general, park management must ensure that the EIP reflects good international standards regarding social management practices across its resident firms and activities. In addition, it should comply with Occupational Health and Safety Standards, and auditing and transparency expectations. Finally, it should apply social safeguards to both its upstream and downstream value chains.

Meeting these social performance requirements can deliver a wide range of benefits, including:

- Adverse social impact on the EIP’s work force and the local community are minimized;
- Better approaches to gender and social issues for workers and the community will contribute to a more resilient and efficient industrial park, improved productivity, and better employee retention;
- Balance workers’ economic, job security, social and up-skilling needs with the necessity to take advantage of emerging technologies that increase productivity and competitiveness; and
- Enhanced reputation and relations with the community, investors and customers through proactively addressing social risks and gender inequality.

Apart from national regulatory compliance, there are several important considerations and social requirements that an EIP must fulfill. Important considerations for improving the social performance in an EIP include:

Social management systems: Customized and fit-for-purpose management systems are required at the park and firm levels to address relevant social, OH&S and grievance procedures and impacts. These should be based on a continuous improvement process approach. The improvement of conditions for workers in industrial parks is also an important concern to address as part of the OH&S management system. Furthermore, all workers have the right to decent work – fairly paid, productive work for women and men, carried out in conditions of freedom, equity, security and dignity. In industrial parks, working hours, working conditions, compensation, annual and maternity leave must be, at a minimum, in line with national and sectoral norms. The risk of job losses due to changing technologies in production and manufacturing processes should be countered by industrial parks through the re- and up-skilling of workers.

Social infrastructure: Essential social infrastructure should be provided in industrial parks or their surroundings to support workers and the local community. Primary social infrastructure should cover local shops, restaurants/cafeterias, recreation areas, medical facilities, training centers, banks, post offices, and emergency fire facilities. This social infrastructure improves the living and working conditions of employees and neighboring communities, and should pay special attention to gender equality, security, crime prevention, and human resource development.

- **Gender equality** is a matter of fundamental human rights, social justice and sustainable development. While the world has achieved progress towards gender equality and women's empowerment, women continue to suffer discrimination and violence in every part of the world. Gender issues need to be addressed through equal employment and capacity-building opportunities, as well as social infrastructure and safe working conditions that respond to the specific needs of women.
- **Security and crime prevention.** Security and crime in industrial parks may be issues of concern depending on circumstances. Security is crucial for both employees and firms in the park. Security arrangements should be guided by good international practice in relation to hiring, rules of conduct, training, equipping, and monitoring of security guards.
- **Human resource development,** vocational training and capacity building should be offered to ensure the continued supply of a skilled labor force that can respond to new market developments.

Local community dialogue and outreach: International experience shows that the engagement of firms in community activities can lead to positive outcomes such as strengthening trust and relationships between industries and local communities.

EIP Social Performance Requirements

The social performance requirements for EIPs are outlined in table 4 in the form of EIP prerequisites and performance indicators. These can help to set international EIP expectations, but may require adaptation to local norms and industry benchmarks.

Table 4: Social - Performance Requirements for Eco-Industrial Parks

EIP prerequisites				
Topic	Sub-topic	Description/Requirement	Prerequisites/Evidence	Checklist
Social management systems	Management team	Functioning system(s) are in place for ensuring social infrastructure provisioning, operations and performance, as well as collecting, monitoring, and managing key social information and impacts relevant to the industrial park.	<ul style="list-style-type: none"> Dedicated personnel exist (as part of the park management entity) to plan, manage and enforce social quality standards. 	Available [Yes / No]
Social Infrastructure	Primary social infrastructure	Social Infrastructure addresses different aspects to improve the living and working conditions of employees and neighbouring communities. Provision of primary social infrastructure is vital for employees' health and welfare, paying special attention to the needs of women. Primary social infrastructure covers inter alia adequate medical services, educational and training institutions, separate toilets and washing facilities, and provision of cafeterias and recreational areas.	<ul style="list-style-type: none"> Essential primary social infrastructure has been adequately provided in the site master plan and is fully operational in the park. Gender perspectives are incorporated in the formulation, management and monitoring of plans and programs. A particular entity (e.g. planning unit or facilitated group of interested firm representatives) exists, which investigates and plans for future developments/ challenges to the social environment due to the introduction of new technologies such as "Industry 4.0" and AI controlled production processes. 	Available [Yes / No]
Performance indicators				
Topic	Sub-topic	Description/Requirement	Performance indicator	Unit [Target value]
Social management systems	OH&S management system	Firms should have an OH&S management system in place (based on ISO 18001 standard) to record occupational diseases, absenteeism, and numbers of work-related injuries and fatalities.	<ul style="list-style-type: none"> Proportion of firms with more than 250 employees that have an OH&S management system in place. 	Percentage of firms [75%]
	Grievance management	A grievance mechanism to receive and address grievances from within and outside the park. Examples include help desks, complaint boxes, and hotlines (phone booths) located inside and outside of the industrial park.	<ul style="list-style-type: none"> Proportion of grievances received by the park management entity which are responded to with statements of reasons within 14 days. 	Percentage of grievances [100 %]
			<ul style="list-style-type: none"> Proportion of grievances received by the park management entity which are concluded within 60 days. 	Percentage of grievances (100%)
			<ul style="list-style-type: none"> Proportion of firms with more than 250 employees that have a code of conduct system in place to deal with grievances. 	Percentage of firms [75%]
	Discrimination and harassment prevention and response	Employees of the park management and resident firms should have a working environment free of violence, harassment, discrimination, exploitation or intimidation. A discrimination and harassment prevention and response system with clear complaint and response procedures should be in place.	<ul style="list-style-type: none"> Proportion of firms with more than 250 employees that have a harassment prevention and response system in place. 	Percentage of firms [75%]
Decent work	Conditions of employment should meet the following work criteria: <ul style="list-style-type: none"> a fair income with security and social protection which allows access to decent housing. recognition of contractually agreed rights of workers and employees including - but not limited to - working hours, leave and maternity leave. establish and join organizations, of their own choosing, and without prior authorization, to represent workers. 	<ul style="list-style-type: none"> At least 80 percent of women and 80 percent of men of the surveyed workers agree that each of these decent work criteria are met. 	[≥80%]	
Social infrastructure	Primary social infrastructure	Social infrastructure should meet the norms and requirements of the workforce, and client expectations, paying special attention to the needs of female workers.	<ul style="list-style-type: none"> Proportion of surveyed employees reporting satisfaction with social infrastructure. 	Percentage of surveyed employees [80%]
	Industrial park security	The industrial park has security systems and services that are fully operational and fit-for-purpose, taking the particular security needs for women into consideration. Examples include, among others: appropriate lighting systems in and around the park, closed circuit television (CCTV) systems, a centralized security office, and provision of transport at night.	<ul style="list-style-type: none"> Proportion of reported security and safety issues that are adequately addressed within 30 days. 	Percentage of reported security and safety issues [100%]
	Capacity building	Programs for skills training and development at park management and firm level are in place, emphasizing equal opportunities for skills training and career development, and addressing new technologies and changes in the labour market. Examples include skills development programs, and women entrepreneurship development programs.	<ul style="list-style-type: none"> Proportion of firms in park with more than 250 employees with a program for skills/vocational training and development. 	Percentage of firms [75%]
<ul style="list-style-type: none"> Proportion of underrepresented genders in workforce in the park management and firms who benefit from skills development programs. 			Percentage of underrepresented gender workforce [≥50%]	
Local community outreach	Community dialogue	Provision of established, accessible communication platforms or other means to maintain regular dialogue with the community and relevant civil society organizations. Examples include news bulletins, regular media releases, and information display boards.	<ul style="list-style-type: none"> Over 80 percent of the surveyed community members are satisfied with the park's efforts to communicate. 	Percentage of surveyed community members [80%]
	Community outreach	The park management entity and resident firms engage in community outreach activities and maintain documentation. These activities could include: an annual day with celebrations inside the park; clean-up drives or public service activities that are organized in community areas by the park management; infrastructure for community areas (for instance, drinking water supply, sanitation).	<ul style="list-style-type: none"> Number of outreach activities implemented by the park management entity annually that are regarded as positive by over 80 percent of the surveyed community members. 	Number of outreach activities per year [2]

4.6 Economic Performance Requirements

Introduction

Industrial parks are an important vehicle used by governments to boost manufacturing sectors and add value to economies. In the planning phase, the proposed park infrastructure needs to be designed to respond to market demand and future development needs. Favoured real and virtual service structures seek to attract investors and firms interested in establishing operations within the park. In addition, strategic EIP interventions can improve park and firm level competitiveness when they are included in EIP design and operational procedures. Interventions should be designed to keep up with changing markets/new technologies (e.g. Industry 4.0) that require continuous improvement.

EIPs offer important synergies between resource and energy efficiency processes and socially compliant practices providing economic gains and competitive advantages. For example, international good practice demonstrates that cleaner production and the implementation of energy efficiency interventions with low capital costs, minimal operational disruption, and strong payback periods can offer important economic gains. EIPs can also offer important employment generation opportunities, industrial added value, and linkages with local businesses. The industrial parks may use green incentive structures to attract high-quality investors, thereby making it easier to comply with EIP targets during operations.

Adhering to these economic performance requirements can deliver a wide range of benefits, including:

- Meeting the government's targets for investments, revenues and employment;
- Attracting local, national and international financing and investments;
- Increasing demand from prospective firms, and high retention rates for current firms; and
- Improving political and social license to operate and expand operations.

Apart from national regulatory compliance, there are a number of important considerations and economic requirements that an EIP must fulfil. Important economic considerations for EIPs are as follows:

Employment generation: Industrial parks create employment. However, employment should be managed and driven in a sustainable manner to ensure: economic linkages are maximized; employees and surrounding communities duly benefit; and diversity and inclusiveness of employment are maintained. Future trends towards automation, and the adoption of AI need to be synchronized with social demands and job creation.

Local businesses, SME promotion and linkages: SMEs are the backbone of the economy and employment in many countries. EIPs provide opportunities for the establishment of SMEs in parks that can, in turn, provide services, parts and components, and add value to other (larger) industries operating in the park. EIPs can also provide strong economic development benefits through the promotion of linkages with local businesses as suppliers to the industrial park and its resident firms.

