



UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION



# IMPLEMENTATION HANDBOOK FOR ECO-INDUSTRIAL PARKS

INCLUSIVE AND SUSTAINABLE INDUSTRIAL DEVELOPMENT



UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION

# IMPLEMENTATION HANDBOOK FOR **ECO-INDUSTRIAL PARKS**

INCLUSIVE AND SUSTAINABLE INDUSTRIAL DEVELOPMENT

## ACKNOWLEDGEMENTS

The authors would like to express their gratitude to all persons who contributed to this handbook. Special acknowledgements to:

- Dr. Dick van Beers
- Mr. Smail Alhilali
- Ms. Elisabeth Mueller
- Dr. Frederic Meylan
- Ms. Nadia Zuodar

This publication was reviewed by Prof. Suren Erkman (University of Lausanne). The publication has also benefited greatly from the continuous institutional contributions to this topic from RECPnet and its members ([www.recpnet.org](http://www.recpnet.org)). The development of this handbook was made possible by funding from the State Secretariat for Economic Affairs of Switzerland (SECO). The content does not necessarily reflect the views of SECO or the Swiss Government. UNIDO would like to thank Johannes Krenner (Joker Design) for the graphic design of this report and Alice Miller for editing the handbook content.  
© Photos: Provided by partners.

## © 2017 by the UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

The designations employed and the presentation of material in this handbook do not imply the expression of any opinion whatsoever on the part of UNIDO and their governing bodies concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The views expressed in this document are those of the authors and do not necessarily reflect the views of UNIDO and its governing bodies.



Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs,  
Education and Research EAER  
State Secretariat for Economic Affairs SECO

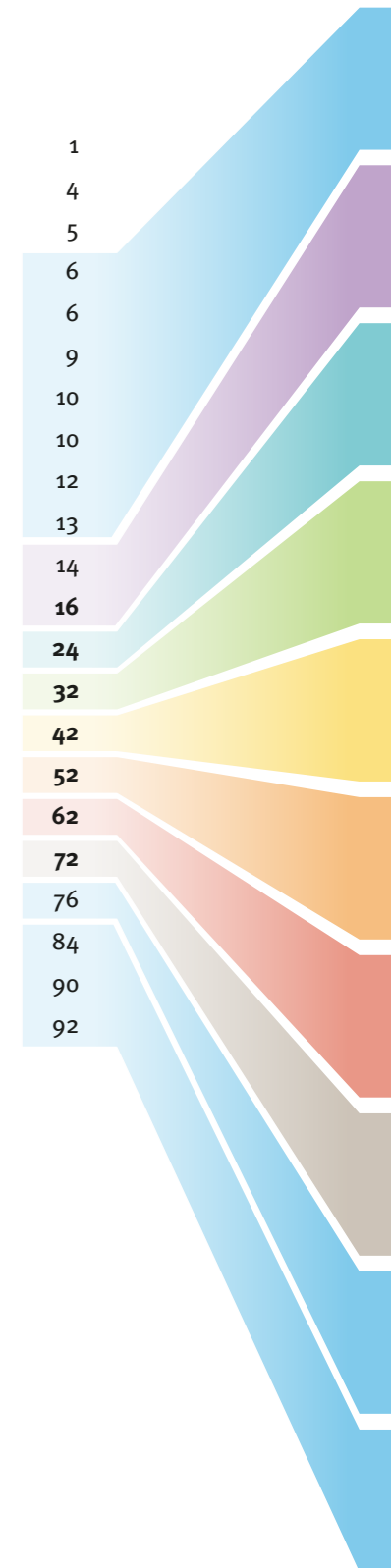
## TABLE OF CONTENTS

Acknowledgements / Disclaimer

Abbreviations

Glossary

1	Introduction	1
1.1	UNIDO and eco-industrial parks	4
1.2	Why this handbook?	5
1.3	Objectives of this handbook	6
1.4	Who is this handbook for?	6
1.5	What is an eco-industrial park?	9
1.6	Why eco-industrial parks?	10
2	The UNIDO implementation approach for eco-industrial parks	10
	a) Scoping EIP interventions	12
	b) EIP awareness raising	13
	c) EIP policy support	14
	d) Park management models	16
	e) Upscaling resource efficiency and industrial synergies/symbiosis	24
	f) Performance monitoring and benchmarking	32
	g) Capacity building (cross-cutting activity)	42
3	Contribution of EIPs to sustainable cities	52
4	Implementation tools	62
	Questions or need support?	72
	References	76
		84
		90
		92



## ABBREVIATIONS

<b>CEO</b>	Chief executive officer
<b>CNPML</b>	Colombia National Cleaner Production Centre
<b>EIP</b>	Eco-industrial park
<b>ELIDZ</b>	East London Industrial Development Zone
<b>GEF</b>	Global Environment Facility
<b>GHG</b>	Greenhouse gas
<b>GIZ</b>	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
<b>GRI</b>	Global Reporting Initiative
<b>ICT</b>	Information and communications technology
<b>IDZ</b>	Industrial development zone
<b>IFC</b>	International Finance Corporation
<b>JSAID</b>	Jiangsu Scitury Allied Investment and Development Co., Ltd.
<b>KPI</b>	Key performance indicator
<b>MPI</b>	Ministry of Planning and Investment (Viet Nam)
<b>NCPC</b>	National Cleaner Production Centres
<b>NGO</b>	Non-governmental organization
<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>OH&amp;S</b>	Occupational health and safety
<b>PCP</b>	Programme for Country Partnership
<b>RECP</b>	Resource Efficient and Cleaner Production
<b>SAZ</b>	Société d'Aménagement Zenata
<b>SDG</b>	Sustainable Development Goal
<b>SECO</b>	State Secretariat for Economic Affairs of Switzerland
<b>SEZ</b>	Special economic zone
<b>SME</b>	Small and medium-sized enterprise
<b>UNEP</b>	United Nations Environment Programme
<b>UNIDO</b>	United Nations Industrial Development Organization
<b>WBG</b>	World Bank Group
<b>WISP</b>	Western Cape Industrial Symbiosis Programme
<b>ZETDZ</b>	Zhenjiang Economic and Technological Development Zone

## GLOSSARY

<b>Eco-industrial park</b>	An eco-industrial park can be defined as an earmarked area for industrial use at a suitable site that ensures sustainability through the integration of social, economic and environmental quality aspects into its siting, planning, operations, management and decommissioning. The term greenfield eco-industrial park is used for completely new EIPs, and the term brownfield is employed when an existing industrial park is transformed into an EIP.
<b>Industrial policy (modern definition)</b>	Any type of intervention or government policy that attempts to improve the business environment, or to alter the structure of economic activity toward sectors, technologies or tasks that are expected to offer better prospects for economic growth or societal welfare than would occur in the absence of such intervention.
<b>Industrial synergies and symbiosis</b>	The term “industrial synergies” covers the concept of industrial symbiosis, but it has a broader focus on the different types of industrial collaborations (Van Beers et al., 2007): <ol style="list-style-type: none"> <li>1. Supply synergies and co-location of suppliers and clients: Co-location and clustering of companies in the supply and value chains.</li> <li>2. Utility synergies: Shared use of utility infrastructure, mainly revolving around water and energy.</li> <li>3. Service synergies: Sharing of services and activities between companies (e.g. joint training of staff and sharing of maintenance contractors).</li> <li>4. By-product synergies and waste exchanges (industrial symbiosis): The use of a previously disposed waste (as solid, liquid, gas) from one facility by another facility to provide valuable by-product.</li> </ol>
<b>Resource Efficient and Cleaner Production (RECP)</b>	RECP builds on cleaner production in accelerating the application of preventive environmental strategies to processes, products and services to increase efficiency and reduce risks to humans and the environment. RECP addresses the three sustainability dimensions individually and synergistically: <ul style="list-style-type: none"> <li>• Production efficiency: optimization of the productive use of natural resources (materials, energy and water).</li> <li>• Environmental management: minimization of impacts on environment and nature through reduction of wastes and emissions.</li> <li>• Human development: minimization of risks to people and communities and support for their development.</li> </ul>
<b>Sustainable city</b>	A sustainable community is one that is economically, environmentally, and socially healthy and resilient. It meets challenges through integrated solutions rather than through fragmented approaches that meet one of the goals at the expense of the others (Institute for Sustainable Cities definition). The global development agenda of the United Nations advocates in Sustainable Development Goal 11, the need to “make cities and human settlements inclusive, safe, resilient and sustainable.”
<b>Tenant companies</b>	Companies that are property owners or leasers in an eco-industrial park.



# 1) INTRODUCTION

## 1.1 UNIDO AND ECO-INDUSTRIAL PARKS

THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION (UNIDO) is a specialized agency of the United Nations that promotes industrial development for poverty reduction, inclusive globalization and environmental sustainability. The responsibility of UNIDO is to contribute to inclusive and sustainable industrial development by improving the environmental performance, resource productivity and safety of existing industries, as well as by supporting the creation of new industries providing environmental goods and services. Over the past three decades, UNIDO has promoted the mainstreaming of resource efficiency and cleaner production in industries and industrial parks located in developing and emerging economies, through pilot demonstrations as well as global knowledge and dissemination projects.

The first UNIDO pilot initiatives on eco-industrial parks (EIP) were implemented in 2010 in India (Vadodara-Ankleshwar Industrial Area and Dahej Petroleum, Chemical and Petrochemicals Investment Region, in the state of Gujarat). The same year, UNIDO introduced the concept of EIPs in Tunisia, targeting two industrial parks (Bizerte Business Park and Djebel Oust and Bir M'cherga Industrial Zone).

Since 2012, the work of UNIDO in the area of eco-industrial parks has expanded under the joint global Resource Efficient and Cleaner Production (RECP) programme with the United Nations Environment Programme (UNEP), funded by the Swiss State Secretariat of Economic Affairs (SECO). This programme conducted a global assessment of eco-industrial parks in developing countries, targeting 33 industrial parks in 12 countries (UNIDO, 2016a). Since 2015, UNIDO has implemented EIP pilot projects in six countries under the global RECP programme (China, India, Morocco, South Africa, Colombia and Peru). Moreover, an EIP country project is implemented in Viet Nam, funded by the Global Environment Facility (GEF) and SECO. A summary of these projects is shown in *Figure 1*.

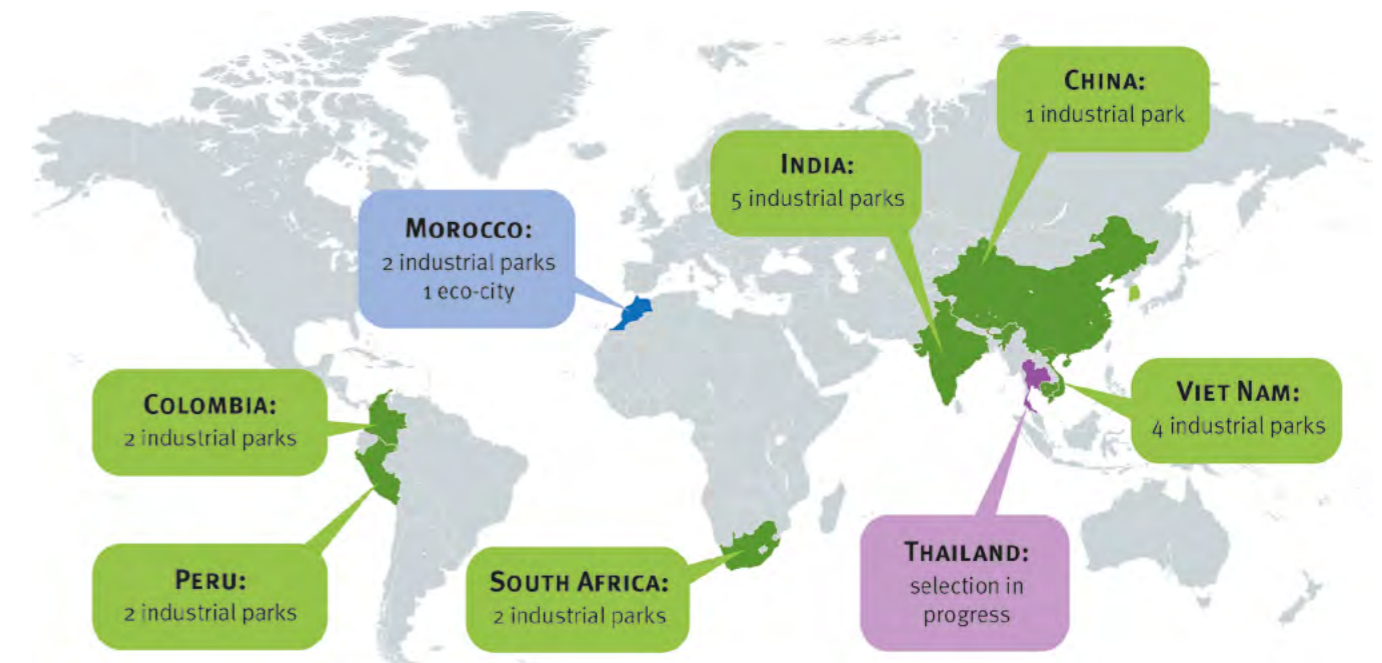


Figure 1: Map of UNIDO's current eco-industrial park projects in developing and transition countries

- **China:** UNIDO is collaborating with the Jiangsu Scitury Allied Investment and Development Co., Ltd. (JSAID) to implement EIP initiatives with a key focus on the promotion and implementation of RECP techniques and industrial synergies. The work is undertaken in the Zhenjiang Economic and Technological Development Zone (ZETDZ) located in the eastern part of Zhenjiang city. Approximately 10 different industrial parks are located in this area, which represents opportunities as well as challenges to implement industrial synergies.
- **Colombia:** UNIDO and the Colombia National Cleaner Production Centre (CNPML) are collaborating on the development of EIP initiatives in Colombia. A pre-assessment phase resulted in the selection of two industrial parks, near the cities of Medellín and Barranquilla. UNIDO support includes RECP assessments in individual companies, the promotion of industrial synergies between companies as well as the strengthening of park management capacities.
- **India:** In India, UNIDO has focused on five industrial parks. Two parks are in the state of Telangana near the city of Hyderabad, one in Andhra Pradesh and two in the state of Gujarat. The work focuses on the implementation of RECP within companies and the development of industrial synergies as well as widespread awareness raising activities in the five industrial parks.
- **Morocco:** In 2006, a dedicated company (Société d'Aménagement Zenata or SAZ) was set up to conceptualize, plan and implement a sustainable city near the city of Casablanca (Zenata). In this project, UNIDO focuses on two industrial parks, namely Zenata Industrial Park (a brownfield park designed to host existing industries previously dispersed throughout the area) and Zenata Cyclopolis - Benichou area (a greenfield park reserved for future industrial activities).
- **Peru:** As part of the UNIDO Programme for Country Partnership (PCP), UNIDO provides technical assistance and policy advice to support the

implementation of the National Plan for Productive Diversification, a comprehensive industrial policy established in 2014 and implemented by the Ministry of Production. A key component of the national plan is the establishment of new industrial parks and transformation of existing industrial areas. Specific UNIDO support includes implementing a GEF-funded initiative for the promotion of a sustainable industrial area in Callao, sustainability reviews of industrial park master plans (e.g. Ancón Industrial Park), and evaluation/prioritization of manufacturing sectors for the development of sustainable industrial parks in the country.