Economic value creation: International experience demonstrates that some industrial parks are developed without establishing market demand for their services, or the role of green infrastructure in competitiveness. As a result, they may not be competitive. Integrating cost-effective, energy-efficient technologies and management processes can provide competitive advantages. "Investment-ready" industrial parks are more attractive, as they present lower risks and investment costs to firms (for example, through the provision of infrastructure, utilities, and services).

Financial viability: The decision to develop a park to EIP standards will be influenced by expected returns on investment and available modes of finance. A financial model will expedite decision making. It will clarify the financial viability of the investment by matching the chosen financing modality and sources with the anticipated pricing of services to be delivered.

EIP Economic Performance Requirements

The economic performance requirements for EIPs are outlined in table 5 in the form of EIP prerequisites and performance indicators. These can be used to set international EIP expectations, but may require adaptation to local norms and industry benchmarks.

Table 5: Economic - Performance Requirements for Eco-Industrial Parks

EIP prerequisites				
Topic	Sub-topic	Description/Requirement	Prerequisites/Evidence	Checklist
Local business and SME promotion	SME development	An EIP provides opportunities for local, regional, and national SMEs, enabling them to benefit from EIP activities.	<ul style="list-style-type: none"> Park management entity allows and promotes the establishment of SMEs that provide services and add value to park residents. 	Available [Yes / No]
Employment generation	Maximizing local benefits	An EIP must generate employment opportunities in the areas in which it operates to ensure revenue linkages and development opportunities.	<ul style="list-style-type: none"> Park management entity has a strategy in place to maximize local benefits. 	Available [Yes / No]
Economic value creation	Market demand for EIP services and infrastructure	The development of an EIP, including green infrastructure and services, must be based on realistic market and industry demands to ensure economic feasibility.	<ul style="list-style-type: none"> A market demand and feasibility study, supported by a business plan for specific “green” infrastructure and services has been undertaken to justify planning and implementation in the industrial park. 	Available [Yes / No]
			<ul style="list-style-type: none"> Park management is financially solvent to operate/provide park infrastructure and services. 	Available [Yes / No]
			<ul style="list-style-type: none"> The park management should be economically viable in terms of contributing to jobs, technology, and acting as a catalyst to development of local industry. 	Available [Yes / No]
			<ul style="list-style-type: none"> Park management entity is responsible for marketing the park and park concepts (EIP concept) to potential national and international investors. 	Available [Yes / No]
Park entity's financial viability	Service delivery pricing	A dedicated financial model capturing EIP salient features must be used to set pricing levels and anticipated revenues in order to enhance financial viability of EIP investments.	<ul style="list-style-type: none"> The park management should render its services at realistic costs to cover operational expenditures. 	Available [Yes / No]

Performance indicators				
Topic	Sub-topic	Description/Requirement	Performance indicator	Unit [Target value]
Employment generation	Type of employment	The EIP provides longer-term employment contracts to employees.	<ul style="list-style-type: none"> Proportion of total firm workers in industrial park employed through direct employment (that is, not employed on a fee-for-output basis or provided through a labor supply firm) and permanent contracts. 	Percentage of employees [30%]
Local business and SME promotion	Local value added	An EIP must use local suppliers where possible. EIPs provide local businesses with opportunities to grow.	<ul style="list-style-type: none"> Proportion of resident firms using local SME suppliers or service providers for at least 25 percent of their total procurement value. 	Percentage of firms [25%]
			<ul style="list-style-type: none"> Proportion of procurement budget paid to local service providers within 100 km radius by the park management entity. 	Percentage of total procurement value of park management entity [90%]
Economic value creation	Investment-ready park for firms	An EIP should be “investment ready” so that it offers lower economic risks and better investment opportunities to firms. Infrastructure should be offered, including water, energy, roads and service corridors.	<ul style="list-style-type: none"> Percentage of space rented or used by resident firms compared to the total amount of available space earmarked for firms within the park. 	Average percentage occupancy rate over 15 years [50%]



Photo Credit: © Sinem Demir.





Concluding Remarks and Future Prospects

The concept and practice of Eco-Industrial Parks offers an important and integrated approach to drive and scale up efforts by the private and public sectors for inclusive and sustainable industrial development.

This publication has highlighted the many ways in which industrial parks and their stakeholders can leverage the performance requirements for EIPs — from creating a common understanding of EIPs, establishing baseline performance for EIPs, identifying opportunities for improvement, and monitoring operational performance.

Tools and methods are available to assist public and private sector organizations to develop and implement EIPs, and support and advice are available from multiple commercial entities (for example, engineering and strategy consultancies) and non-commercial organizations (for instance, international development agencies). The type and frequency of support will depend on the specific local needs and context of the industrial park.

UNIDO, the World Bank Group, and GIZ welcome the opportunity to discuss options and support for EIPs with stakeholders. They are committed to using this International EIP Framework in their projects and programs. The three organizations also encourage partners and stakeholders outside of their projects to apply this Framework in industrial park planning, development, management, and monitoring.

The development of internationally accepted standards for EIPs is a long-term, multi-stakeholder process, and the authoring organizations hope that this framework will set in motion the development of these standards at country level. They also hope that this publication will provide a common understanding of EIP concepts, benefits, performance requirements, and performance monitoring needs.

Given the importance and complexity of this topic, the authoring organizations also intend to refine this framework based on further testing and on-going stakeholder consultations.

Organizations interested or involved in the development and implementation of EIPs are invited to send their suggestions and feedback on this framework to the following individuals and organizations:

UNIDO	<p>Nilgun Tas Email: n.tas@unido.org Website: http://www.unido.org/</p>
World Bank Group	<p>Etienne Kechichian Email: ekechichian@worldbank.org Website: http://www.worldbank.org/</p>
GIZ	<p>Mareike Boll Email: mareike.boll@giz.de Website: https://www.giz.de/en/</p>

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Annexes

Annex 1: Going Beyond the EIP Performance Requirements

Approach

Going beyond the performance requirements and instilling a culture of continuous improvement is crucial to achieving a lasting and significant impact for EIPs. Meeting the performance requirements is an important and meaningful step for an industrial park to achieve. However, achieving these requirements is not meant to be an end goal. Instead, instilling a culture of continuous improvement in park- and firm-level efforts and systems is fundamental to protecting the environment, improving social standards, and achieving economic competitiveness.

There are several ways in which an EIP can exceed performance requirements. It is recognized that various approaches exist to evaluate the performance of EIPs. This framework and guidance on performance requirements is based on the principle that individual countries and international development organizations establish their own frameworks, and build on the requirements set out in this publication. Flexibility and sensitivity is required for countries, regions, and stakeholders to design their EIP programs, which should be customized to their specific needs and local contexts. Some may prefer a standardized approach that is updated regularly, whereas others may prefer a formal certification system based on different performance levels.

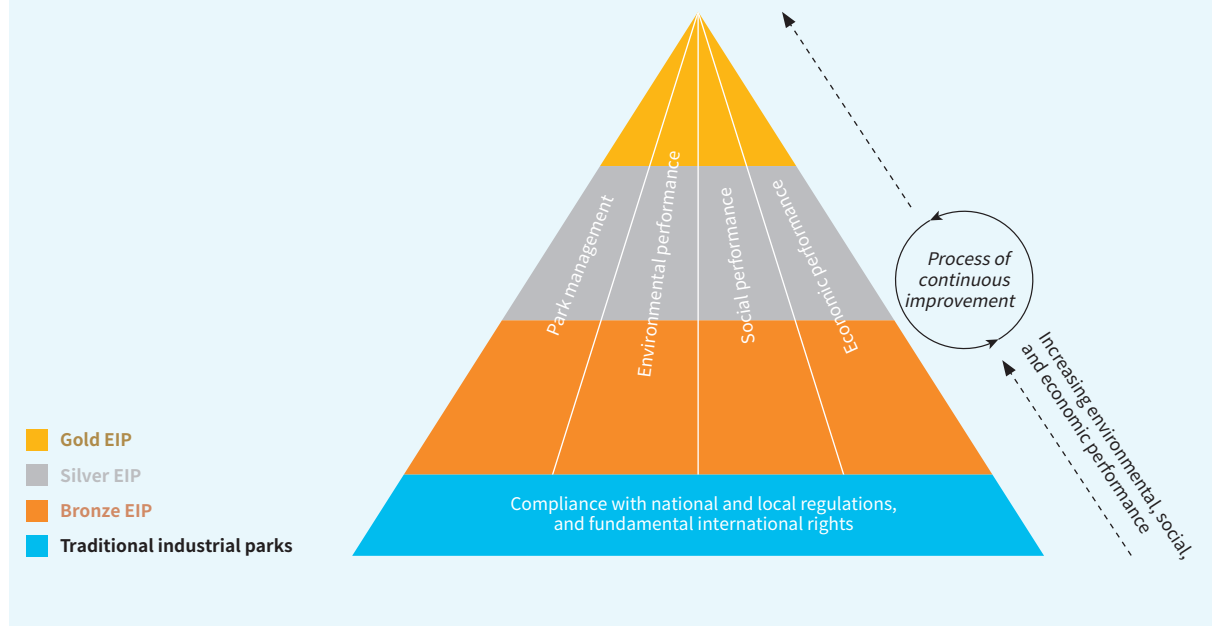
The examples and suggestions presented here highlight the potential ways in which EIPs could move beyond the performance requirements (see box 3). The intention in including these examples is to stimulate the thinking within EIPs about how to keep improving. Discussions should take place more broadly among EIP stakeholders about ways to exceed performance expectations.

Box 3: An Example of Continuous Improvement based on the Framework

The figure below presents an illustrative example that can be applied by national authorities in line with national regulations of an approach for assessing the performance level of EIPs through a classification system (that is, bronze, silver, and gold levels). Performance assessment can be applied both to support the planning and development of new EIPs (greenfield), and to the conversion and optimization of existing industrial parks into EIPs (brownfield).

Starting from the premise that parks should comply with national and local regulations, this model applies three different performance levels.

Example of Performance and Continuous Improvement-Based Framework for Assessing Eco-Industrial Parks



Opportunities to Exceed the EIP Performance Requirements

Given the diversity of industrial parks, their activities, geographic location and policy environments, it is expected that some parks and firms may excel in a particular sustainability area. Table 6 highlights international benchmarks that will encourage EIPs to go beyond those given in this framework.

One way for industrial parks to exceed the EIP requirements is by increasing the target value of the performance indicators outlined in this framework. Another way is by addressing additional performance requirements in selected (sub-) topics most relevant to the industrial park concerned.

Table 6: Suggestions for Exceeding Eco-Industrial Park Performance Requirements

Category	Topic	Sub-topic	Illustrative suggestions for exceeding the EIP performance requirements
Park management	Park management services	Technical training services	The park management entity provides regular technical training to resident firms (for example, waste management, cleaner production, OH&S procedures, and apprenticeship training).
		Building standards	Ecologically sustainable building design is incorporated in park management and facility buildings, and uses principles such as: <ul style="list-style-type: none"> • Natural lighting and ventilation; • Roof-top solar photovoltaic system; • Rainwater harvesting for domestic water supply to park management entity's facility building; and • Solar electricity use (kWh) in park management's administrative buildings to go beyond <i>business-as-usual</i> baseline (kWhs per employee per year). In the case of existing national green building standards, building upgrades could be accredited against such standards.
	Monitoring and risk management	Advanced information systems	Cloud-based information systems with geographic information systems (GIS)-based spatial and attribute data are used by the park management entity to monitor and manage the industrial park, including infrastructure, services, plot-wise details, biodiversity register, and so on.
		Integration of collective utilities within spatial planning and zoning service and utility corridors	<p>A parcel of park land, beyond national norms, is allocated to integrated and collective utilities (including cogeneration, waste, and off-gas processing). Park land planning allows for development of on-site renewable energy facilities (for instance, wind, biomass, geothermal, solar, and hydropower) to meet a proportion of energy demand for firms operating in the park.</p> <p>The industrial park master plan optimizes a percentage of lots with service and utility corridors.</p>
	Planning and zoning	Energy management systems	One hundred percent of resident firms whose total energy consumption (thermal and electric) is more than 100 Tera joules (TJ) per year are certified under the ISO 50001 Energy Management Standard.
		Energy efficiency	The top 60 percent of energy-consuming firms are part of an industrial park Energy Efficiency Network (EEN) to assist each other to achieve energy savings.

Category	Topic	Sub-topic	Illustrative suggestions for exceeding the EIP performance requirements
Environmental performance	Management and monitoring	Local sustainable materials use	Program/mechanism by park management entity to promote and encourage the use of locally and responsibly produced materials by firms in the park.
	Energy	Subdivision works	Program/mechanism is in place to maximize use of land and soils (for example, overburden, topsoil), minimize earthworks, and maximize re-use of excavation materials.
	Waste and materials use	Native biodiversity	One hundred percent of landscaping uses indigenous vegetation, and non-potable water is used for irrigation.
		Air, GHG emissions and pollution prevention	Fifty percent of firms have a GHG emission cadastre; regular reports are made to the park management.
	Natural environment	Native biodiversity	Fifty percent of firms have GHG prevention and reduction strategies to reduce the release of GHGs beyond national reduction targets.
Social performance	Social management systems	Gender empowerment and entrepreneurship	Park management entity provides or facilitates services focusing on the empowerment of women (for example, training focused on sustainable livelihoods, consulting on domestic abuse, women's healthcare campaigns, and so on).
		Competitiveness strategy	Means to assist parks and firms to adapt to changing markets, sectors, and technologies.
		Protection of cultural heritage	In line with international good practices (IFC 2012) and, where applicable, the park retains a list of heritage sites and historically significant names. This conserves cultural values, and areas important to indigenous people.
	Social infrastructure	Long-term, diversified economic growth	Conditions to support tenant firms and attract new ones that will offer long-term, diversified economic benefits to the region and local economy, including promotion and branding of the park.
		Accommodation standards	Accommodation for park employees which meets standards related to building structure, basic facilities, space, thermal environment, illumination, electricity, water supply and effluent disposal.
Economic performance	Economic value creation	Financial liabilities	Systems to manage financial risks related to environmental and social matters, environmental regulatory risks, climate change/disaster risks, local unrest, and so on.

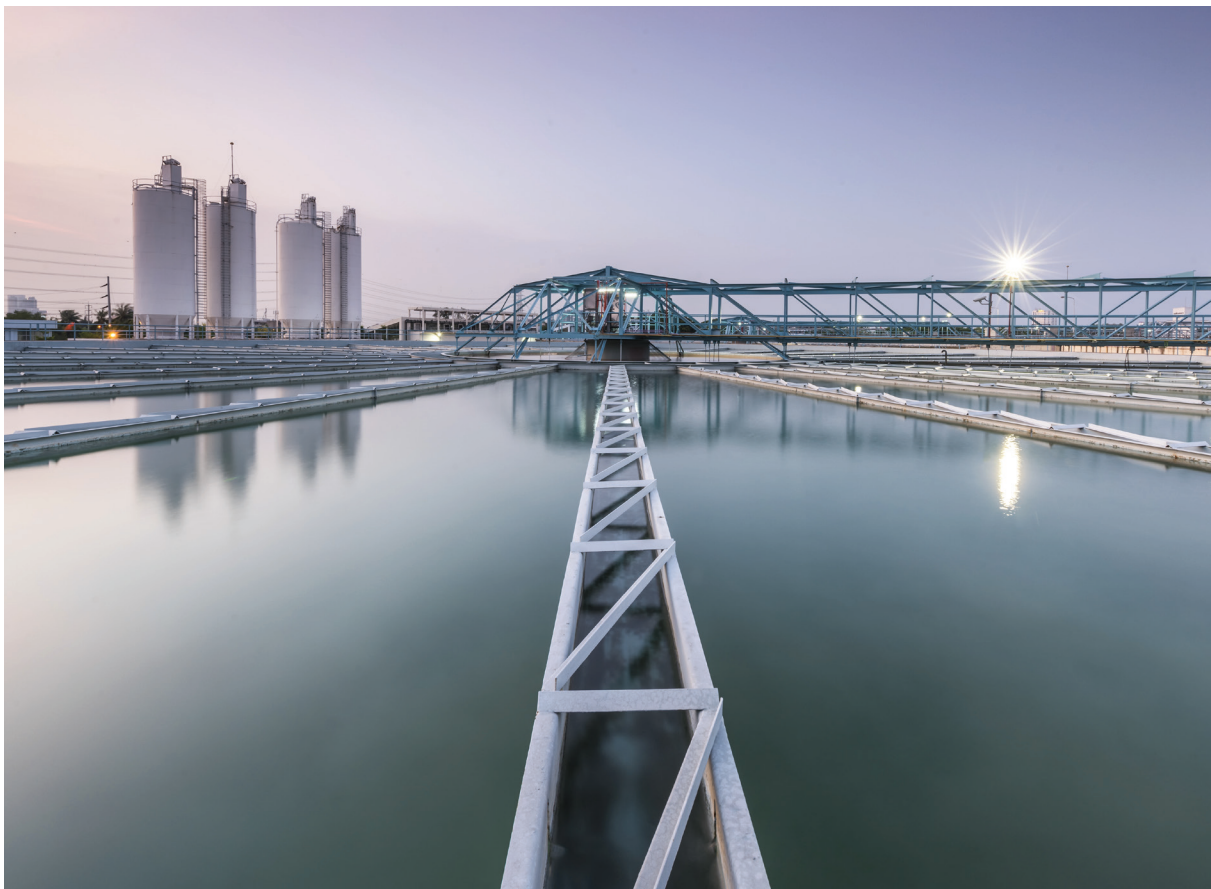


Eco-Industrial Park Case Studies

The following annexes provide examples of EIPs, parks working toward EIP status, the three authoring organizations' experience of EIPs, and national level EIP Framework implementation. These case studies demonstrate that the EIP concept provides a practical approach toward the sustainable and inclusive development of industrial parks worldwide.

The selected case studies have been compiled based on the specific projects, collaboration and networks of UNIDO, the World Bank Group, and GIZ. They represent only a few examples of countries making progress toward sustainability worldwide.

Annex 2 Existing EIPs	<ul style="list-style-type: none"> • Industrial Zone NÖ-Süd, Austria • Ulsan Mipo and Onsan Industrial Park, South Korea
Annex 3 Industrial Parks working towards becoming EIPs	<ul style="list-style-type: none"> • Hoa Khanh Industrial Zone, Vietnam • Izmir Ataturk Organized Industrial Zone, Turkey • ALEAP Green Industrial Park - Telangana, India
Annex 4 Industrial Park level EIP Framework Implementation	<ul style="list-style-type: none"> • Parque Industrial Malambo SA, Colombia • Engineering Square (E²) and East Port Said (EP) Industrial Parks, Egypt
Annex 5 National level EIP Framework Implementation	<ul style="list-style-type: none"> • Turkey, Green Organized Industrial Zones Programme • Vietnam, Eco-Industrial Park Initiative



Annex 2: Existing Eco-Industrial Parks

Industrial Zone NÖ-Süd, Austria



Industrial Park Overview

IZ NÖ-Süd was established in 1962 in the Lower Austria Province, Austria. The park covers 280 hectares and comprises 370 companies. The companies are mostly SMEs, and international companies that rent facilities for office, storage and production space. Examples of active sectors include the following: food and beverage; aluminium and steel converting; production of energy and technical components; environmental services and technologies; and logistics.

Park Management and Governance Structure

The industrial park is managed by “Ecoplus,” which is a private business holding company. Ecoplus has 55 years of experience in managing 17 industrial parks and employs approximately 80 people in Lower

Austria. The mandate of the industrial park realized by Ecoplus is to ensure added value for the region, create local jobs, and build sustainability for regional development. The core competence of Ecoplus is the development and management of customized rental properties. However, to further create a productive environment for firms, Ecoplus has expanded its core competence by offering a variety of services.