- **South Africa:** Two industrial parks with different management models were selected in South Africa, namely Epping City Improvement District (an industrial area close to the city of Cape Town), and East London Industrial Development Zone (Eastern Cape Province). A key focus of the work in South Africa is capacity building activities for park management entities as well as identifying industrial symbiosis options.
- **Thailand:** In 2017, a GEF-funded project preparation phase is being implemented, focusing on industrial and urban symbiosis as well as green chemistry, to reduce the release of hazardous chemicals and greenhouse gas emissions. Industrial parks that will participate in the project have not yet been selected, but several provinces have already expressed interest.
- **Viet Nam:** The Vietnamese Ministry of Planning and Investment (MPI) and UNIDO jointly developed a GEF- and SECO-funded project to introduce and implement management systems in selected industrial zones in the country. The project's objectives are to reduce greenhouse gas (GHG) emissions, water consumption, water pollution, persistent organic pollutants and other chemicals of global concern and to demonstrate innovative, clean and low-carbon practices in industries. Industrial zones are targeted in three different provinces, namely Ninh Binh, Can Tho and Da Nang.

## 1.2 WHY THIS HANDBOOK?

In promoting and supporting the development of eco-industrial parks, UNIDO aims to mainstream and up-scale the application of Resource Efficient and Cleaner Production (RECP) by businesses and government and contribute to sustainable consumption and production. In 2015, 17 Sustainable Development Goals (SDGs) were accepted as a set of targets and indicators by United Nations members to frame their agendas and political policies. Eco-industrial parks can serve as a catalyst to all SDGs (to various extents), but most explicitly to SDG 9, to build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.

Numerous publications, tools and studies, delivered with UNIDO support, are directly or indirectly related to the development and implementation of eco-industrial parks. The rationale for this handbook is to bring together the technical experience of UNIDO in developing and implementing EIP projects as well as to provide demonstrated guidance in this area.

### This handbook is intended to be applicable to:

- Industrial parks in various international contexts with core focus on transition and developing countries
- All development stages of industrial parks (e.g. scoping and concept planning, pre-feasibility and feasibility studies, investment decisions, design and construction, operation, redesign and optimization)
- Industrial parks with different characteristics (e.g. types of industry sectors in park, park size, level of technology development, park management model)

### 1.3 OBJECTIVES OF THIS HANDBOOK

The overall aim of this handbook is to assist private and public sector stakeholders with the practical implementation of eco-industrial park concepts into existing industrial parks (brownfields) and new industrial parks (greenfields).

**This handbook aims to:**

- Assist practitioners with the implementation of EIPs, covering scoping EIP interventions, awareness raising, policy support, park management models, up-scaling resource efficiency and industrial synergies/symbiosis, performance monitoring and benchmarking, and contribution to sustainable cities.

- Summarize the success factors which are important to consider when implementing EIP approaches.
- Clearly outline the implementation steps of EIP development.
- Introduce practical tools available to support the implementation of EIPs.
- Present practical examples to illustrate lessons learned and benefits from international experiences.
- Raise awareness of the benefits and added value of EIPs, including alignment with international priorities such as the Sustainable Development Goals, climate change mitigation and sustainable and inclusive industrial development.

### 1.4 WHO IS THIS HANDBOOK FOR?

The key beneficiaries of this handbook are governmental institutions seeking to develop or adjust current industrial park-related policies, and private sector stakeholders who are involved in the actual development and improvement activities of eco-industrial parks.

The target audiences for this handbook are:

- Industrial park operators and management
- Industries and businesses operating in the industrial parks
- Governments and regulators responsible for the development and operation of industrial parks
- Providers of infrastructure and utility services for industrial parks

- Private sector organizations responsible for industrial land development
- Financial sector and funding agencies
- International support organizations and service providers, including National Cleaner Production Centres (NCPCs), development agencies, technical and management consultancies
- Educational institutions providing training and capacity building services

Building on the points above, the intended use of the handbook by targeted stakeholders is summarized in Table 1.

Intended use	Intended use of the handbook					
	Develop improvement opportunities and reduce risks in design and planning of industrial parks	Inform investment decisions, funding allocation and due diligence studies, access funding	Assist with scaling up, replicating, promoting existing good EIP practices	Gain recognition and build market profile	Serve as consolidated approach to provide better services and support to customers	Provide a practical approach to support decision-making within their own organization
<b>Stakeholders</b>						
Park operators and management	✓	✓	(✓)	✓	✓	✓
Park tenants (industries and business)	✓	(✓)				✓
Governments and regulators	✓	✓	✓	✓		✓
Private sector organizations in industrial land development	✓	✓	✓	✓		✓
Financial sector and funding agencies		✓	✓			✓
International support organizations and service providers	✓	✓	✓		✓	✓
Educational institutions			✓			

TABLE 1: Intended use of the handbook by targeted stakeholders

## 1.5 WHAT IS AN ECO-INDUSTRIAL PARK?

Throughout the world, eco-industrial park approaches are characterized by different definitions, classifications and contexts. A recent UNIDO study on the review of eco-industrial park practices (UNIDO, 2016a) concluded the following:

- Eco-industrial parks mean different things to different parties.
- Practice does not yet match ambition.
- Process and continuous improvement-based approaches appear most useful.
- Lack of experience, awareness, supporting regulations and their enforcement slow down the development and implementation of eco-industrial parks.
- Many good practice elements exist, yet need to be brought together and implemented routinely in planning, development and management of industrial parks.

Various definitions are used in relation to eco-industrial parks. This handbook refers to the following definition, commonly employed at UNIDO, which recognizes the importance of the three pillars of sustainable development and of integrating EIP considerations into all phases of the development and operations of industrial parks:

An eco-industrial park can be defined as “*a community of manufacturing and service businesses located together on a common property. Member businesses seek enhanced environmental, economic, and social performance through collaboration in managing environmental and resource issues.*” (Lowe, 2001)

In this regard, compliance with national and local regulations is the baseline for all industrial parks, whatever the geographical location and specific characteristics of the park. Eco-industrial parks therefore should go beyond compliance with local and national regulations on environmental and social requirements (“compliance+”).

Under the current cooperation between UNIDO, the World Bank Group and GIZ such minimum requirements are being developed with the aim to enable a streamlined international framework for eco-industrial parks. Different terminology is used by different organizations in different countries (e.g. sustainable industrial parks, low carbon zones, green industrial areas). Each title alludes to a dedicated area for industrial development supported with park level infrastructures and utility services which enhance their business performance, while at the same time addressing technical, infrastructural, managerial, environmental, social, economic and monitoring aspects to make the area more sustainable.

## 1.6 WHY ECO-INDUSTRIAL PARKS?

INTERNATIONAL GOOD PRACTICES illustrate that the types of economic, environmental, and social benefits from eco-industrial parks vary greatly and go well beyond the conventional business case benefits (UNIDO, 2016a; Van Berkel, 2006; WBG, 2016).

The benefits are not just commercial but also strategic, leading to reduced exposure to risk, increased competitiveness, business development, production continuity and a better reputation with key stakeholders. Eco-industrial parks enable companies to benefit from greater collaboration and exchanges within companies (between management, technical and environmental staff, finance, etc.), as well as between companies, government and service providers. Companies are enabled collectively to turn environmental problems into business solutions by using resources efficiently and cooperating through shared infrastructure.

THE MAIN ECONOMIC BENEFITS are direct and indirect employment creation; cost savings due to reductions in waste disposal, resource and energy consumption; and increased competitiveness. Some eco-industrial parks report higher foreign direct investment in their parks. Indirect benefits are often more difficult to quantify but are important for the long-term economic sustainability of the park and the companies. These can include indirect employment creation through skills upgrading and training, technology transfer, positive image, demonstration effect arising from application of best practices, and regional development.

ENVIRONMENTAL BENEFITS from eco-industrial parks are very diverse and include reduction of pollution levels, more efficient use of resources (e.g. raw materials, water, energy), preservation and protection of biodiversity and nature, and reduction, reuse and recycling of wastes. Additionally, improved management of chemical and hazardous substances in an eco-industrial park can lead to significant environmental benefits.

SOCIAL BENEFITS from EIP development range from the creation of local jobs, better working and labor conditions, local community well-being and community outreach, improvement of gender equity, crime prevention and better security. Eco-industrial parks often involve the creation of a social infrastructure as well, which is particularly important for developing countries. Examples include vocational training centres, skills development training as well as broader community services.

DRIVERS, such as access to finance, technical support, role of government agencies, policies and economic benefits were noted by most of the cases analyzed by a UNIDO comparative study (2016a). Drivers highlighted in international cases are to a large degree specific to the respective industrial parks. One of the most significant drivers for eco-industrial parks remains grounded in business competitiveness.

Industries operating in well-designed and well-managed eco-industrial parks are in a better position to take advantage of resource efficiency, value-adding and risk-mitigating measures and services available at the park level. The full list of drivers and barriers in terms of EIP developments can be found in the UNIDO global assessment (2016a).

From an industrial competitiveness perspective, the main drivers for eco-industrial parks are:

- Reducing operating costs and improving productivity
- Greening supply and value chains
- Mitigating climate change
- Improving resource supply security, management and efficiencies (e.g. materials, water, energy)
- Reducing business risks, by recognizing that environmental and social risks are economic risks
- Addressing environmental and social topics relevant to local community and government to ensure long-term license to operate industrial parks



## 2) THE UNIDO IMPLEMENTATION APPROACH FOR ECO-INDUSTRIAL PARKS

UNIDO IMPLEMENTATION APPROACHES for eco-industrial parks are based on international experience (Lowe, 2001; WBG, 2014; GIZ, 2015; UNIDO, 2016a). An overview is provided below.

These approaches focus on both new and existing industrial parks, covering the development process from scoping and concept development, pre-feasibility studies, design and construction, park operation, and redesign and optimization of industrial parks. The development and implementation of eco-industrial parks covers a wide range of disciplines, activities and supporting tools. This handbook builds upon and highlights the current and evolving core expertise of UNIDO on eco-industrial parks. It is acknowledged that the approaches outlined in this handbook are not all-inclusive.

In line with its mandate to promote and accelerate sustainable and inclusive industrial development in developing countries and economies in transition, the UNIDO EIP approach covers the following:

- **SCOPE INTERVENTIONS** to identify and prioritize EIP activities which are most suitable and most effective for stakeholder groups to work on.
- **RAISE AWARENESS** among key stakeholder groups in private and public sectors of the benefits and added value of EIPs and associated implementation processes.
- **PROVIDE POLICY SUPPORT** to translate the EIP concept and associated practices into national policies and

government decision-making processes. An enabling policy environment is important to ensure the successful development and implementation of EIPs and mainstreaming in private and public sectors.

- **DEVELOP AND ADVISE ON PARK MANAGEMENT STRUCTURES** to take care of a range of topics required to develop and operate an industrial park sustainably, to attract investments and to provide attractive working conditions. Having a formalized and well-functioning park management structure is a key requisite for an EIP. Park management assists EIPs and their tenant companies to take advantage of opportunities associated with RECP, industrial synergies, integration with local community and natural environment, spatial planning/zoning, and park level infrastructure and utility services.
- **PROVIDE TECHNICAL SUPPORT** to upscale resource efficiency and industrial synergies/symbiosis. RECP and industrial synergies increase efficiency and reduce risks to humans and the environment, both at the company and park levels. Industrial synergies can be for instance shared infrastructures, service and utilities, or by-product and waste exchanges between companies. EIPs apply integrated and collective approaches to infrastructure and utilities to avoid isolated, inefficient and ineffective systems.
- **UNDERTAKE PERFORMANCE MONITORING AND BENCHMARKING** to track progress of EIPs against set objectives and thus demonstrate environmental, economic and social outcomes in an efficient,

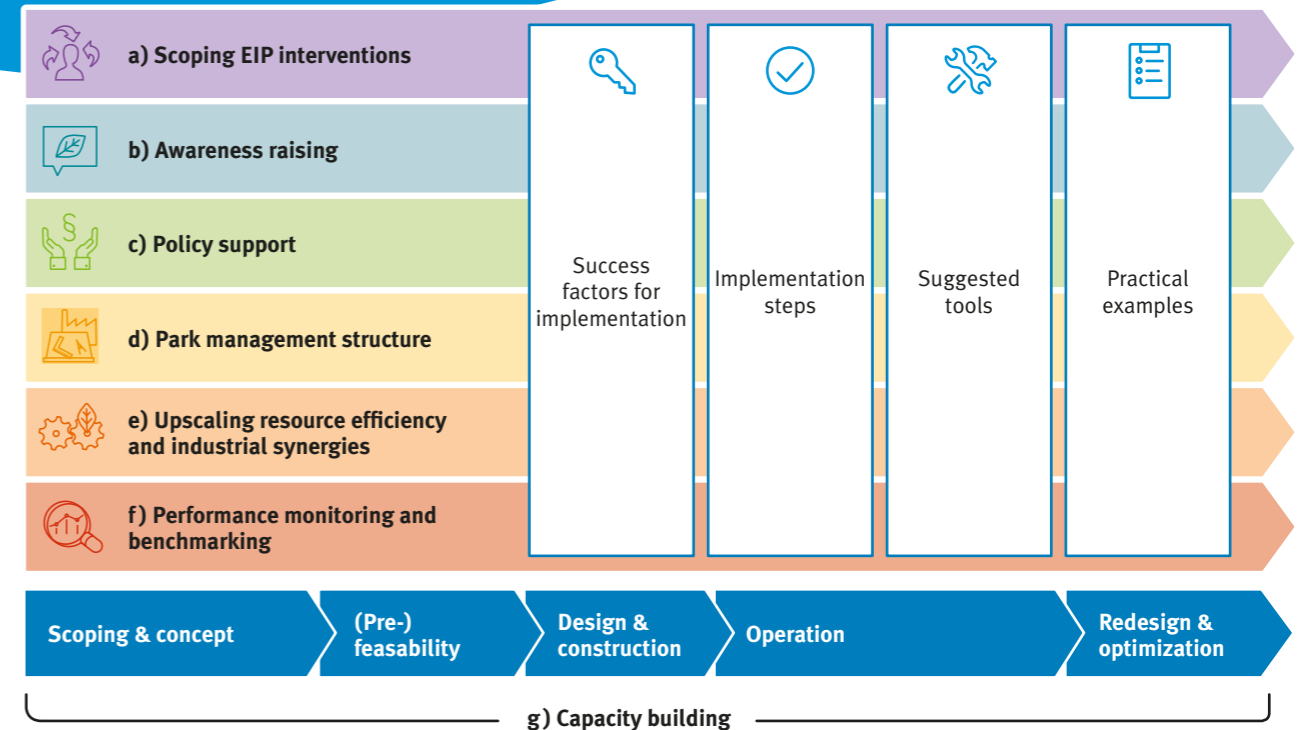


Figure 2: Key components of eco-industrial parks

transparent and accountable manner.