EIP Performance and Impacts

Park management: Ecoplus provides a one-stop service hub which connects institutions, public authorities and partners. It offers guidance from conceptualizing business ideas to their financing. In this regard, Ecoplus has handled 200 investment project requests, and managed the realized investment projects. Additionally, Ecoplus helps tenant firms to obtain permits from local authorities.

Economic performance: Currently, Ecoplus business park IZ NÖ-Süd employs around 11,000 people. The industrial zone collaborates with local vocational schools in four neighbouring municipalities (namely, Biedermannsdorf, Guntramsdorf, Laxenburg and Wiener Neudorf), leading to smooth recruitment and retention of skilled labor.

Ecoplus offers other economic core features, including the creation of business networks, the operation of conference and event facilities, and coordinating joint media efforts for companies and the industrial park. Additionally, Ecoplus addresses industrial, environmental, and social sustainability issues through collaborations with academia and dialogues with businesses. In 2017, Ecoplus attended the European Forum Alpbach, which brought together high-level industry representatives.

Environmental performance: Ecoplus operates a number of central infrastructure services for the park, including a central wastewater treatment plant (totally renovated in 2015–2017), 17 km of access roads and bus routes, rail connections, and a freight station with the Austrian railroad (ÖBB). Further, Ecoplus maintains 100,000 square meters of green space, shrubs and trees within its parks, with recreational areas and attractive landscaping.

Social performance: An extensive social infrastructure provision exists in and around IZ NÖ-Süd, which has grown into a small city. The park offers postal offices and customs services, restaurants, a business hotel, two small on-site shopping malls, Europe's biggest shopping mall (SCS), a private childcare facility, and security system (video surveillance). Due to its size, and frequent visits from investors and business partners, Ecoplus has a navigation system to guide visitors through the park. There are many recreational facilities near the park for employees and local communities to enjoy, including tennis courts and golf courses.



Areas for Continuous Improvement

Ecoplus has attempted to speed the commissioning of building upgrades for greater energy efficiency. It is also working on renewable energy generation to meet low energy standards (that is, thermal renovations, and preparation of infrastructure for charging stations for electric vehicles). These improvements are also being implemented at the rental properties owned by Ecoplus.

An outstanding example is the on-site kindergarten, which has been accredited with gold status by klima:aktive, the Austrian Green Building Standard. Built in 2015, the house offers space for 5 groups of children between the ages of 18 months and 6 years. It has an indoor area of 1,200 m² and an outdoor playground of 2,500 m². Approximately € 3.8 million has been invested in innovative architecture, environment-friendly building materials, and cosy, wooden furniture. Investments also include a rooftop solar plant which provides underfloor heating and controlled living space ventilation, and the rainwater utility is used to water the garden and flush toilets.

In conclusion, IZ NÖ-Süd offers a good example of an EIP that goes beyond the quality criteria and performance indicators established by the international framework as defined by UNIDO, the World Bank Group and GIZ. In this regard, UNIDO and Ecoplus plan to collaborate in order to transfer knowledge and good practice examples to international partners.

For further information:

- <http://www.Ecoplus.at>
- www.Ecoplus.at/wp.iz
- www.Ecoplus.at/izibizi

Ulsan Mipo and Onsan Industrial Park, South Korea



Industrial Park Overview

The Ulsan metropolitan city is a small fishing and agricultural town with rich historic and natural resources. It was designated as a special industrial zone in 1962, during the first five years of the national economic development plan, and subsequently developed into the industrial capital of South Korea.

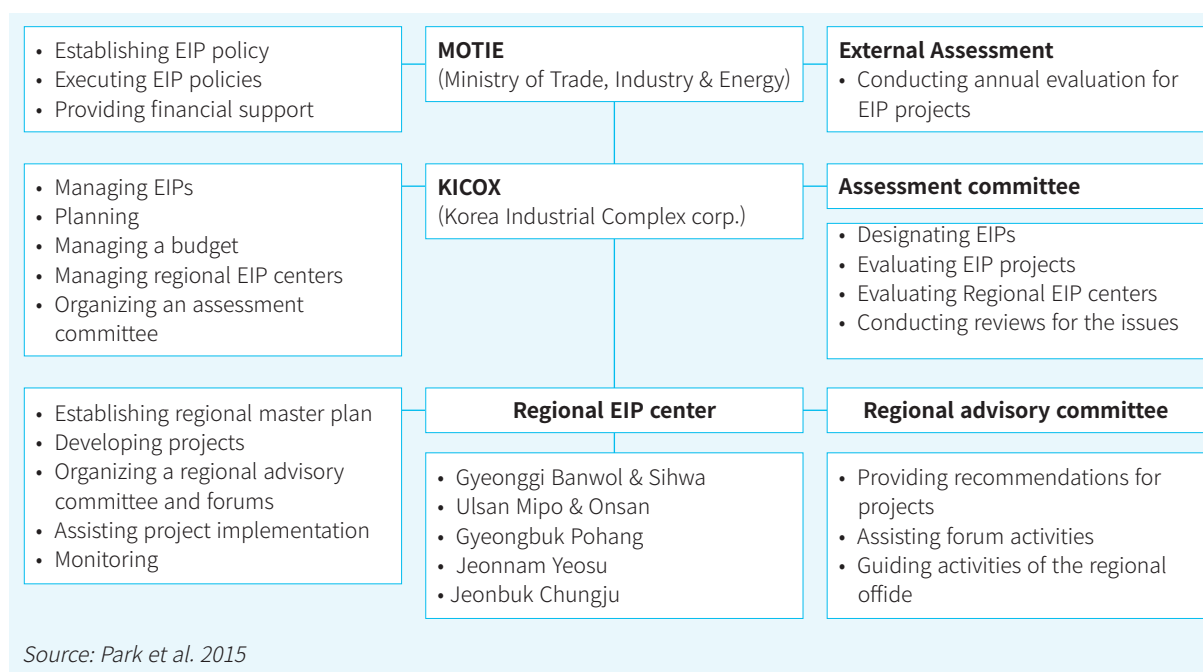
The Ulsan Mipo and Onsan industrial park is spread over an area of 6,540 hectares, and hosts 1,000 firms. The park includes a variety of industries, such as vehicle manufacturing, shipbuilding, oil refineries, machineries, non-ferrous metals, fertilizer and

chemical industries. Collectively, they employ over 100,000 people. The main objective of the Ulsan EIP initiative was to transform the Mipo-Onsan conventional national industrial complexes into sustainable EIPs based on the national Eco-Industrial park development master plan.

Park Management and Governance Structure

The overall execution of the national EIP initiative is implemented by the Korea Industrial Complex Corporation (KICOX), a semi-governmental body that manages national industrial complexes. It handles overall planning, budget accounting, approval of project proposals, and liaison with governmental bodies and concerned organizations. The Ulsan regional EIP center is interested in local industrial symbiosis (IS) project development. It is led by an advisory board composed of representatives from local government, academia and industry. They also provide assistance with project development, proposal writing, follow-up actions for existing projects, and coordinating with local authorities and related organizations.

Figure 4: Park Management and Governance Structure of Ulsan Mipo and Onsan Industrial Park



Country Policy Environment

The Korean National Cleaner Production Center launched the National Eco-Industrial Park program in 2003. It is in line with the efforts of the Ministry of Trade, Industry, and Economy to promote innovative industrial development, which simultaneously achieves environmental sustainability throughout the Korea Industrial Complex Corporation (KICOX) (Act on the Promotion of the Conversion into Environment-friendly Industrial Structure, Article 4-2 [Designation, etc. of Ecological Industrial Complex]).

The 3-stage EIP Program adopted a gradual approach to building national Eco-Industrial networks over 15 years. The first phase (November 2005–May 2010) aimed to establish the foundation of the program through an experiment with five pilot industrial sites (5 regions, and 6 parks). The second phase (June 2010–December 2014) focused on expanding the network beyond its individual industrial complexes (9 regions, and 46 parks) through a hub and spoke strategy. The third phase (January 2015–December 2016) aims to establish a national network to integrate industrial complexes and urban areas (12 regions, and 105 parks).

EIP Performance and Impacts

Park management: The Ulsan EIP Center received around 96 project proposals, of which 77 projects were funded for further research and development, and 34 for operations. Economic, environmental and social benefits are also monitored by the Ulsan EIP Center.

Economic performance: The economic benefits were calculated as the sum of cost savings (resource procurement, operations, and environmental/waste management by replacing virgin materials with by-products) and revenues (revenues generated by selling by-products) annually reported to KICOX since project operations began. Government investments have totalled US\$ 14.8 million for project research and development, including center operations. From this government research fund, further income of US\$ 65 million/year has been generated from selling by-products and waste for recycling purposes. An additional income of US\$ 78.1 million/year was generated from energy and material savings in 2016.

Environmental performance: Environmental benefits were evaluated in terms of the direct reduction of energy consumption, and reduction in the generation of waste or by-products, wastewater, and CO₂ emissions. From an environmental perspective, the





Ulsan EIP program saved 279,761 tons of oil equivalent in energy use. This resulted in a reduction of 665,712 tons of CO₂ emissions and 4052 tons of toxic gases, such as SO_x and NO_x during 2005–2016. In addition, 79,357 tons of water and 40,044 tons of by-products and waste were reused. This redressed the image of industrial complexes as polluters, and enhanced relations with neighboring local communities.

Social performance: A private investment of US\$ 245.8 million (as of 2016) for the construction of industrial symbiosis networking facilities created 195 new jobs.

Areas for continuous improvement: The Ulsan EIP Center has led the Korean EIP initiative based on the research and development (R&D) business model of development. As a result, the Ministry of Strategy and Finance supported the National EIP project in 2016, and there is now an urgent need to develop a post-EIP project to replicate and mainstream Eco-Industrial development. This will help to establish self-reliance in Eco-Industrial development, increase business awareness and motivation, maintain an up-to-date resource database, and grow opportunities for industrial symbiosis.

For further information:

- Strategies for sustainable industrial development in Ulsan, South Korea: From spontaneous evolution to systematic expansion of industrial symbiosis. <http://www.sciencedirect.com/science/article/pii/S0301479707000175>
- Evolution of ‘designed’ industrial symbiosis networks in the Ulsan Eco-Industrial Park: ‘Research and development into business’ as the enabling framework. <http://www.sciencedirect.com/science/article/pii/S0959652612000832>
- A review of the National Eco-Industrial Park Development Program in Korea: Progress and achievements in the first phase, 2005–2010. https://ac.els-cdn.com/S0959652615012160/1-s2.0-S0959652615012160-main.pdf?_tid=087b4ea6-a283-11e7-bdb5-00000aabb0f27&acdnat=1506407112_ed1da04053f9373ec5eb13a2c1753c50
- Securing Competitive Advantage through industrial symbiosis development. <http://onlinelibrary.wiley.com/doi/10.1111/jiec.12158/pdf>
- Greening Industrial Parks — A Case Study of South Korea’s Eco-Industrial Park Program. www.greengrowthknowledge.org/sites/default/files/downloads/best-practices/GGI%20Case%20Study_South%20Korea%20Eco-Industrial%20Park%20Program_June%202017.pdf

Annex 3: Industrial Parks Working Toward Becoming Eco-Industrial Parks

Hoa Khanh Industrial Zone, Vietnam



Source: UNIDO Eco-Industrial Park Initiative in Vietnam – Hoa Khanh Industrial Zone

Industrial Park Overview

The Hoa Khanh Industrial Zone (IZ) was established in 1996 by the Da Nang Administrative Committee. It belongs to the Lien Chieu District of Da Nang City. The park covers 396 hectares and hosts 168 companies. Resident firms operate their businesses through leasing contracts. Under its current investment strategy, Hoa Khanh IZ focuses on the following industries: mechanics; assembly; food and seafood processing; forest products processing; construction materials; and electronics.

Park Management and Governance Structure

The park is managed by the Da Nang Industrial Zones and Export Processing Authority, which is an administrative organization that belongs to the Da Nang People's Committee. The authority directly monitors planning, investment, labor, security, and environmental issues within industrial zones in Da Nang.

Country Policy Environment

With support provided under a current UNIDO project, a cooperation framework between the Vietnamese Ministry of Planning and Investment and the World Bank was established. The goal was to develop a technical guideline on environmental aspects regarding EIPs. Prior to this process, the UNIDO project conducted a review of the existing national legal framework, with the objective of informing a national strategy on EIPs in Vietnam.

EIP Performance and Impacts

Park management: The ongoing UNIDO project focuses on scaling-up park management capacity through dedicated training sessions, expert group meetings and study tours. The aim of these activities is to share examples of international good practice. Currently, the park management has a functioning monitoring system in place but does not yet provide for centrally managed services.

Economic performance: In November 2015, the Hoa Khanh IZ reported accommodating 73,215 employees, of which 99 percent were domestic SME workers. Currently, better career development programs are offered by international companies than domestic SMEs.

Environmental performance: The current UNIDO project targets firms in the park to increase their environmental performance and resource efficiencies. The Vietnam National Cleaner Production Center (VNCPC) has conducted resource efficient and cleaner production (RECP) assessments with 20 firms. The implementation of RECP under the VNCPC achieved annual savings of Vietnamese dong (VND) 11.34 billion (equivalent to US\$ 500,000). Further, these assessments have saved 2,571 tons of solid waste, 1,034,300 kWh of electricity, and 6,000 kilolitres of water per year over the course of the projects.

The main source of air pollution in the park stems from the activities of steel, paper and forest product processing industries. Together, they discharge large amounts of dust, SO₂, NO_x and heavy metals. Transportation activities are the main source of floating dust, noise and vibration.

Since 2007, the centralized wastewater treatment plant has been operating at a capacity of 5,000m³/day. It applies chemical-biological technology and is managed by the Central Branch of Hanoi Urban Environment Company (URENCO). The biological treatment was assessed as relatively efficient, resulting in reduced chemical consumption rates and chemical sludge generation. However, the volume of wastewater treated exceeds the capacity of the treatment plant by an average of 40 percent.

Every firm located in the IZ must contract with the Da Nang URENCO for waste collection and treatment services. According to a study conducted under the UNIDO project, the total volume of waste amounts to 3,600 tonnes/month (94 percent is industrial waste), of which 55 percent is landfilled. Due to the absence of an IZ strategy for waste reuse and recycling, firms in the park rely on their contracts with Da Nang URENCO for waste disposal.

Social performance: Essential social infrastructure is available in the immediate vicinity of the Hoa Khanh IZ, and includes local shops and banking facilities. Employees of the firms located in the IZ use their private vehicles due to the lack of public or park transportation.

Working conditions generally follow national standards. However, SME standards generally do not match those of international firms. Although most firms have equipped their workers with personal protective equipment and occupational health and safety training, incidents and accidents still occur.

Areas for Continuous Improvement

The UNIDO project has completed the social screening and solid waste assessment, firm level RECP audits, and a study of the wastewater treatment plant's efficiency. In the next stage, the project will target essential resource-efficiency practices at the park level. It will also strengthen capacities for technology transfer. In this regard, UNIDO collaborates with IFC and the University of Ulsan to identify industrial symbiosis options for firms in the park. The project will also scale-up provision of services and infrastructure.



Source: UNIDO Eco-Industrial Park Initiative in Vietnam - Training Workshop

For further information:

- www.eipvn.org/ (UNIDO project website)
- www.dananginvest.com/en/industrial-zones/expanded-hoa-khanh-iz.html (Hoa Khanh Industrial Zone website)

Izmir Ataturk Organized Industrial Zone, Turkey

Context

Established in 1990, the Izmir Ataturk Organized Industrial Zone (OIZ) is in Western Turkey, in Ciğli County of the izmir Province. The OIZ is currently seeking opportunities to transition to an EIP framework. The OIZ is owned and operated by the Izmir Ataturk Organized Zone Authority. It has 556 tenants, and a 100 percent occupancy rate across an area of 6,239,756 square meters. The park has a mix of sectors, the largest of which are (in terms of the number of firms) machinery-metal casting; plastics; food and beverages; textiles and ready-made clothing; and chemicals.

Country Policy Environment

There is currently no dedicated policy governing EIPs in Turkey. However, the Organized Industrial Zones Law No. 4562 of April 15, 2000 governs the establishment, construction, and operation of organized industrial zones in Turkey. The law contains provisions on management and supervision, duties, authorities, and responsibilities of the persons and organizations related to such zones.

EIP Governance Structure

The OIZ is privately owned and established, pursuant to OIZ Law No. 4562, and following the endorsement of the governorship of Izmir province. The OIZ governance structure includes the following bodies:

Table 7: Governance Structure of the OIZ

Enterprise Committee	This is the general assembly for the operational stage, and the highest decision-making body of the OIZ. It is responsible for commitments and mortgages, and the OIZ's investments and budget.
Board of Directors	The Board of Directors is elected by the Enterprise Committee. Its principal duties are: to determine and collect rentals, levies, and other fees for the shared areas of the OIZ, infrastructure participation shares, management dues, and so on. It also determines utility prices (such as power/water), and grants licenses and permits.
Board of Auditors	Elected by the Enterprise Committee, the Board is responsible for auditing the spending and implementation of the budget, and producing the annual general and interim audit reports for the Enterprise Committee.
Zone Directorate	The Zone Directorate includes the regional director and administrative and technical personnel. Its composition is subject to the approval of the Ministry of Science, Industry and Technology. The zone director is responsible for the management and administration of the OIZ.



EIP Performance and Impacts

Park management and shared services: The zone offers 50 km of internal roads that are connected to the airport, bus terminal, and port and city centers. The zone authority owns a natural gas-fuelled combined cycled power plant with a capacity of 120 megawatts (MW). The Zone is responsible for distributing municipal water. In addition, there is a 75-km rainwater drainage system with 11 pumping stations and a firefighting station.

Economic performance: The zone supports 37,500 employees. Approximately 75 percent of the firms export their products, with the majority going to the European Union (EU). Annual turnover of the firms is US\$ 7.8 billion and annual exports are valued at US\$ 2.5 billion. Annual imports amount to US\$ 1 billion.

Increased competitiveness can be achieved through lower operational costs at the firm level through energy and water efficiency upgrades. Across seven energy intensive sectors there is potential to save, as follows:

- 2,200 MWh/year through the upgrading of electricity motors;
- 16,100 m³ of water and 644,000 kWh of electricity annually, with a payback period of c. 1 year. This can be achieved by employing continuous washing with counter-current water/textile flow after dyeing and printing operations;
- 5,655 MWh annual energy efficiency savings with a payback period of c. 0.2 years. This can be achieved by installing additional automated metering and monitoring of electricity, fossil fuel and/or thermal energy consumption; and

- 5,000 MWh of electricity annually within the zone with an estimated payback period of c. 1.4 years. This can be achieved through the optimization of chilled water systems (for process support) across five key sectors.

Environmental performance: The OIZ is TS EN ISO 90001 and TS EN ISO 14001 certified and has environmental and energy management units within its organizational structure, and a full-time personnel unit with a staff of three.

- **Management:** The environmental management unit is responsible for operations, maintenance and retrofitting of wastewater, storm water, water supply networks and a wastewater treatment plant. Periodic audits are carried out by this unit, and corrective measures are put into place. The environment unit has its own laboratory to measure wastewater treatment plant inlet/outlet quality parameters. The energy management unit is responsible for monitoring the energy facilities owned by the zone authority. Upon request, 'energy walkthroughs' are conducted by the unit for tenants. It also organizes periodic sessions to raise awareness about energy efficiency improvement interventions among tenants.
- **The Wastewater Treatment Plant (WWTP)** is owned and operated by the management team and consists of two parallel facilities with capacities of 12,000 m³/day and 9,000 m³/day. The OIZ goes beyond the national discharge standard and applies stringent discharge parameters compared with other OIZs in Turkey. The head of the OIZ is directly responsible for meeting these standards. Within the WWTP, sludge formed after treatment

is stored on-site at a dedicated sludge drying beds unit from which the drained water is cycled back to the WWTP. The dried sludge is sent to a municipal landfill. All firms are obliged to connect to the WWTP system.