- **DEVELOP CAPACITY BUILDING** of key stakeholders throughout the entire development of EIPs (technical and non-technical capacities).
- **CONTRIBUTE TO LOCAL COMMUNITY/CITY** to enhance well-being of local population and overall regional development. The operation of companies and welfare of workers and local community in the park depend on functioning eco-system services (e.g. water supply for production processes, and clean air for employees' health and productivity). Therefore, functioning ecosystems need to be preserved

while at the same time reducing business as well as social risks (e.g. water shortages, skilled workers) through functioning social management systems and outreach programmes in place.

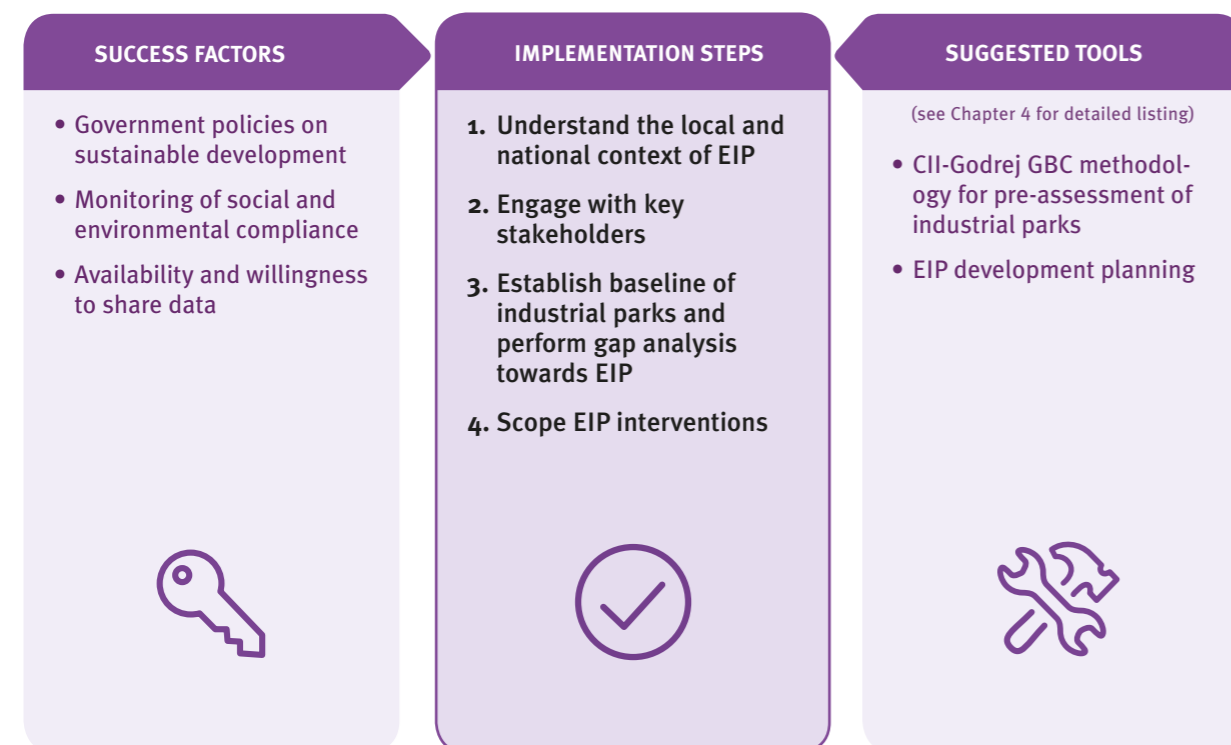
Each element of this approach is outlined in detail in the following sections, covering success factors, key implementation steps, practical examples, and tools to assist with the implementation of eco-industrial parks. The last point – which covers the contribution of EIPs to (sustainable) cities – is relatively innovative and specific. It will be described separately (Chapter 3).

# A) SCOPING EIP INTERVENTIONS



## MAIN OBJECTIVES

- Assess compliance level of EIPs
- Assist in the selection of industrial parks
- Guidance for types of interventions required to venture towards EIPs



## RATIONALE

Before implementing eco-industrial park approaches, it is important to understand the starting point and suitability of existing industrial parks. The selection and scoping process identifies the suitability of committed industrial parks as well as the right type of interventions, to ensure a successful transformation to internationally acceptable EIP models. The objective of a selection can also be the generation of demonstrable success cases and transformative programmes for the future.

The scoping of EIP interventions seeks to refocus and streamline the application process to target potential industrial parks and their transformation towards eco-industrial parks. This is necessary as demonstrated by the recent UNIDO global assessment (2016a). The assessment found that no streamlined approach or common understanding of EIP development was applied in the surveyed countries. As a result, some industrial parks lacked basic EIP requirements (e.g. park management, industrial synergies, park level infrastructure and utilities).

Scoping EIP interventions is also required for greenfield eco-industrial parks, as EIP criteria must be considered in the design and planning stages. In this case, selection of appropriate areas and analysis of key features (e.g. park management, infrastructure already developed, local communities or industrial activities surrounding the park, etc.) of the future eco-industrial park must be carefully evaluated.

## OBJECTIVES

The approach outlined here is a proven method, incorporating inputs and results from many pre-assessment studies conducted by National Cleaner Production Centres (RECPnet members) for the selection of suitable UNIDO pilot projects. One successful pre-assessment exercise was conducted in the UNIDO India EIP pilot project by the Confederation of Indian Industry – Sohrabji Godrej Green Business Centre (CII – Godrej GBC, 2016). This project ensured that the practical interests and needs of stakeholders involved in EIP projects were taken into consideration.

Key objectives of the scoping exercise to select suitable EIP interventions can be summarized as follows:

- Inform on the status of industrial parks, as well as their compliance with national and international standards and regulations, and analyze any gaps within existing monitoring and reporting systems and availability of important data.
- Assist in the selection of industrial parks that are best suited to transform towards EIPs.
- Provide guidance on the types of interventions and technology upgrades needed to meet minimum (and where possible advanced) EIP requirements.
- Advise industrial park managers and operators on basic operational requirements for the transformation towards EIPs.
- Identify key stakeholders that are relevant to the EIPs upgrade or design process, and who should be kept involved and informed.



- Inform funding institutions of the financial requirements to upgrade infrastructure and attract investment targeted at the development of EIPs to meet investors' expectations.

## APPLICABILITY

Due to the variety of stakeholders involved in eco-industrial park projects, the scoping assessment should take into consideration the types of information that might be available to different stakeholder groups. As such, the scoping assessment should involve cooperation between park management entities, industrial park operators and relevant government agencies, with guidance – if required – from (inter)national support organizations.

## SUCCESS FACTORS

UNIDO experiences show that the success of eco-industrial park projects depends strongly on the selection of the most suitable industrial parks and selection of fit-for-purpose and feasible interventions. This is not an exhaustive list, but for the scoping exercise, the most important factors appear to be:

- Availability of data and willingness to share necessary information in a transparent manner.
- Capacity available for the implementation of RECP solutions and industrial synergies, on a company and park level.
- Monitoring and record keeping of environmental and social compliance issues as well as strict enforcement.
- Fit-for-purpose selection of indicators and conscientious completion of a scoping exercise.

## IMPLEMENTATION STEPS

The scoping exercise for identifying suitable eco-industrial park projects and intervention areas presented in this chapter is based on international good practices and benchmarks that can be applied in a comparative manner to scope EIP interventions and evaluate the

performance level of industrial parks. The activities and steps described below have proven successful and essential in the EIP development process. This chapter presents a streamlined approach based on methodologies applied in the UNIDO pilot/demonstration projects in countries such as Colombia, India and South Africa (see Section 1.1).

The scoping exercise should apply a low-threshold screening system where key criteria can determine whether an industrial park is a viable option for intervention, and what interventions should be accomplished to transform an industrial park into an EIP. During the assessment process, the high heterogeneity of industrial parks – particularly their variation in size, type of industries, physical and social infrastructure – must be considered. Thus, the applied key criteria must be cross-cutting and allow for comparison.

### STEP 1: Understand the local and national context of EIPs

As part of national industrial strategies, countries have often invested in industrial park projects to spur economic development and to create local jobs, higher income levels and tax revenues. However, during the planning stages of industrial parks, developers frequently fail to cater to the needs and interests of tenant companies as well as local communities. Thus, when transitioning to an eco-industrial park model, it is important to be mindful of the national and historical context in which industrial parks operate and the trajectories that are possible. This includes the following:

- **POLICY AND REGULATORY FRAMEWORKS:** The starting point is to identify the existing national legal framework and whether there are any policies linked to EIP developments. During the screening process of the existing legal framework, it is indispensable to understand the institutional conditions in which industrial parks operate within a given country. Information needs to be obtained concerning governance models to identify the state bodies responsible for the setting of environmental and social standards and the monitoring of companies and industrial parks' compliance. In this regard, UNIDO promotes the development of national programmes on EIPs. This will enable upscaling of best practices and

lessons learned, which can be exchanged in a supra-regional approach and implemented in a more systematic and sustainable manner. Finally, programmes on EIPs will also support the integration of outcomes into national policies and planning as well as explore further areas for collaboration with the financial sector.

- **FUNDING OPTIONS:** Any available national funding mechanisms should be considered that could support industrial parks and companies when implementing EIP approaches. Appropriate funding should be pre-screened to assess the availability of financial models including investment aid, direct subsidies and favorable loans. As such, organizations and agencies offering green financing modalities and instruments for companies and industrial park operators need to be explored.
- **GEOGRAPHICAL SITUATION AND LOCAL CONDITIONS:** Another key factor during the scoping process concerns the availability of site master plans, accounting for geographical specificities and sound environmental and social management. This indicates that issues of land use and desired environmental and social infrastructure have been considered during an industrial park's establishment. Environmental, social and as-

sociated economic risks should have been assessed and appropriately documented. It is important to note that industrial parks located near a natural reserve or environmentally sensitive land with high biodiversity should only be considered where no suitable alternative locations are available. In these cases, strong environmental safeguards must be in place and well documented (UNIDO, 2016a).

### STEP 2: Engage with key stakeholders of EIP

The second step in scoping eco-industrial park interventions is to understand who the stakeholders are and what their expectations entail. This is vital to enable a sound transition to EIP models and to maximize long-term benefits.

Following consultation rounds with various stakeholder groups, the next step is to analyze their power, influence and interest. This will help to determine which stakeholder groups need to be involved throughout the project implementation, as well as assisting to specify the terms of engagement. Therefore, it is recommended to undertake a stakeholder mapping exercise. This may be cumbersome due to the great variety of stakeholder groups with different roles, responsibilities and expectations with regard to EIP developments. However, this exercise is very important and helps to develop an appropriate engagement strategy and action plan. The process of stakeholder characterization is shown in *Figure 3* (left).



Figure 3: Process of stakeholder characterization

Stakeholders are any organization or group that are affected by or can affect industrial parks' efforts to implement an eco-industrial park. Stakeholders can be members of the local community, government officials, NGOs, other companies located inside and outside the industrial park, or many other groups or individuals.

The following list is not exhaustive:

- **LOCAL GOVERNMENT OFFICIALS:** Set environmental and industrial standards, and provide an adequate policy and institutional framework.
- **PARK MANAGEMENT:** Maintains the common facilities in the park and collects taxes from companies.
- **COMPANIES:** Operate and manufacture products and services in the park.
- **INDUSTRY ASSOCIATION:** Reflects the interest of companies.
- **POLLUTION AND COMPLIANCE CONTROL BOARDS:** Responsible for the periodic auditing of pollution levels and the abatement of companies with national compliance regulations.