- **Water:** The OIZ sources water from the municipal water supply network. Rainwater and wastewater are collected separately through a 75 km-long storm water drainage system and a 45 km-long wastewater line.
- **Power generation:** The zone owns and operates a natural gas-fuelled 120 MW combined cycle power plant and a 500 kW Solar photovoltaic (PV) plant generating 780,000 kWh annually. In addition, one firm currently has its own solar PV system.
- **Recycling:** A private firm operates a plastic recycling facility on site. Firms periodically report solid waste volumes to the Ministry of Environment and Urbanization. Hazardous waste is disposed of by waste management companies.

Social performance: The OIZ owns a Private Technical College which accommodates 285 students and offers full scholarships to eligible recipients. The OIZ also owns and operates a vocational training center, a sports center, a dispensary, and a kindergarten. The OIZ has enhanced its security with smart camera technology and works with the izmir Police Department. It also organizes sectoral workshops, R&D competitions, and seminars, and pursues relationships with universities. OH&S are governed by national regulations, although there is currently no obligation to be certified under the Occupational Health and Safety Assessment Series (OHSAS).

Partner Engagement

In November 2017, the World Bank Group initiated a project with the Turkish Ministry of Science, Industry and Technology to transform conventional OIZs into EIPs through the development of a national EIP framework.

The project has partnered with Izmir Ataturk OIZ to investigate technical opportunities for EIP transformation. Specifically, it has identified the areas for EIP improvement as follows:

- The project team and zone authority have worked on the waste data of 45 firms and matched 83 different types of waste (EWC codes) with 31 different sectors (NACE codes). This has led to the identification of 10 industrial symbiosis opportunities.
- Izmir Ataturk OIZ has decided to establish a green OIZ/EIP unit with full time personnel to mainstream an ‘EIP culture’ among its tenants. This will involve the development of industrial symbioses projects, and awareness raising about EIP interventions and their operational/monetary benefits. Once the EIP framework is rolled out by the Ministry, the Unit will take over monitoring, verification, and evaluation (MV&E) duties.
- Until recently, izmir OIZ received water from municipal sources. A pilot scheme has been introduced which uses local groundwater to supply up to 50 percent of demand from the OIZ’s top 10 water users. These 10 users account for 50 percent of the OIZ’s total water use, and thus, a reduction of 25 percent in municipal water use is expected under this scheme.
- Opportunities have been identified to further reduce municipal water use through wastewater recycling. This will reduce the OIZ’s reliance on municipal water while also lowering demand and increasing capacity within the municipal network. Wastewater recycling offers the OIZ cost, energy and carbon savings estimated at US\$ 1–2 million per year.

For further information:

- <http://www.iaosb.org.tr/>
- <http://www.investinizmir.com/en/28346/Ataturk-Organized-Industrial-Zone>

ALEAP Green Industrial Park in Telangana, India



Industrial Park Overview

The Association of Lady Entrepreneurs of India (ALEAP) (now known as the Association of Lady Entrepreneurs of Andhra Pradesh) is a national level organization which aims to uplift and empower women through the establishment of small and medium enterprises. Given the paucity of government-funded industrial parks for women, ALEAP raises funds to develop industrial parks exclusively for women entrepreneurs.

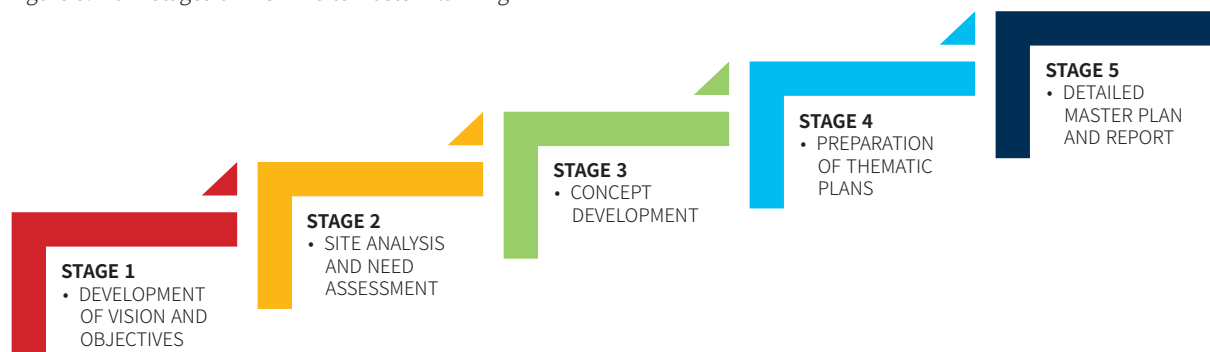
On behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), GIZ GmbH provided technical support to ALEAP for site master planning of the ALEAP-Green Industrial Park (A-GRIP) project. It is located at Nandigama, near Hyderabad in Telangana State. A-GRIP covers 334,094 m² (82.55 acres) of land outside the settlement area of the Nandigama village, and hosts 170 women entrepreneurs. For site master planning, many criteria were considered. These relate to economic, social, environmental, gender and resource efficiency issues. These considerations have now been integrated into the planning of the industrial park, and use benchmarks set by the German Sustainable Building Council (DGNB).

Processes

At the outset, the special requirements for women entrepreneurs and employees, and overall development needs, were identified. Since most of the women entrepreneurs were unable to clearly communicate their needs, a series of workshops, meetings, and field visits were organized. In addition, case examples and international conferences were used to gather ideas and requirements for the A-GRIP. A site master plan was developed according to the DGNB rating system, and reviewed at various stages by stakeholders, especially the women entrepreneurs and ALEAP.

ALEAP steered the process (see figure 5) with technical support from GIZ, coordinating with government agencies for land use conversions, plan approvals, and so on. It also played an important role in negotiating and decision-making, including gathering different perspectives, catalysing political and strategic decisions, and enhancing cooperation among partners and stakeholders.

Figure 5: Main Stages of A-GRIP Site Master Planning



Source: GIZ Indo-German Environment Partnership Programme



Design Strategy

The ALEAP Green Industrial Park provides a favorable environment for women entrepreneurs. It employs state-of-the-art technologies, including clean, renewable energy, and environmental technologies, as well as cost-effective common infrastructure. The park has over 100 plots allotted to non-polluting industrial units for sectors such as: herbal products, food and juices, paper and packaging, textiles, engineering, warehousing, and so on. As such, the following elements were prioritized during the park's spatial design and planning:

- Environment friendly site master plan; efficient circulation system;
- Green buildings for factory sheds; efficient industrial plot and building layouts; environment friendly building materials; standard fencing design; and signage;
- Green energy master planning; PV roof tops; solar streetlamps; and a solar power plant;
- Pollution control: wastewater treatment recycle/reuse; waste treatment/reuse; rainwater harvesting;
- Cost effective common infrastructure, for example, a common effluent treatment plant; a vermi-composting plant (for organic waste); a handmade paper unit (for paper waste); incubator facilities, and so on;
- Safety and security measures, for instance, security fencing; access control; closed circuit (CC) cameras; and fire alarms and fire-fighting systems;

- Services for women employees (for example, crèches; rest houses for recovery from extended work; first aid; catering/cafeterias; (centralized) kiosks; common toilets; an internal shuttle service (battery operated); an external connection to public transport; water dispensers; a guest house; and a ladies' room);
- Micro-entrepreneurships for common services, for example, with respect to business centers; warehousing; access control at entries/exits; canteens/cafeterias; provisions for outdoor functions/events; battery-operated vehicles for internal transport, and so on; and
- According to the site master plan, the land use mix is: 55 percent industrial; 2 percent commercial, 11 percent recreational and green; 10 percent facilities/utilities; and 22 percent transportation.

Provisions for Sustainability

Sustainability standards applied: A-GRIP's site master plan adheres to the local building by-laws, norms and standards. It also considers various environmental planning and design measures for development of a 'Green Layout' according to the norms prescribed under the Zoning Regulations of the Hyderabad Metropolitan Development Authority. The German DGNB certification system standards for industrial locations were also considered.

Measures for economic performance:

- It has been proposed that tenders for services such as waste and wastewater management will be awarded to firms with appropriate business models such as build-own-operate-transfer (BOOT) and green procurement principles.
- Services such as manning entry/exits, security, and so on are to be outsourced.
- Infrastructure such as weigh-bridges, warehouses, commercial areas, and parking areas are to be leased through a tender process.
- The sale value of allocable land is within market rates (Indian rupee [INR] 1,170 per m², or, US\$ 18.5 per m²), and investments are targeted for a total of INR 377.5 million, or US\$ 5.9 million.

Measures to ensure environmental performance:

- Prevention of soil contamination and surface water pollution.
- Storm water management systems, including collection, treatment, and recycling/reuse to prevent pollution of surface/ground water.
- Wastewater management system, including tertiary treatment for recycling/reuse to prevent contamination of soil and surface/ground water.
- Biological and chemical water quality: Decentralized wastewater treatment systems with tertiary treatment to prevent bacterial or chemical contamination.
- Eco-efficient battery-operated vehicles, compressed natural gas (CNG) buses for internal/external transport, cycling tracks and pedestrian pathways.
- Vermi-compost plant, handmade paper unit, and a waste recycling center.
- Waste management systems.

Measures to ensure social performance:

- Special provisions for women employees, including play schools and crèches for infant children of workers, ladies' restrooms, and accommodation for employees who work late.
- Safety and security.
- Internal and external transport, including an internal, battery-operated shuttle service.
- Health center, cafeterias/food outlets and kiosks.
- Training center and vocational training for local communities to create employment opportunities.
- Opportunities for nearly 200 women entrepreneurs and 10,000 employees, including employment for local communities.

For further information:

- www.igep.in/live/hrdpmp/hrdpmaster/igep/content/e54413/e54441/e62974/20150630_ALEAPCaseExamplea.pdf
- www.aLeap.org
- http://www.dgnb-system.de/en/system/certification_system/index.php

Annex 4: Park Level Eco-Industrial Park Framework Implementation

Parque Industrial Malambo SA, Colombia



Historically, PIMSA was a real estate company providing customized buildings to tenant firms, but over recent years, its function and services have expanded. The park management is committed to transitioning to an EIP, extending its business model towards renewable energy and resource efficiency, and pursuing social and economic community outreach activities.