- **FINANCING INSTITUTIONS:** Assist companies and industrial parks to improve their competitiveness by providing necessary funding opportunities and green financing schemes.
- **COMMON SERVICE PROVIDERS OR PARK OPERATORS:** Offer joint infrastructure provisions for companies located inside the industrial parks (e.g. industrial effluent treatment, waste management).
- **LOCAL COMMUNITY MEMBERS:** Consider direct effect of industrial park operations on local community.
- **EMPLOYEES OF COMPANIES LOCATED IN THE PARK:** Might engage in the capacity building and awareness raising initiatives under anticipated EIP projects.
- **NON-GOVERNMENTAL ORGANIZATIONS AND INTERNATIONAL ORGANIZATIONS:** Might provide technical assistance and act as key facilitators in the development process towards eco-industrial park models.
- **RESEARCH INSTITUTIONS (e.g. university, high school):** Might help with specific assessments or technical development.

Each stakeholder has a different role and set of responsibilities, and thus different expectations of the EIP project. It is important to understand these expectations to assess whether a stakeholder's interests and needs are aligned with the project objectives. The below example of stakeholder mapping highlights the stakeholders that are crucial to engage with and how they can benefit from the project's impact. The information generated allows for the identification of different groups' roles and objectives, and helps formulate the right set of engagement strategies and activities targeted to different groups. This will further assist the development of targeted awareness raising activities (see Section b). Stakeholder mapping can be conducted at any stage of a project or intervention, but it is particularly useful at the outset of planned interventions. This example is a generic and simple demonstration of possible mapping schemes that can be applied.

Effective stakeholder engagement during the scoping of EIP interventions includes:

- Conducting useful risk assessments by obtaining credible information on the region, industrial park area or specific location.
- Providing early warning systems to highlight potential challenges in relationships between companies, park management, local authorities, communities and other stakeholders.
- Understanding which stakeholders may be vulnerable to the environmental and social risks arising from the operation of an industrial park.
- Obtaining valuable support (e.g. policy, funding) for company and park management efforts to implement RECP solutions and industrial synergies.

### STEP 3: Establish baseline of industrial parks and perform gap analysis

Step 3 helps to clarify the potential to convert an industrial park into an eco-industrial park, depending on a number of different parameters. The identification of these parameters can be challenging, but it is very important to obtain exact data to identify the most significant areas for RECP and industrial synergies implementation.

Based on the data obtained for each parameter, a scoring system must be established to allow comparison and identification of the most important gaps (i.e. most promising area for EIP intervention). Although quantitative scoring is usually recommended, it is not possible for all parameters, whereby a qualitative evaluation must be employed (e.g. low, medium or high).

UNIDO applies a checklist modality when collecting relevant data on the suitability of industrial parks for technical assistance in the area of eco-industrial parks (this checklist is included in the list of suggested tools in Chapter 4). Table 2 presents an overview of parameters to determine the suitability of industrial parks for technical assistance.

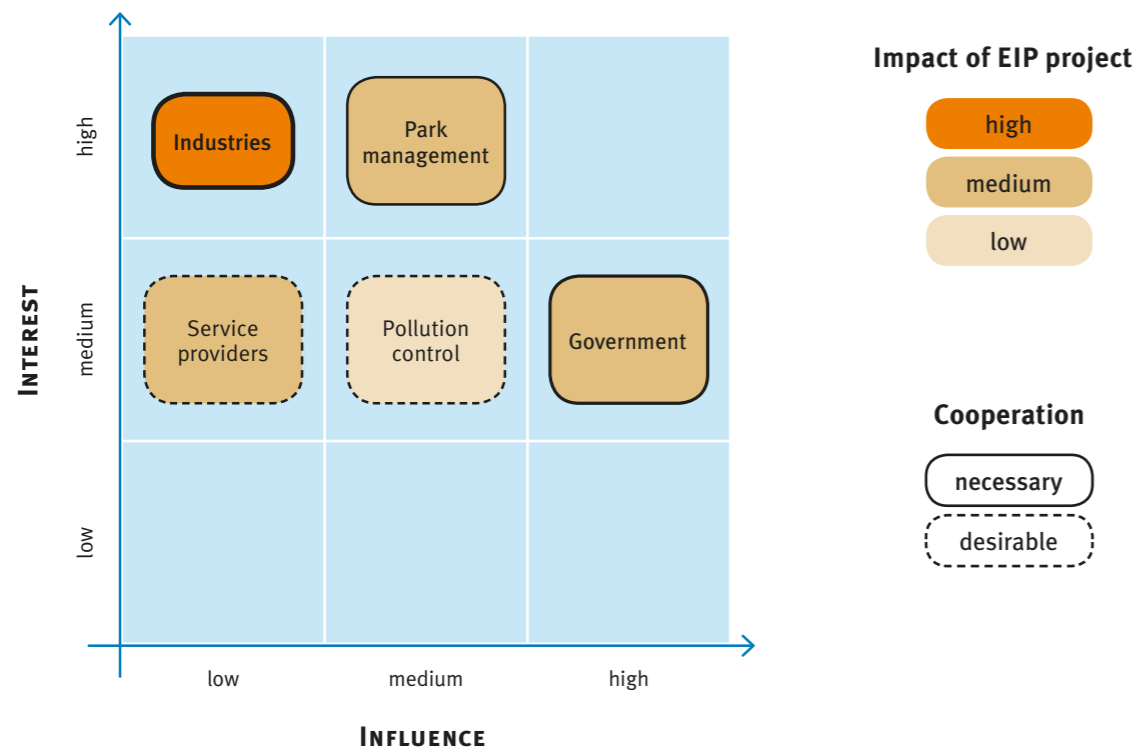


Figure 4: Example of stakeholder mapping, adapted from CII-Godrej GBC (2016)

PARAMETERS	RATIONALE AND GENERATED INFORMATION FOR EACH PARAMETER
<b>Location</b>	To understand the size and scale of the industrial parks. This includes aspects of land use and master planning of the park (e.g. commercial and industrial area, roads, drainage, etc.).
<b>Number of units / companies</b>	To know the number and size of industrial units located in the park, as some EIP approaches require a large number of industries.
<b>Basic environmental and social infrastructure</b>	The industrial park should have basic infrastructure to manage and reduce environmental and social impacts (e.g. wastewater treatment, recreational areas for employees, etc.). The performance level of such infrastructure must be compliant with national regulations or internationally acceptable practices.
<b>Community involvement</b>	Many industrial parks are located near residential areas, which makes it especially critical to address environmental concerns, such as air pollution, water pollution, waste generation, etc. To understand the relevant concerns, it is very important to involve local communities in EIP projects.
<b>Support and awareness from park management</b>	The support from local park management and industrial associations is also critical as they will play a major role in driving the project. A dedicated park management entity needs to be in place and involved throughout the EIP development.

TABLE 2: Examples of parameters to consider in scoping EIP interventions, adapted from CII-Godrej GBC (2016).

#### STEP 4: Scope EIP interventions

Step 4 is to identify the corresponding eco-industrial park measures to address the identified gaps in the previous step. For the identified intervention areas (i.e. serious, major or minor), a categorization system might be applied. Once the intervention areas are classified, opportunities for EIP interventions and assistance can be assessed and prioritized.

Intervention areas can be identified on the park level by conducting a survey and organizing consultation rounds with the park management, local authorities and business representatives. Additionally, reviewing the industrial park site master plans as well as the industrial park charter and policy can offer further insights

into the existing and planned provisions, particularly in terms of environmental and social infrastructures. Through the application of sustainability reviews of such documentation, preliminary technical intervention areas can already be identified and further addressed during the next stages of EIP transformations.

Step 4 of the scoping exercise should closely consult the four key components of eco-industrial parks (see Figure 2), which are holistic and cover all cross-cutting issues of EIP practices. Companies are approached individually, industrial synergies concepts are encouraged, shared environmental and utility services are assessed and upgraded, and park management's capacity is strengthened in accordance with international good practice examples.

#### GOOD PRACTICE EXAMPLE – Status quo assessment and scoping EIP interventions:

Resource Efficient and Cleaner Production (RECP) pilot project to foster eco-industrial park development in India



##### Overview:

UNIDO and the Confederation of Indian Industry – Godrej Green Business Centre (CII – Godrej GBC) fostered the development of eco-industrial parks in India (States of Andhra Pradesh and Telangana). In addition to obtaining basic information about the implementation of EIPs, the most important objective of this project was to demonstrate the pertinence and possibility of converting standard industrial parks into EIPs.

A status quo assessment and scoping exercise was conducted to shortlist and select the most suitable industrial parks for the pilot programme. In addition to the parameters illustrated in this chapter, a good potential for replicability was a key criterion.



##### Important considerations:

- More than 300 industrial parks are located in the State of Andhra Pradesh and Telangana in India, which is why a systematic method was required to select the most suitable.
- The assessment process was based on eight different criteria which can be adjusted or expanded to specific situations.

##### Key activities:

- Based on stakeholder consultations, eight industrial parks were identified for the status quo assessment and scoping exercise.
- Parameters and basic indicators were selected from previous research.
- The eight industrial parks were assessed and data was collected from field visits, meeting with park managers, industrial associations and companies mandated for providing services.
- A score-based methodology was developed to shortlist and select the most appropriate pilot industrial parks. This methodology provides a rating for various aspects of the industrial parks and thus allows for comparisons based on different parameters.

##### Applied tools (not all-inclusive):

- Stakeholder mapping
- Score-based methodology

##### Benefits to date:

Three parks with different features were selected. The scoping of EIP interventions has highlighted the importance of RECP assessments for one of them (Jeedimetla Industrial Estate), which is constituted mainly of small and medium enterprises. Assessed companies and park management provided very positive feedback, as predicted by the status quo assessment.

Criteria	Indicator	Score
Area	1300 acres	3
No. of Units	1500 nos	5
Diversity	More than 10 sectors	5
Environment Structure	CETP	3
Replicability	High	4
Environment Concerns	High	3
Environment Initiatives	Medium	3
IALA and Industrial Association	Strength	High
Total (35)		26

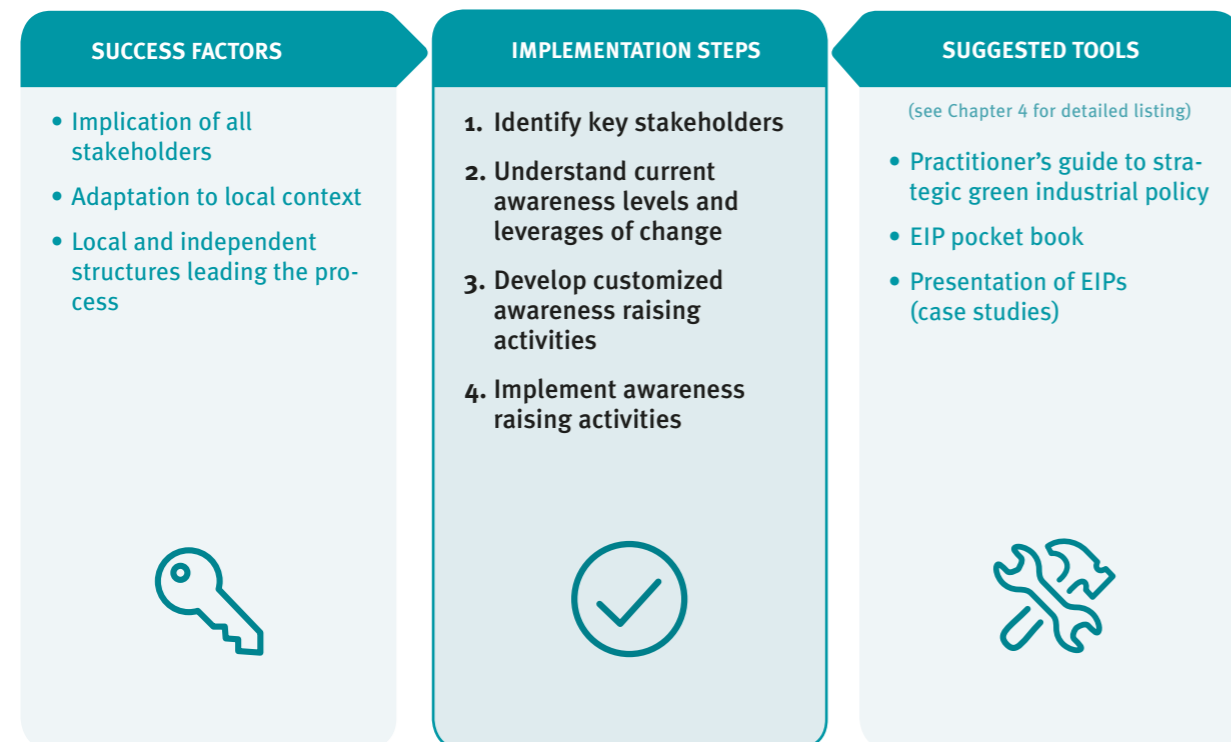
Source: (CII – Godrej GBC, 2016) and [www.greenbusinesscentre.com/site/ciigbc/index.jsp](http://www.greenbusinesscentre.com/site/ciigbc/index.jsp)

# B) EIP AWARENESS RAISING



## MAIN OBJECTIVES

- Raise stakeholder awareness of benefits of EIPs
- Inform stakeholders about possible challenges related to the development of EIPs



## RATIONALE

The concept of eco-industrial parks is relatively innovative and often not fully understood. Awareness raising is therefore required, because the full potential of an eco-industrial park can only be developed if stakeholders are convinced by the usefulness of the concept and associated benefits relevant to them. Otherwise, it has been demonstrated that lack of awareness can be detrimental for developing industrial synergies (Francis and Erkman, 2001).

## APPLICABILITY

Awareness raising initiatives are required both in greenfield and brownfield eco-industrial parks. All key stakeholders potentially involved or affected by the development of an eco-industrial park should be informed about its implications, challenges and opportunities. Since contexts are very different for each EIP project, a proper stakeholder mapping exercise is necessary to precisely determine the applicability of awareness raising (for more information see Section a).

## OBJECTIVES

Awareness raising is useful for all stakeholders at each developmental and implementation stage of an eco-industrial park, but particularly during the initial steps. In this regard, there are two main objectives of awareness raising:

- Raise stakeholder awareness of the environmental, economic and social benefits of EIPs, in order to gain their support and motivate their participation in industrial park development.
- Inform stakeholders about the possible challenges related to the development of EIPs, to avoid possible problems and setbacks resulting from a misunderstanding of EIP requirements (e.g. by local authorities, local communities, tenant companies in the park, etc.).