Assessment of PIMSA Against the International EIP Framework

In 2018 PIMSA was the first industrial park that UNIDO assessed against the International EIP Framework. The assessment was undertaken in collaboration with and under the guidance of the park management team, with national and international experts assisting. UNIDO's EIP Assessment Tool was piloted for this exercise, and significantly informed the outcome. A post-assessment report presents opportunities and recommendations for PIMSA, and detailed action planning has followed for selected EIP opportunities.

Industrial Park Overview

The Parque Industrial Malambo SA (PIMSA) is located in the urban metropolitan area of Barranquilla. In 2016, PIMSA contributed 17 percent of total exports from the Atlántico Department (Colombia). The industrial park covers 120 hectares of industrial land and hosts approximately 30 firms (20 manufacturing industries), including steel transformation, battery production, food and chemical sectors. PIMSA is situated close to the airport of Barranquilla and has its own seaport.

Results of the Assessment

The review against the international framework demonstrated that PIMSA performs and compares favorably against many of the framework's benchmarks.



Source: UNIDO Eco-Industrial Park Project in Colombia



Source: UNIDO Eco-Industrial Park Project in Colombia

PIMSA met 11 of the 18 prerequisite benchmarks (approximately 60 percent). Three prerequisites were not met, and four needed to be confirmed through additional data validation. The key learning of this first practical application of the EIP Framework has been considered, and the updated prerequisites (i.e. in the present version of the EIP Framework) are based on more accessible data.

PIMSA met 24 of the 33 performance indicators of the EIP Framework (73 percent). Five indicators (3 environmental indicators, 1 social indicator and 1 indicator related to park management) were not fulfilled (about 15 percent), while four needed to be confirmed through additional data validation (approximately 12 percent).

Together with workshops organized with firms and park management, the assessment allowed the identification and prioritization of approximately 20 industrial synergy and symbiosis opportunities. For instance, a feasibility assessment was undertaken for the collection and utilization of hazardous waste generated by PIMSA firms (currently about 600 tons per year) by a cement plant located outside of the industrial park. The assessment demonstrated that alternatives to waste disposal to landfill are available at a lower cost. To assist in the implementation of promising EIP opportunities, an action and monitoring plan details key actions, responsibilities and timelines.

Areas for Continuous Improvement

UNIDO continues to implement EIP approaches in Colombia through the Global EIP Program – Colombia country-level intervention. The program is funded by the Swiss Government through its State Secretariat for Economic Affairs (SECO). It started in June 2019 and aims at parallel and integrated application of EIP strategies at the national governmental level, and in pilot industrial parks, to mainstream and upscale industrial symbiosis and EIP strategies.

Three industrial parks have been selected for technical assistance, advisory services and capacity building, including PIMSA. They are located near three cities with significant industrial activities. PIMSA is well placed to serve as a “model” industrial park, and UNIDO will build upon the work already accomplished there to further implement EIP approaches. Using International EIP Framework benchmarks, progress will be regularly monitored to evaluate the benefits of the EIP approach.



For further information:

- www.unido.org/our-focus-safeguarding-environment-resource-efficient-and-low-carbon-industrial-production/Eco-Industrial-parks
- www.pimsa.co

Engineering Square (E2) and East Port Said (EP) Industrial Parks, Egypt



Industrial Park Overview

On behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), the Egyptian-German Promotion of Small and Medium Enterprises (PSME) is a bilateral technical cooperation programme under the guidance of the Egyptian Ministry for Trade and Industry (MTI) with Technical Assistance provided by GIZ GmbH. PSME and the Industrial Development Group (IDG) are working together to transform E² and EP Industrial Parks into Sustainable Industrial Areas (SIA)/Eco-Industrial Parks. IDG is a private industrial park operator managing three industrial parks. In parallel with IDG's management activities, the EIP framework was used to develop a roadmap for IDG with E²-Park and East Port Said Park as pilots. E² Park is a fully developed park (brownfield park) located in the 6th of October City in Giza. It occupies an area of 310 ha, and hosts 145 firms, with an occupancy rate of 75 percent. The firms work in Automotive, Engineering, Chemicals, Pharmaceutical, Food and Logistics industries. The park also has a vocational training

center (NASS Academy), conference and meeting area, a business hotel, a day care center, restaurants, 24/7 Medical center, Shuttle Bus service, Business Offices and commercial shops. East Port Said Park is under construction (greenfield park) in a strategic area in the Suez Canal Special Economic Zone where it occupies 1,600 ha and will host medium and light industries.

Assessment Against the Eco-Industrial Park Framework

In July 2019, the assessments began with training IDG employees from different departments on the concept of SIA and the EIP framework in order to set a common understanding for all team members. The training was followed by several workshops with E² park management and investors to understand the park's current situation and execute a gap assessment based on the prerequisites and performance indicators outlined in the EIP Framework. GIZ conducted a situational analysis of environmental, economic, social and management aspects of E² to identify

areas and processes in which the prerequisites and performance indicators were not yet fully applied. A gap analysis of the assessment, and a list of action-oriented interventions were generated to guide the park management's new priorities. Also, several meetings with the engineering department of East Port Said took place. Based on the Master Plan and EIP framework, actions related to the infrastructure and implementation sequence for East Port Said have been integrated into the transformation roadmap.

Results

Based on the gap assessment and discussions with East Port Said, a five-year transformation roadmap was developed as a guideline for achieving outstanding pre-requisites and performance indicators. It addresses IDG as the park operator, and supports IDG to plan the conversion of E² into an SIA/EIP. The roadmap was developed using a multilevel approach covering the following levels:

- Macro level: park management which creates favorable framework conditions;
- Meso level: regarding cooperation among companies and networks; and
- Micro level: companies implement resource saving and management principles.

The measures outlined in the transformation roadmap include, inter alia: specific job descriptions for park operation, key performance indicators for assessments, Code of Conduct formalizing investor commitment to transformation, new services based on customer demands and quality specifications, regular meetings of park management with investors, "Park Committee" as decision making body, energy and environmental management systems for investors, "energy efficiency consultation" service, renewable energy solutions and Industrial Symbiosis workshops. As East Port Said is still being developed, other measures related to infrastructure were introduced as part of the roadmap, based on anticipated investor demand. In anticipation of Industry 4.0, and the move to renewables, these measures include smart meters, digitization technologies, and communication components such as HMI, M2M, NFC, IoT and 5G.

Areas for Continuous Improvement

Following the assessment, IDG began implementing measures to achieve SIA/EIP status. They conducted a survey to assess the response of investors and customers to park services, and, as the SIA concept requires cooperation between park management and investors, held the first meeting of the Park Committee in November 2019. The transformation process was introduced to investors, and their commitment and engagement was sought.

IDG management formed a multi-department team, with the COO as change agent, to define roles and responsibilities, and to implement the roadmap using action plans. The team worked towards a total quality management system, including environmental and energy management. They started to upgrade street lighting to solar energy, and contracted a waste management company to maximize the value of waste, reusing it via other industries instead of dumping it. The engineering team is being trained to provide Energy Efficiency and Energy Management System services to park tenants.



For further information:

- <https://www.psmeegypt.org/>
- <https://www.engineering-square.com/>
- <https://www.ep-egypt.com/>

Annex 5: National Level Eco-Industrial Park Framework Implementation

Turkey Green Organized Industrial Zones Program



The World Bank Group/IFC has been supporting Turkey's Ministry of Industry and Technology (MoIT) since November 2016 via the Green Organized Industrial Zones (OIZ) Technical Advisory Project using the EIP Framework. The program aims to improve industrial productivity and drive the sustainability agenda of MoIT through technical and legislative means, while upscaling the competitiveness of the OIZs and their industries in the global marketplace. Furthermore, it aims to curb GHG emissions from OIZ operations, and support Turkey's climate action commitments.

As a first stage, the Program engaged with stakeholders, namely, MoIT, line ministries, regional development agencies, OIZ Authorities and private sector participants. It promoted EIP principles, EIP interventions to improve park management, environmental and social concerns, monetary and environmental benefits of EIP interventions, financial instruments for sub-projects, and regulatory reforms for private-sector-friendly implementation of the EIP Framework nationwide.

Following these steps, the Program has partnered with four OIZs in the cities of Adana, Ankara, Bursa and Izmir to conduct in-situ diagnostics and identify gaps and technical opportunities which mesh with current operations. These interventions will also upscale the productivity and competitiveness of the manufacturing sector through: introduced energy and environmental management systems, resource efficiency and cleaner production, industrial symbioses, green infrastructure improvement to enable more sustainable water supply (e.g., rainwater harvesting), circularity of treated wastewater (via membrane technologies), and increased RE utilization (e.g., solar rooftop, biogas). The existing regulatory framework was compared against the EIP's pre-requisites and performance standards; and building on the in-situ diagnostics, a tailored list of EIP performance criteria was derived to qualify OIZs as EIPs based on their management, environmental, social and economic performance.

Based on the studies piloted in the four partner OIZs, the Program developed a National Framework for EIPs in Turkey for the use of MoIT. The Framework highlights

the regulatory, financial, and technical opportunities currently in place, and identifies the most viable opportunities in the areas of resource efficiency, green infrastructure development and circularity for replication in other OIZs in Turkey. It also puts forward a set of recommendations, including those on regulatory and institutional aspects, which will help transform Turkey's conventional OIZs into EIPs.

The results of diagnostics from the four partner OIZs suggest potential annual savings of US\$ 95.4 million, with an estimated capital investment of US\$ 350.3 million, giving an average payback of 3.7 years. This would result in a potential overall annual energy efficiency of 1.0 million MWh, carbon reduction of 357 kt CO₂, water saving of over 11.7 million m³, waste reduction of around 71.291 tons and chemical reduction of over 14,550 tons. The study at the four OIZs was then expanded to include a broader range of OIZs. The Project has gathered data from 14 additional OIZs and performed technical analyses based on which US\$ 1.1 billion of investments in resource efficiency, industrial symbiosis and green infrastructure have been justified across the 18 OIZs (accounting for five percent of overall operational OIZs in Turkey). These improvements will save approximately US\$ 194 million in electricity per year, US\$ 86 million in water per year, and would abate 1.2 Mt CO₂ eq annually.