## SUCCESS FACTORS

The success of awareness raising is very dependent on the local context. Usually, the following factors must be considered:

- **INVOLVEMENT OF ALL STAKEHOLDERS:** It is very important that all key stakeholders are involved in the development of an EIP. No stakeholder group should be, or consider themselves excluded, as this can threaten the whole EIP implementation process. For instance, the inclusion of local communities can bring significant advantages, but they are frequently forgotten, which can create significant delays or possible grievances.
- **ADAPTATION TO LOCAL CONTEXT:** Every industrial park is unique (e.g. park size, industry mix in park, community concerns, business opportunities, etc.), and therefore each park requires customized awareness



raising activities. These efforts may be different in two neighboring countries, or even between two regions in the same country. For instance, pilot studies in China have demonstrated that environmental awareness is much more developed in coastal than in inland areas (UNIDO, 2016a). The strategies used to raise awareness must therefore be precisely tailored to the local context, building on a detailed pre-assessment and a thorough identification of stakeholders. A variety of different tools are recommended to reach as many people as possible (see Table 3 for suggestions).

- **LOCAL OWNERSHIP AND INDEPENDENCE:** UNIDO and international experiences have demonstrated that it is easier to raise awareness if an independent entity (e.g. university, consultants) leads this process, because it usually contributes to the credibility of the process (Massard et al., 2014). It is also advisable to hire local consultants to contribute to awareness raising. Local consultants' understanding of the context leads to the most appropriate and significant arguments for EIPs. For instance, UNIDO usually involves National Cleaner Production Centres to promote EIPs to local stakeholders in the country.
- **CONTINUITY AND COHERENCE OF THE PROCESS:** EIPs are continually evolving and so are their stakeholders. Some new industries can establish onsite, and some might relocate. The same is true within industries (e.g. young employees replacing retiring colleagues). In addition, new technologies with potential application to EIPs can be developed. It is crucial to ensure that all relevant stakeholders maintain sufficient awareness during the life stages of an EIP. It is also very important that the information provided to every stakeholder is clear, coherent and unambiguous to avoid confusion.

## IMPLEMENTATION STEPS

Awareness raising must be carefully developed and adapted to each situation. The following sequence is recommended.

### STEP 1: Identify key stakeholders

As explained in Section a, it is necessary to identify stakeholders who require awareness raising at the beginning of the process. This effort can be useful later, by excluding those who are not affected by the EIP development. For instance, denomination of different governmental agencies can be confusing, and it can be a challenge to know which ones will be implicated and to what extent.

### STEP 2: Understand current awareness levels of key stakeholders and leverage of change

Because the primary objective of awareness raising is to convince stakeholders of the benefits and added value of eco-industrial parks and ensure their support, the second step is to determine their current awareness levels and their main concerns in relation to the topic. Stakeholders can be drawn to different advantages of eco-industrial parks. For instance, representatives of a local community are likely to be interested to learn that eco-industrial parks can contribute to build better infrastructure (roads, water supply, shops) and local employment, whereas a company manager may be more interested in economic revenues and cost savings that could be generated by industrial synergies. As explained above, the advice of national or local partners is very useful to correctly evaluate what type of awareness raising is required by different stakeholders. In addition, stakeholders' levels of awareness can be evaluated via face-to-face meetings or based on surveys or questionnaires.

### STEP 3: Develop customized awareness raising activities

The development of targeted and efficient awareness raising activities must be based on the information obtained during the previous steps. Different materials / channels must be prepared, sometimes for the same objective. Even in the same group of stakeholders, people can be reached by different materials / channels, depending on their personality. Although most awareness raising efforts should be accomplished during the initial phases of EIP development, it is necessary to continue awareness raising activities during the operational phase, to ensure that key stakeholders are continuously informed of the EIP process.

### STEP 4: Implement awareness raising activities

As suggested above, awareness raising usually requires significant efforts during the initial phase. Following initiation, it is important to maintain a sufficient information level amongst key stakeholders. Usually, this phase is easier and requires less effort, and the material / channels can be adapted.

Table 3 summarizes suggested ways to increase awareness among various stakeholder groups followed by a brief discussion of key points. It is noted that the list of stakeholders in the table below is not exhaustive. Other stakeholders may include for instance non-governmental organizations, academic institutions or local associations.

STAKEHOLDERS	IMPORTANT ITEMS THAT STAKEHOLDERS SHOULD BE AWARE OF
<b>Park operator and management</b>	<ul style="list-style-type: none"> <li>• Advantages of EIPs (economic, social and environmental) and international trends</li> <li>• Pollution issues that can be caused by poorly designed and operated industrial parks</li> <li>• Problems that could be potentially faced when operating an EIP</li> </ul>
<b>Companies</b>	<ul style="list-style-type: none"> <li>• Advantages and business case for EIPs, including mitigating environmental and social risks</li> <li>• Practical approaches to implementing RECP and industrial synergies</li> </ul>
<b>Governments and regulators</b>	<ul style="list-style-type: none"> <li>• Advantages and business case for EIPs</li> <li>• Interest from government agencies will depend on their specific function (e.g. energy and climate change, industrial development, job creation, OH&amp;S)</li> <li>• Characteristics of EIPs and possible challenges related to industrial regulations</li> </ul>
<b>Local communities</b>	<ul style="list-style-type: none"> <li>• Advantages of EIPs include well-being of local communities, avoidance of odor disturbance, etc.</li> <li>• New infrastructure or services that will be constructed and could be used by local communities</li> </ul>
<b>Financial institutions</b>	<ul style="list-style-type: none"> <li>• Advantages of EIPs (mainly economic, but also environmental and social, because a sound business case also entails mitigating environmental and social risks).</li> <li>• Financing mechanism requirements for EIPs</li> </ul>

TABLE 3: Stakeholder awareness and relevant awareness raising activities

**Potentially suitable activities to raise awareness**

Meeting
Workshop
Interviews of other EIP managers
Website and newsletter
Social networks
Information material (brochures, factsheets, etc.)
Official events (kick off meeting, inauguration of an infrastructure, etc.)
Invitation of representatives in meetings and workshops
Conference (for instance presentation in a business school)

TABLE 3.B: Stakeholder awareness raising activities

**PARK OPERATOR AND MANAGEMENT:** As the park management is usually responsible for the dissemination of information inside and outside the industrial park, it should be informed of every aspect relating to eco-industrial parks. Specific awareness raising activities should be planned for the park management, and initiated as soon as possible. In particular, park managers should be aware of the advantages of the EIP approach to curb potential problems caused by industries. Similarly, park management should be informed about possible challenges and opportunities related to the development of EIPs. Where possible, the park management should attend all awareness raising activities with other stakeholders, taking the role of a coordinator and leader of the process.

**COMPANIES:** Except in the environmental division (if any), employees and managers of industries are seldom aware of the benefits of eco-industrial parks. Usually SMEs in developing and emerging countries require more awareness raising than large companies (UNIDO, 2016a). Economic advantage is usually the most attractive aspect of eco-industrial parks for companies in an industrial park. However, social and environmental assets should not be underestimated because they can also have direct economic impacts (environmental and social risks are business risks). The challenge of awareness raising in companies is how to reach very different people in diverse departments. Managers can be informed during meetings, and it is possible to organize trainings and workshops for employees. In the usual UNIDO activities framework for EIP development, RECP assessments (see Section e) can be a suitable indirect way to raise company awareness of EIPs. Although RECP assessments usually focus only on a single company, it is possible to take advantage of the trust established during that evaluation to promote EIPs approaches. When the RECP assessments have been completed, companies can be invited to share their experience during conferences. This is a very effective way to disseminate results and encourage other companies to participate in such activities.

**GOVERNMENT OFFICIALS AND REGULATORS:** A local or national directive, for instance about waste handling, can hamper the development of an eco-industrial park. It will be easier to avoid or solve this kind of problem if the authorities' representatives are aware of the advantages of eco-industrial parks. Usually, government officials are very concerned about environmental and social issues related to industries. It is therefore very important to demonstrate to government officials how EIP strategies can help companies to decrease their impacts and exceed expectations in relation to local and national regulations.

Because administrative procedures can take time, it is important to begin government officials' awareness raising at the very first phases of EIP development. At this preliminary step, a personal meeting is the preferred way to reach government officials, which requires proper meetings and identification of key stakeholders (Steps 1 and 2). After the initial phase to implement an eco-industrial park, it is very important to maintain the awareness of officials to a sufficient level to maintain their interest and support for the EIP project.

**LOCAL COMMUNITIES:** These groups are often not addressed sufficiently in the planning, design and operation of eco-industrial parks, although they are directly impacted by the park and its industries. To gain local community support and avoid any potential opposition, it is important to intervene early. Awareness raising informs local communities that the development of an eco-industrial park can significantly help decrease pollution and other nuisances in the case of a brownfield EIP project. For a greenfield project, awareness raising helps to show that the construction of an eco-industrial park represents an opportunity for local communities, for instance by offering shared services and infrastructures. Therefore, awareness raising should be based on informative events such as community forums. Communication through the creation of a website or articles in a local newspaper can also be very useful. Because local communities may also propose valuable suggestions to improve the operation of eco-industrial parks, the events organized for awareness raising should leave sufficient time for open discussions and questions regarding potential community concerns and opportunities.

**FINANCIAL INSTITUTIONS:** The development of eco-industrial parks is a relatively complex process and requires alternative financing options to offer better conditions for the implementation of EIP strategies. For instance, local financial banks can receive credit lines from international financial institutions and propose them to companies (WBG, 2016). Obviously, financial institutions should be aware of the benefits of eco-industrial parks before such engagement occurs. As with other stakeholders, awareness raising must occur in the initial phases of EIP development.



### GOOD PRACTICE EXAMPLE – Awareness raising on eco-industrial parks:

Resource Efficient and Cleaner Production (RECP) pilot project to foster eco-industrial development in Zhenjiang Economic and Technological Development Zone (ZETDZ) in China



#### Overview:

In China, UNIDO has commissioned the Jiangsu Scitury Allied Investment and Development Co., Ltd (JSAID) to manage the conversion of an industrial area based on the promotion of RECP and industrial synergies. Approximately 10 different industrial parks are located close together, which is causing challenges in terms of awareness raising and communication. The project initially focused on identification and characterization of different stakeholders, which was particularly important given the complexity of the situation. After the stakeholder characterization, awareness raising was designed in collaboration with JSAID, UNIDO and the Chinese Research Academy of Environmental Science.



#### Important considerations:

- Large number of stakeholders involved (e.g. the parks consist of multiple and very different industrial sectors)
- Great variety of awareness raising tools used to involve all key stakeholders
- Close collaboration between JSAID, Chinese Research Academy of Environmental Sciences, National Cleaner Production Centre and UNIDO

#### Key activities:

- RECP assessments accomplished in different industrial areas. In addition to technical recommendations, these assessments served to raise awareness about sustainability issues in companies.
- Meeting organized to highlight advantages of EIPs, notably with managers of the neighboring industrial parks
- Several events organized in the park for various stakeholders (e.g. presentation of the EIP concept, training for companies, academic conferences, etc.)
- A project brochure created and disseminated
- Contacts established to promote EIP approach on the Zhenjiang circular economy platform (see website link below)

#### Applied tools (not all-inclusive):

- RECP training for industries, which includes EIP concepts
- Project brochure
- Contribution to website for promotion of circular economy

#### Benefits to date:

Although it is difficult to estimate net benefits of awareness raising, there is no doubt that the stakeholders of the ZETDZ are more aware of sustainability issues and potential advantages of the EIP approach. For instance, the possibility of creating synergies with restaurants was carefully analyzed during the pre-assessment of a new agro-industrial park.



(A page from the SSZEIP brochure)

Source: www.jsxhjj.com

### GOOD PRACTICE EXAMPLE – Awareness raising on eco-industrial parks:

Eco-industrial park initiative for sustainable industrial zones in Viet Nam



#### Overview:

In collaboration with the Ministry of Planning and Investment of Viet Nam, this UNIDO project aims to transform existing industrial zones into eco-industrial parks. The project has focused on key activities described in this chapter to increase awareness on issues concerning EIPs. Various target groups were identified and assessed, and the material for awareness raising was developed according to the interests and needs of the different target groups.



#### Important considerations:

- Awareness raising tools are customized for target groups
- Consistency maintained across all communication and visual identity used in the project
- Correct and latest available information on EIP development strategies is shared, to maintain engagement of different stakeholders

#### Key activities:

- Organized 18 events (9 training courses and 9 workshops/seminars) on different specific aspects of EIPs (e.g. finance, policy support, etc.). Substantial communication and awareness raising contents integrated in these events.
- Project website developed and regularly updated in Vietnamese and English languages (see below).
- Communication strategy developed, describing tools to be utilized. Logo and brand identity guideline created to generate overall project visual identity and increase recognition.
- Project introduction video (1 short video) and industrial zones videos (3 short videos) produced and introduced at important events. Videos now available on the project website.
- Project brochure widely disseminated.

#### Applied tools (not all-inclusive):

- Communication strategy
- Project brochure and other communication products
- Knowledge management plan

#### Benefits to date:

The main benefits of awareness raising can be observed after communication events. For instance, many banks expressed interest after financial training on EIPs. Similarly, government representatives indicated that seminars were useful as a source of reference to build a roadmap for implementing EIPs in Viet Nam in the future.