In addition to the Framework, a roadmap was prepared, as per the Project's scope, to guide MoIT and other key stakeholders to implement the National Framework for Green OIZs in Turkey through regulatory and institutional improvements. In stepwise structure, the roadmap details actions to improve the regulatory environment, and suggests institutional changes in roles, activities, and responsibilities of MoIT and other core ministries to operationalize the Framework. The main institutional responsibilities include training, capacity building, communicating procedures and related documents, monitoring, and compliance. In doing so, the roadmap facilitates the implementation of the National Green OIZ Framework and aims to enhance inter - ministerial and multi - stakeholder participation in this process.

Among other actions, the roadmap also recommends new coordination bodies (e.g., the Green OIZ Program Coordination Unit, the Green OIZ Development Unit, and Green OIZ Regional Directorates), based on the analysis of institutional and organizational settings made within the Green OIZ National Framework. The roles and responsibilities of these bodies are summarized below:

- Regional Directorates of OIZs which take part in the Green OIZ Program, either as establishing greenfield sites or operational sites aspiring to transform to EIP status, are regarded as **“Green OIZ Regional Directorates.”**
- The purpose of the **“Green OIZ Program Coordination Unit”** to be established within the MoIT will be to coordinate productivity enhancement at regional- and national-levels to promote consistent communication with all Green OIZs.
- The establishment of a **“Green OIZ Development Unit (GDU)”** within relevant OIZs is recommended to drive, implement and oversee sustainable manufacturing related initiatives among tenant firms, the Green OIZ Regional Directorate, and institutions. On approval of their application to the MoIT, OIZ Regional Directorates will be required to establish this unit. The GDU is tasked with carrying out coordination, technical support and secretarial duties for voluntary Green OIZ programs within their respective OIZs.

To take the next step, the Government is working with the World Bank Group and institutions in Turkey to fine tune EIP indicators for OIZs and legitimize them by amending current regulations and introducing a national EIP certification system.



Vietnam Eco-Industrial Park Initiative

UNIDO and the World Bank Group have been supporting the Government of Viet Nam since 2015 to develop and operationalize an EIP Framework at national level.

World Bank Group and UNIDO have provided policy support and capacity building to the Ministry of Planning and Investment (MPI) and other ministries relevant to the country's ambition to transform conventional industrial zones (IZs) into EIPs and develop new EIPs. The support included studies at selected industrial zones to identify bankable opportunities for resource efficiency improvement, addressing dated policies and developing sustainability and competitiveness tools. Within the scope of the combined EIP programs, technical diagnostics were conducted at 11 industrial zones, and financial and regulatory frameworks were analyzed to identify barriers to the implementation of EIP standards. In light of these findings the World Bank Group has prepared EIP technical guidelines and a roadmap for MPI that tailors International EIP Framework performance criteria to the Viet Nam context. These tailored guidelines establish a foundation for EIP development in Viet Nam by introducing environmental and park management pre-requisites. Subsequently, MPI asked UNIDO to support the further development of the indicators to include socio-economic aspects. The UNIDO report "Social and Economic Indicators for Eco-Industrial Parks in Viet Nam" was published in June 2019.

The joint UNIDO and World Bank Group work led to the release of Decree 82/2018/ND-CP ('Decree 82', which took effect in July 2018) and the National Technical Guidelines for Eco-Industrial Parks in Viet Nam. Decree 82 introduces the concept of EIPs in national legislation and regulates their operation. It also prescribes planning, establishment, operation

of industrial parks and economic zones, and related policies and state management modalities. It is applied to regulatory bodies, organizations, and individuals involved in investment and business in industrial parks and economic zones.

On the basis of Decree 82, and under the lead of MPI, UNIDO is now supporting the Government of Viet Nam to operationalize the Decree. This includes the development of Ministerial circulars, which will serve as national technical guidelines for industries and government authorities. To this end, staff from Ministries responsible for the operationalization of Decree 82 participated in an intensive 2-week EIP training in Switzerland. The training focused on existing successful policies and practical EIP-related interventions.

With over 328 industrial zones, of which more than 250 are in operation, Viet Nam has much to gain from adopting an EIP framework. Once established, EIPs attract investors requiring high environmental, social and governance standards.

The EIP framework proposed for Viet Nam focuses on the potential conversion of existing industrial parks to EIPs, and the guidelines and related indicators are set to enable this transition.

The guidelines include a detailed overview of monitoring requirements, targets against indicators, methods for calculating indicators, and related regulatory frameworks. They are based on version 1.0 of the International Framework for EIPs.

The selection of indicators for EIPs considered ease of monitoring and ease of setting targets. The indicators were predominantly drawn from best practices in other countries and were adapted to the Vietnamese context. A scoring methodology complements the



indicators so they can be used to rate the performance of an industrial zone.

The guidelines were complemented by a development roadmap for EIPs in Viet Nam until 2030 and beyond. In the future, UNIDO will continue supporting MPI to develop the institutional framework required for data management (based on selected indicators), knowledge management, and support to industrial zones and their tenants to monitor and implement EIP-related opportunities.

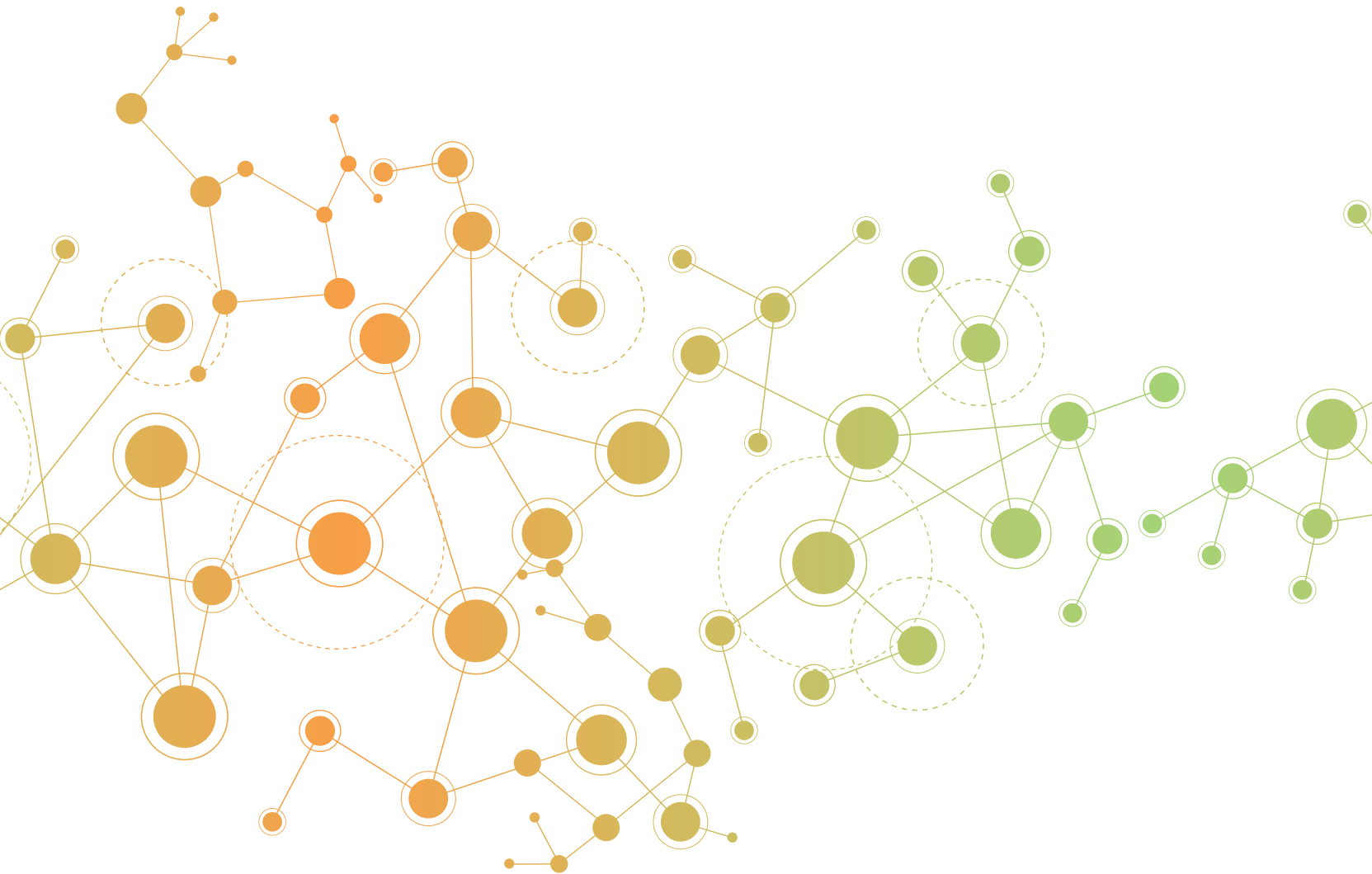
In promoting EIPs, the two organizations have supported selected industrial zones in the North, Center and South of Viet Nam to identify and implement RECP interventions. An additional US\$ 10 million of private investments in tenant firms was mobilized over 2015–2019.

Furthermore, the two organizations explored investment opportunities in industrial symbiosis, working toward bankable investment proposals to mobilize financing. Both the willingness of IZs and tenant firms to consider EIP interventions, and the financial feasibility of such interventions, are important for successful implementation.

Knowledge management (sharing of EIP best practices, awareness building on the EIP framework for Viet Nam) will facilitate both the success of monitoring and awareness of resource efficiency opportunities, and these will contribute to the sustainability of the industrial sector in Viet Nam and the implementation of Viet Nam's Green Growth strategy.

For further information:

- <https://open.unido.org/api/documents/5366397/download/Pamphlet%20Eco-Industrial%20Park.pdf>



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