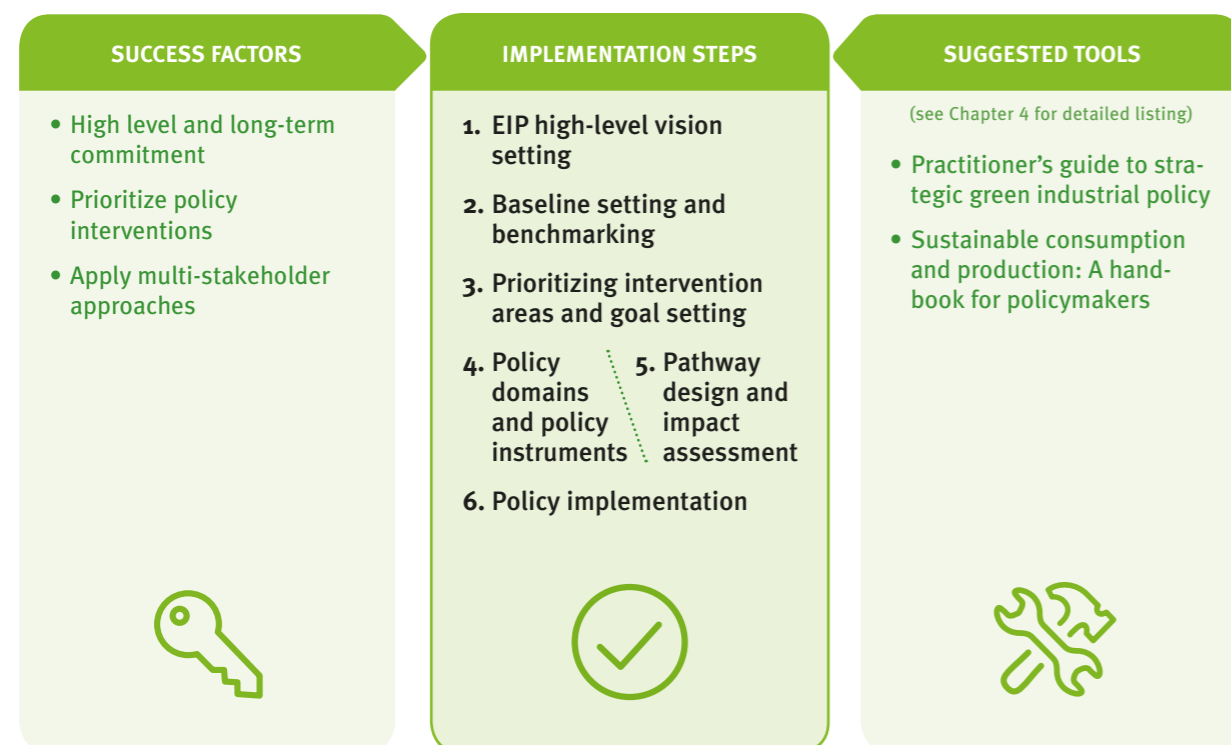
Source: www.khucongnghepsinhthai.vn and www.eipvn.org

# c) POLICY SUPPORT



## MAIN OBJECTIVES

- Create effective policies to support the implementation of EIPs
- Mainstream environmental and social issues into industrial development policies



## RATIONALE

The translation of the EIP concept into national policies creates opportunities as well as challenges. Eco-industrial parks involve inputs from a variety of disciplines and stakeholders representing a wide spectrum of interests. The interrelated topics relevant to eco-industrial parks (e.g. advancing resource efficiency, industrial synergies, collective park level infrastructure and utility services, effective park management structures) are often unfamiliar to decision-makers in the public sector. Awareness, knowledge and skills on these topics are critical for advancing analysis, reform and implementation of EIP-related policies at all levels. Governments will play a crucial role by creating the appropriate market conditions, policy and regulatory frameworks, technical guidelines, and by initiating learning and participation processes.

EIP-related policies can benefit the economy by inducing industrial parks and their companies to become more resource efficient and innovative, by developing and providing access to new technologies and by fostering the creation of new industries and markets (e.g. renewable energy, industry 4.0, waste recycling, green chemistry, bio-based products and circular economy). These economic benefits can in turn lead to social benefits, such as the creation of local jobs, job security and better working conditions. Some of these benefits are particularly relevant for lower-income countries. These countries can use EIP and green industrial policies to develop their industries, upgrade domestic capabilities,

reduce dependence on finite resources such as fossil fuels, and improve not only access to basic services, but also the livelihoods of lower-income groups. Through international support mechanisms these countries can benefit from technology transfer, capacity building and financial support (PAGE, 2016a).

## OBJECTIVES

Key objectives of EIP-related policies can be summarized as follows:

- Create effective policy and regulatory processes to support the planning, development and implementation of EIPs and associated practices (e.g. RECP, park management, spatial planning and zoning, park level infrastructures and utility services).
- Facilitate enabling settings and structural changes to capture sustainable and inclusive industrial development opportunities through industrial parks emerging from rapidly changing technical, economic, environmental and social conditions.
- Mainstream environmental and social issues into economic and industrial development policies.

## APPLICABILITY

The suggestions below are not an exhaustive list, but rather present a general overview. The importance of specific stakeholders depends on the specific situation of the country concerned and details of the policy interventions.

Targeted stakeholders of this handbook	Illustrative examples of stakeholder contributions and relation to EIP-related policies
Park operators and management	<ul style="list-style-type: none"> <li>• Represent industries in policy making and modification processes</li> <li>• Participate in EIP (policy) demonstration projects</li> </ul>
Park tenants (industries & business)	<ul style="list-style-type: none"> <li>• Provide input and industry perspective for policy processes and comments on draft policies</li> <li>• Participate in EIP (policy) demonstration projects</li> </ul>
Private sector organizations in industrial land development	<ul style="list-style-type: none"> <li>• Provide input and private sector perspective for policy processes through stakeholder forums and comments on draft policies</li> </ul>
Governments and regulators	<ul style="list-style-type: none"> <li>• Lead processes to develop new or modify existing EIP-related policies and ensure their implementation</li> <li>• Ensure collaboration between national, local or regional governments in policy transition processes</li> </ul>
Financial sector and funding agencies	<ul style="list-style-type: none"> <li>• Provide input and financial sector perspective into policy processes through stakeholder forums and comments on draft policies</li> <li>• Participate in EIP (policy) demonstration projects</li> <li>• Develop and promote financial incentives for eco-industrial park policy development and implementation</li> </ul>
International support organizations and service providers	<ul style="list-style-type: none"> <li>• Provide customized support to policy processes, building on international experiences and learnings</li> <li>• Promote international good practices on EIP policy development and implementation through demonstration projects</li> <li>• Develop practical policy tools</li> <li>• Support capacity building processes</li> </ul>
Educational institutions	<ul style="list-style-type: none"> <li>• Support capacity building processes</li> <li>• Develop (inter)national good practice case studies on EIP-related policies</li> </ul>

TABLE 4: Stakeholder applicability of EIP policies

## SUCCESS FACTORS



The success of industrial policymaking lies in the processes that underscore it. Based on selected sources (PAGE, 2016a; UNEP, 2015), a summary of success factors and general tips to keep in mind when developing a country's sustainable industrial policy (which includes eco-industrial parks) is provided below.

- **HIGH-LEVEL AND LONG-TERM COMMITMENT:** Political support is necessary for any successful policy implementation. Most countries take from two to three years to draft new policies, and at least one year to revise old ones. Speed should not take precedence over quality when drafting policy interventions.
- **PRIORITIZE POLICY INTERVENTIONS:** Policy interventions should be prioritized, ideally based on systemic impact (i.e. incorporating feedback effects), instead of attending to a long wish list. Where possible it is important to try generating “quick-wins” to encourage continued support for the policy process.
- **APPLY MULTI-STAKEHOLDER APPROACHES:** Adequate communication and education for all stakeholders increases the likelihood of successful implementation. EIP policies are highly cross-cutting, so their formulation, implementation and monitoring require a high degree of inter-agency collaboration within government, but also with the business community and civil society groups.
- **WORKING WITH CHANGE AGENTS:** A change agent is a person who facilitates positive and effective transformation processes within organizations through his/her professionalism, personal commitments and interpersonal interactions. Working with change agents in influential ministries and regional institutions to drive forward the development, integration and implementation of EIP policies (or any other policy intervention) is critical to create impacts. In addition to knowledge of sustainable industrial development concepts, these change agents need to have good communication, negotiation, and multi-stakeholder engagement skills.
- **INTEGRATE POLICY INTERVENTIONS:** Integrating EIP policy interventions into already existing national plans/programmes is preferable to formulating them as stand-alone policy areas. Developing and implementing EIP policies acknowledges that industrial

activities cannot be viewed in isolation from other policy intervention areas (e.g. energy, water, finance, labor and skills development, sectoral initiatives). Therefore, EIP policies need to recognize the deep interrelationships between industrial activities and other development factors.

- **RECOGNIZE BENEFITS, COSTS AND RISKS:** To ensure the success of sustainable industrial policies, it is vital to understand and continuously address their risks, costs and benefits. The type and significance of benefits depends on a variety of factors, such as resource endowments, existing technological capabilities and government capacity to develop and implement coherent long-term strategies (PAGE, 2016a; UNIDO, 2016a).
- **ADDRESS POLICY IMPLEMENTATION AND ENFORCEMENT CHALLENGES:** The overall challenge of effective governance, policy implementation and enforcement of regulations remains in many developing and transition countries. It is therefore important to also address direct policy mainstreaming, effectiveness and enforcement activities. Voluntary instruments and outputs (e.g. green awards, roadmaps, eco-labelling) cannot function without a functional legislative framework. This needs to be taken into consideration in any policy efforts, including those on EIPs. In many developing and transition countries, there seems to be a case to increase efforts on the integration and implementation of sustainable consumption and production through existing policies, regulations and roadmaps which are already supported by relevant and influential ministries in the relevant country. This is preferable to developing new policy documents and roadmaps mainly through one ministry.
- **MONITORING AND PERFORMANCE INDICATORS:** Continuous monitoring and evaluation of policy development and implementation is necessary to ensure the effectiveness of measures. Indicators represent selected pieces of information that are chosen because they highlight areas of key importance for policy making. They can be used both internally by government agencies and for communication with citizens, industries and other stakeholders. Further details on performance monitoring and indicators are provided in Section f of this handbook.



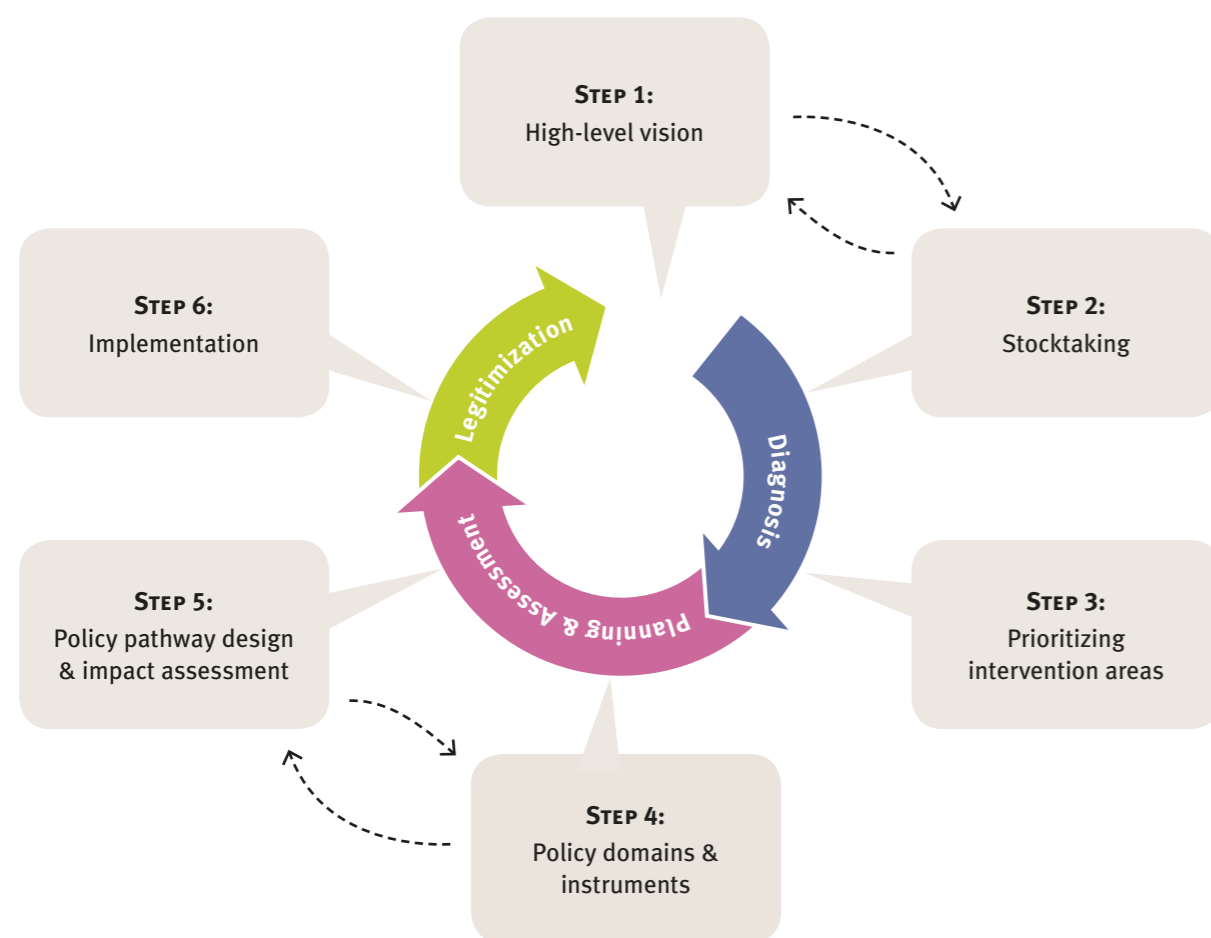
## IMPLEMENTATION STEPS



Following the process presented in *Figure 5*, this section outlines the different steps of a complete policy cycle as a holistic and investigative instrument to develop sustainable industrial development policies (including eco-industrial parks).

The description of the key steps are based on a practitioner's guide for policy and decision makers, which UNIDO developed in collaboration with various international organizations (PAGE, 2016a).

It is noted that the steps do not always occur according to the cycle described, and that there are differences between countries according to local/national context and political systems. Therefore, the process is not a fixed set of steps to be followed in a linear fashion, but rather an indicative cycle.



Source: UNIDO (2016), PAGE (2016)

Figure 5: Steps of a policy cycle for sustainable industrial development, based on PAGE (2016a)

### STEP 1: EIP high-level vision setting

It is recommended that at the start of the policy intervention process, an easily communicated long-term vision/goal for EIP development and implementation is defined. For example, the transformation of X existing industrial parks into eco-industrial parks, the development of Y new eco-industrial parks in the country, or the increase of resource productivity of EIPs by a factor of Z within the next five to 20 years. The vision must be strong enough to provide enough overarching direction, but also enough flexibility to adjust to any key findings or developments identified at a later stage.

### STEP 2: Policy and data stocktaking for baseline setting and benchmarking

- **Policy stocktaking:** This requires a detailed analysis of existing policies, including a review of policy instruments which are already in place (e.g. rules, regulations, voluntary sector-based partnerships and existing programmes, financial instruments). An assessment needs to be undertaken whether or not these are still valid for promoting and increasing the value of industrial development and whether there are any frictions with the concept of EIPs.
- **Data stocktaking for baseline setting, benchmarking and understanding the systems:** The availability of tools, reliable indicators, and definition of criteria for setting baselines, are critical prerequisites for the implementation of measures to improve the performance of (eco-) industrial parks in the country, as well as measuring the success of EIP policies.

### STEP 3: Prioritizing intervention areas and goal setting

The analyses undertaken in previous steps facilitate an understanding of the stakeholders, the issues, and (sub-)sectors where EIP policy intervention will be most effective, as well as the data from which baselines and benchmarks can be established and monitoring and evaluation undertaken. These data will assist in the development of short and medium-term goals.

For many lower-income countries there is an urgent need for growth, but improving the overall infrastructure and business environment will take time and require substantial resources. In these countries, the concentrated use of limited resources focused on specific sectors or locations can reap “quick wins”. Sector-focused industrial policies have succeeded where the prioritized sectors truly reflect the country's existing and potential strengths (or its latent comparative advantage) and where the policy makers closely follow market trends. This new approach is known as Growth Identification and Facilitation (GIF), and offers practical development paths that enable developing countries to follow their comparative advantages in industrial development and thereby directly work towards sustained and dynamic growth. Further details of this approach are included in a UNIDO technical note (2015). The adoption of Agenda 2030 and the SDGs make sustainable (industrial) development a priority for international, regional, and national government agencies. The SDGs will assist in positioning and framing sustainable development in policy making processes, and therefore it is important for policy interventions to further align its work with SDGs at the international, regional and country level. The SDGs will also enable policy initiatives to work more closely with multiple influential government agencies.

#### STEP 4: Policy domains and policy instruments (in parallel with Step 5)

Any policy intervention requires a careful selection of policy domains and policy instruments (Step 4) as well as the design of policy pathways in which they will be operationalized (Step 5). The selection of policy domains and instruments should take into account the country's local context, including the ability to implement, monitor and enforce compliance if necessary. Elements to consider when selecting policy domains and policy instruments can be summarized as follows:

- When identifying key domains and instruments, policymakers need to assess their potential impacts (Step 5).
- The selection of policy instruments needs to be carefully considered to identify the options that are best suited to the country's level of industrialization, environmental and socio-economic needs.
- As SMEs represent a very significant share of industries in most industrial parks in developing and emerging countries, the inclusion of a coherent SME policy framework could be essential in formulating an inclusive EIP policy intervention.

The selection of policy instruments is the most critical step in the policy cycle, and this is also the step where causes of policy failure often occur. EIP policies are interventions into interdependent human-natural-industrial systems. This is a complex task and demands complex interventions.

Categories of policy instruments can be defined as follows:

- **MANDATING:** Regulatory instruments related to norms and standards, environmental liability, control and enforcement.
- **INFLUENCING THE MARKET:** Market-based instruments influence the market price or quantity to encourage a behavior change by market actors (e.g. subsidies for renewable electricity or quotas for CO<sub>2</sub> emissions).
- **INFORMATIONAL AND VOLUNTARY INSTRUMENTS:** These include a range of incentives for different target groups, focused on learning effects and stimulation of sustainable and inclusive industrial development.

#### STEP 5: Policy pathway design and impact assessment (in parallel with Step 4)

A variety of policy paths and scenarios should be developed to aid in visualizing and anticipating how the EIP policy intervention and its respective policy instruments could be operationalized. Pathways should consider the need for gradually phasing in any significant departures from existing policies to provide time for affected individuals and industries to adjust.

Pathway design often involves changes to existing policies as well as identifying a set of “trigger projects” or “pilot sectors” that can help to demonstrate the potential of eco-industrial parks and accelerate stakeholder acceptance and institutional change. The identification of existing measures at the sub-national level of specific eco-industrial parks should be included as well as identifying how to leverage from this work and/or reconcile any major differences.

It is essential that the policy domains, instruments and their pathways are assessed for any potential negative impacts over the short, medium and long-term. This is normally done through impact assessments. Impact assessments should, at the very least, be undertaken in the areas of environment, industry and the economy at large, as well as social impacts (including underrepresented groups in society such as women and youth). Mitigation strategies should be developed to address potential negative outcomes.

#### STEP 6: Policy implementation

The implementation of new policies should be strengthened by regular monitoring and evaluation, and requires ongoing attention as it is a dynamic process which may need adjustment.

In summary, implementation planning typically includes the following considerations (UNEP, 2015):

- Is additional information required for key policy officials engaged in policy implementation?
- Are there others who will be involved or affected by the policy that will need additional information? How will this information will be generated and communicated?
- Are all the statutory and administrative requirements and the resources in place that will be needed during implementation?
- Are all issues of enforcement and compliance including resourcing and responsibilities in place?
- Has a monitoring process been put in place, including defining routine data capture and responsibilities?

## GOOD PRACTICE EXAMPLE – Policy support on eco-industrial parks:

Gujarat Cleaner Production Centre (GCPC), India



### Overview:

In 1998, the Industries and Mines Department of the Government of Gujarat established the Gujarat Cleaner Production Centre (GCPC), with technical guidance provided by UNIDO. In addition to a number of practical RECP assessments and implementations in diverse industrial sectors, the GCPC provides policy support in the state of Gujarat. The EIP approach was developed early in Gujarat, with first initiatives implemented in 2010. In 2016, UNIDO assigned the centre to foster RECP and industrial synergies in two industrial parks, namely Nandesari Industrial Estate (NIE) and Dahej Petroleum, Chemicals and Petrochemicals Investment Region (Dahej PCPIR). Both are managed by industrial associations.



### Important considerations:

- Gujarat is one of the most industrialized states of India because of the government's initiatives to promote economic development and industrialization. However, this economic prosperity also raised environmental concerns.
- Through multiple efforts, the government and concerned organizations sought to curb pollution with end-of-pipe technologies. Since these efforts were not sufficient, GCPC was created to implement and promote resource efficiency and cleaner production, as well as EIP approaches. GCPC played an active role in framing Gujarat Industrial Policy 2009 and 2015.



### Key activities:

- GCPC actively organizes events and seminars which are relevant to policy support for industrial parks (e.g. infrastructure development) with representatives of government and official departments (e.g. Pollution Control Board).
- Government representatives, as well as members of GCPC and UNIDO are participating in steering committees organized by the associations which manage the two pilot industrial parks selected in the RECP project.
- Consequently, government officials are consulted as part of the decision-making processes and informed about (potential) issues related to policies and regulations.



### Applied tools (not all-inclusive):

- Meetings/seminars/workshops with relevant departments and government agencies (mainly at state level).
- Company input/output database in two pilot industrial parks with the support of Gujarat Pollution Control Board.

### Benefits to date:

In terms of RECP, the activities accomplished to date are very successful. For instance, the Government of Gujarat has included financial assistance for implementing RECP measures in its 2015 Industrial Policy. The pilot project for two industrial parks is ongoing, and government representatives have increased their awareness and commitment towards EIPs and strengthened their collaborations with park industries. For example, the concept of EIPs is described on the Government of Gujarat website.

Source: (GCPC, 2017; Gujarat Government, 2017), and [www.gujaratindia.com/business/indus-parks.htm](http://www.gujaratindia.com/business/indus-parks.htm)

## GOOD PRACTICE EXAMPLE – Policy support on eco-industrial parks:

Eco-industrial park guidelines in Viet Nam



### Overview:

In collaboration with the current UNIDO project, a cooperation framework between the Vietnamese Ministry of Planning and Investment (MPI) and the International Finance Corporation (IFC) was put in place to establish a technical guideline on eco-industrial parks. This initiative also serves as a complement to the UNIDO project. The draft guideline is expected to be finalized by the end of 2017 and will inform the development of national criteria for EIPs in Viet Nam.



### Important considerations:

- Members of the UNIDO project management unit based in Hanoi participated in the discussions and provided inputs – in terms of EIP criteria for three new decrees on the Economic Zone, Industrial Zone and Processing Zone – to the drafting board hosted by MPI.
- New decrees and a Vietnamese technical guideline will lay out the basis for further UNIDO implementation activities in terms of industrial park service provision in the transition to EIPs.

### Key activities:

- Expert group meeting brought together all key stakeholders from the local and federal level to learn about international good practice examples of EIPs, organized under the UNIDO project (Quang Nam, 29 and 30 September 2016).
- The official technical guideline on EIPs is scheduled to be available by the end of 2017.



### Applied tools (not all-inclusive):

- International good practices examples of EIPs: 30 international experts from Austria, United Kingdom, United States of America, France, Switzerland, South Korea, India, China and leading international organizations, shared their EIPs experience with 110 national Vietnamese experts from policy making agencies, academic organizations and provincial authorities. The meeting included 23 presentations and was divided into five sessions with 12 discussion groups.
- Following the expert group meeting, bilateral meetings were conducted to identify the status quo and international policy examples in terms of EIP planning.
- Study tours of industrial parks in Viet Nam and their evolution stage as well as availability of data and information.

### Benefits to date:

A review and assessment of existing legal and regulatory frameworks was carried out with the publication of a dedicated evaluation report. The objective was to inform the development process of official guidelines on EIPs in Viet Nam.

Source: [www.eipvn.org](http://www.eipvn.org)

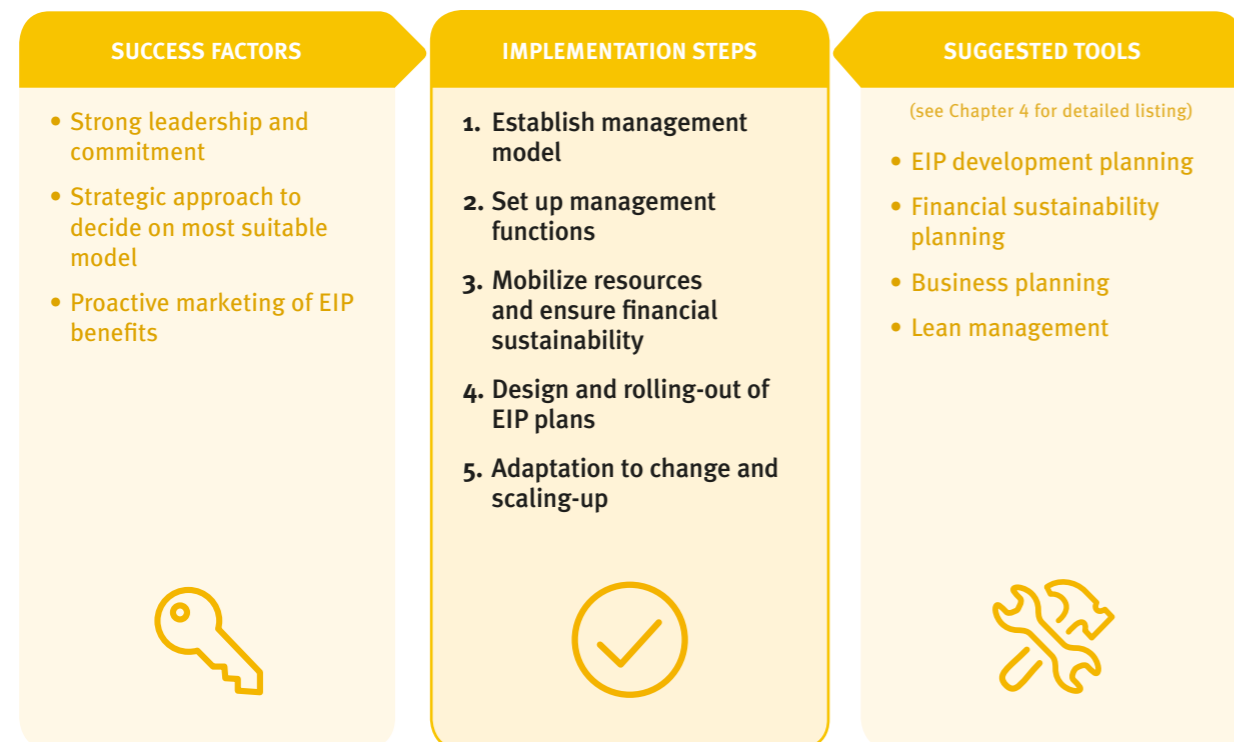


# D) PARK MANAGEMENT MODELS



## MAIN OBJECTIVES

- Coordinate services provision to tenant companies
- Play a leadership role in designing and monitoring key performance indicators
- Provide an interface between companies and authorities



## RATIONALE

Recent studies on eco-industrial parks have highlighted the importance of a centralized management model to ensure the smooth operation of the park (Massard et al., 2014; UNIDO, 2016a). Effective park management requires dedicated responsibilities and functions, ranging from common infrastructures and services management, coordination with various stakeholders and attracting investment for financial sustainability. To manage eco-industrial parks, both general business tools (e.g. on lean management, and project/programme management) and specialized EIP tools can be used.

EIP management ensures continuity over time and consistency with EIP goals for companies, end customers, authorities and communities. This section looks into various organizational models that can perform EIP management functions. In Table 5, illustrative management models as well as specific terms used in this section are summarized.

## OBJECTIVES

The key objectives of eco-industrial park management structures can be summarized as:

- Be accountable for park property management and coordination of service provision to tenant companies, particularly favoring RECP and industrial synergies in the form of common infrastructures and services as well as other forms of industrial symbiosis.
- Play a core leadership role in designing and monitoring key performance indicators (KPIs) for the park, looking at economic, social and environmental criteria that are aligned with EIP standards.
- Provide an interface between tenant companies and the authorities. May act as a facilitator, moderator and/or mediator.

Eco-industrial park leadership	The leadership role in an EIP is usually represented by a board, committee or shareholders' group united by common interests that provide the vision and hold the EIP accountable to its overall goals. The goals should be aligned with EIP standards but also with the country's development goals.
Eco-industrial park management	The EIP management takes care of the operationalization of the park and the most effective ways to reach its goals measured through KPIs. It is accountable to the EIP leadership.
Tenants' association	A tenant association is a union of all or most of the companies that are property owners or leasers in an EIP. When the association is legally formalized, it can act as EIP management. Informal tenant associations can represent tenants' interests through joint lobbying activities.
<b>EIP management models</b>	
Associative management model	In this model, EIP tenant companies organize themselves in an association with the mandate to manage usually one and sometimes several industrial parks. In this model, there is no distinction between park leadership and management and little or no intervention from government.
Government management model	The government ensures the management of the EIP through a dedicated team issued from a designated national, regional or municipal authority (for example trade ministry). It is often the case for special economic zones requiring high government investment. It is possible to have a government managed EIP model whereby the park operation may be subcontracted to one or several private operators (refer to EIP private management model in this case).
Mixed public-private management model	This model refers to a government managed EIP where assistance from a private contractor is required in addition to government employees. This partnership can be permanent (e.g. a government liaison officer is a permanent staff member while the private company provides the other park management positions) or temporary (e.g. as part of a capacity building process until the government can perform all park management functions itself). An NGO or foundation can be set up by a mix of tenant companies and local authorities to manage the EIP by facilitating a cooperative approach to service provision, shared between a city and private sector.
Private company or individual management model	In this model, the park management is run by a private operator or real estate agent.

TABLE 5: Useful definitions for this chapter

## APPLICABILITY

Good governance applied to eco-industrial parks includes consulting a wide range of stakeholders who can participate in the design of the park management structure, as well as in monitoring performance.

This chapter is primarily applicable to park operators and management, but may also apply to:

- **PARK TENANT COMPANIES:** Even when the tenant companies are not part of the EIP management itself, the more they are informed or participate in the park management deliverables, the better. A clear understanding of roles and responsibilities and an open dialogue is a strong contributor to the tenants' perception of value for money, as well as efficient provision of services by the park management.
- **OTHER GOVERNMENTS AND REGULATORY REPRESENTATIVES:** It is common for governments to contribute to EIP leadership by sitting on the board or governance committees. This section focuses on EIP management operations and structure so that government authorities are capacitated to deliver a leadership function for EIPs. It focuses on EIP management structures rather than leadership structures. Within the management structure, the communication channels and focal points allocation need to be clear to link with government authorities. Thus, this section is recommended for government officials dealing with industries, environment and public service provision to understand EIP accountability, deliverables and coordination with public authorities.
- **FINANCIAL SECTOR AND FUNDING AGENCIES:** EIP management is the cornerstone for any investor to assess a park's sustainability.

## SUCCESS FACTORS



In summary, the key factors for the successful selection of suitable park management models can be defined as follows:

- **STRONG LEADERSHIP AND COMMITMENT:** An EIP managing body needs a representative leadership, an efficient structure (e.g. following lean management principles), transparency and strong capacity for dialogue. Strong commitment from park management

towards EIP objectives and standards is essential, along with a clear definition of mandate and attributions.

- **STRATEGIC APPROACH TO DETERMINE MOST SUITABLE PARK MANAGEMENT MODEL:** As each management model presents advantages and disadvantages, it is important to set up a strategic approach to decision-making related to park management to find the best option. In greenfield EIPs, exploring and deciding on management models should have taken place at the design phase.
- **EFFECTIVE MODEL TO SHARE AND RECOVER PARK LEVEL COSTS/BENEFITS:** From the planning phase onwards, it is necessary to think about the cost recovery model envisioned for the EIP to ensure that: a) the park management cost is factored into the cost-recovery strategy and b) tenant companies are willing to pay for the services offered by the EIP. The design of the park should optimize the contributions from various revenue sources such industrial synergies within and outside the EIP (see Section e and Chapter 3). RECP measures, as well as common infrastructures and services, are direct contributors to cost-savings from the tenant companies of an EIP. They need to be well-documented to ensure that tenant companies will implement such measures and pay for common services. It is widely recognized that management is more effective when it provides incentives rather than inflating subscriptions or service fees.
- **CAREFULLY MANAGE RISKS ASSOCIATED WITH FINANCIAL SUPPORT FROM GOVERNMENT:** To attract foreign investment, it is common practice to offer a range of incentives including tax exemptions, free access to public resources or other government subsidies. Nevertheless, such incentives should progressively be replaced by full cost recovery factoring EIP operational costs appropriately in the acquisition or lease by tenants, progressive taxation and other financial revenue streams.
- **CONTRIBUTE TO COMMUNITY OUTREACH:** EIP management may also facilitate: organization of community events, awareness raising on public issues, coordination in resource users' groups, contribution to training young professionals, housing rehabilitation and other collective actions. Additionally, sound grievance management systems should

be operational to ensure dialogue and continuous attention to community concerns.

- Ensure good governance: Separated from the operational aspect of managing an EIP, good governance covers the regulation and inspection aspect of industrial parks. In this regard, full compliance with local, national and international standards in the area of environmental protection and social development need to be upheld.

## IMPLEMENTATION STEPS

### STEP 1: Establish park management model

There is no universal model for EIP management models, which are highly dependent on the nature of the park (e.g. industrial sector, size), its constitutive enterprises, the prevailing political environment (national and local), the level of investment and financial availability and the capacities of the stakeholders in the EIP site location. There can be a diverse range of models in the same country and even same locality.

Figure 6 presents a non-exhaustive selection of models mainly as seen in UNIDO supported pilots (see Table 5

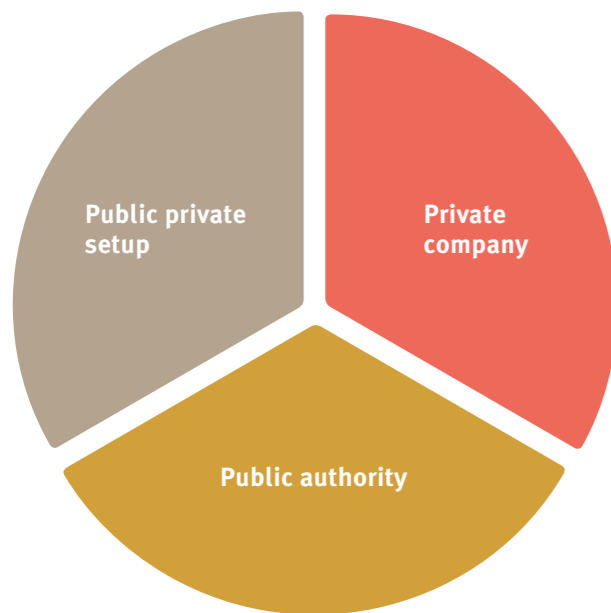


Figure 6: EIP management options

for the definitions of the park management models). Based on the experience of UNIDO, park management structures set up as managers and service providers rather than as administrative units tend to be more successful for EIP development. The legal and organizational set up of management units often differ considerably in industrial parks. Depending on the existing context and policy frameworks, park management models may be the following (or combinations thereof):

- Public administration units or state-run companies, which can cover both the management and some aspects of leadership of the industrial park
- Private associations, private companies or real estate agents, generally responsible for park management aspects with participation in leadership remaining optional

Pragmatically, EIP management models should be participative and decided at the earliest developmental stage. Instead of reproducing forms of management from a pre-existing company or government body (which can lead to bureaucracy), the selection should be based on a detailed assessment, such as a Strength Weakness Opportunities and Threats Analysis (SWOT analysis).

Each management model presents advantages and disadvantages. It is possible to make general observations:

- EIPs that require substantial investment and need to attract large international companies, even when under government leadership, may often opt for a private management contractor as international companies prefer to follow business modalities.
- SMEs-based industrial parks may prefer the association management model, except in cases where there are legal limitations to charge for services.
- Public-private arrangements with municipalities and tenants' associations are often best fitted for brownfield industrial parks and a mix of companies of different capacities, where large infrastructure investments are not required.
- Government leadership and management is common in Asia as a result of large-scale industrialization programmes and subsidization. Nevertheless, the cost-recovery of the park management may be not fully guaranteed.
- Real estate agents are key players in the management of industrial parks and represent a valuable

model for EIPs. This is particularly true for industrial parks where real estate agents take on a more extended role. Beyond premises sales, lease and maintenance, they can also manage shared infrastructure and service provisions.

### STEP 2: Set up park management functions

A management structure identifies units for particular functions. Those functions may be delivered by the EIP

management staff itself or subcontracted to service providers. All functions need to be rationalized following a lean management approach (McKinsey, 2014), which aims to maximize customer value while minimizing inefficiencies in critical resources such as human effort, space, capital or time. There is not a single set of functions that would fit every EIP, although it is obvious that EIP management would hardly work without a CEO or a finance officer. Main functions in an EIP management structure are illustrated in Figure 7:

## EIP MANAGEMENT ORGANIZATIONAL CHART EXAMPLE

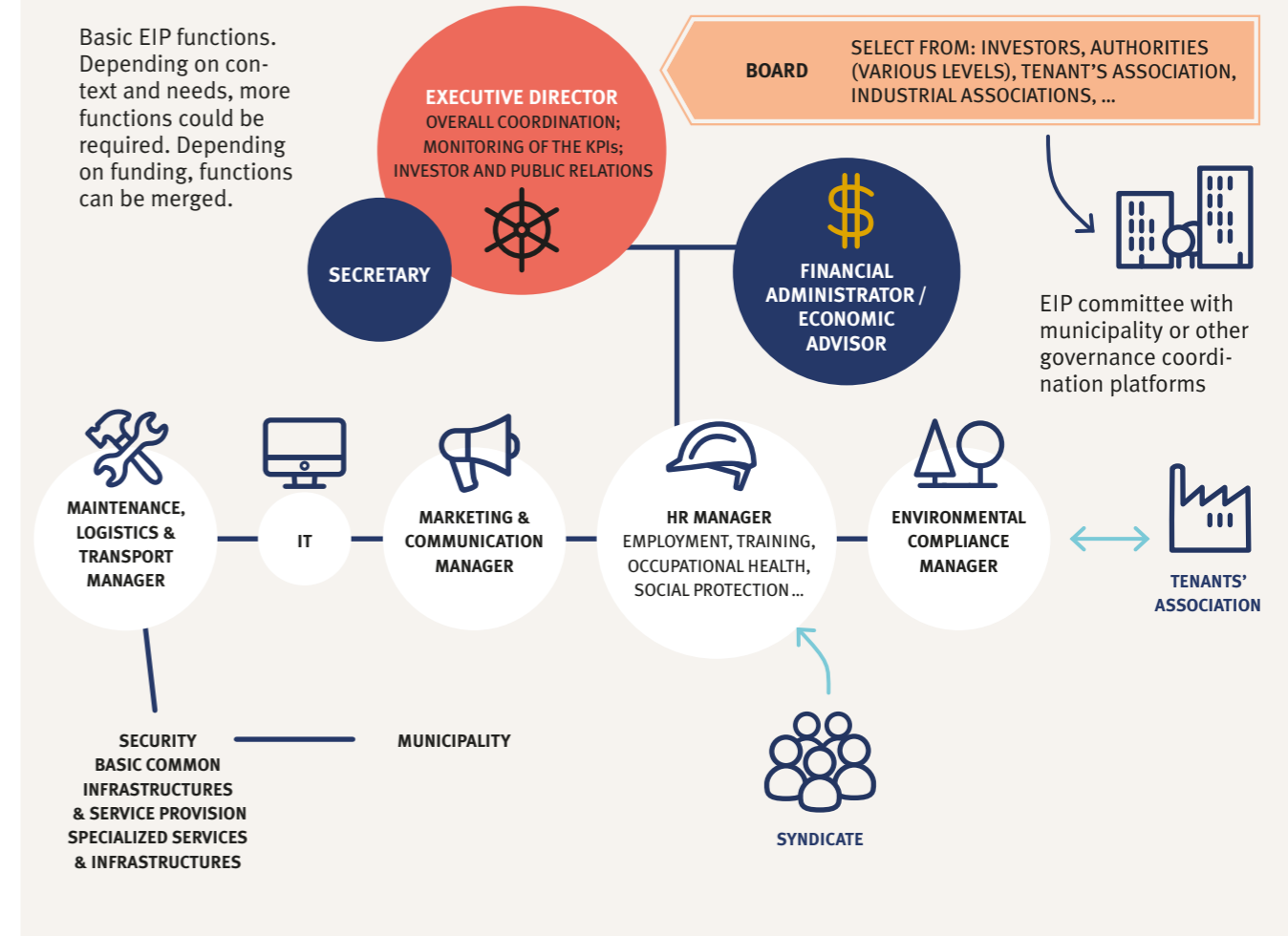


Figure 7: Main functions in an EIP management structure

Key functions of park management which are particularly important to classify as an eco-industrial park are:

- Environmental monitoring and recording, enforcement of the park's code of conduct (including confidentiality and intellectual property issues) and relevant regulatory compliance issues with regards to infrastructure and services
- Risk, accident and incident management in park
- Stakeholder consultations including local citizens and government officials to take on board respective goals and visions
- Facilitation of knowledge sharing and collaboration between companies (e.g. waste management, cleaner production, health and safety procedures, etc.)
- Maintenance of facilities and infrastructure in the industrial park, and ensured financing for these services
- Facilitation to establish new companies in the industrial park (e.g. determine optimal location based on infrastructure/service needs, risk profile, industrial synergies)
- Representation of interest and objective of the park at local or regional disputes and stakeholder meetings

The EIP leadership can mandate the park management to design the criteria, contracts and charters to process with the selection of tenant companies. The EIP leadership sets up a vision to enhance economic competitiveness and EIP standards, which informs the KPIs at park level.

The EIP management will closely assess the evolution of the park's overall competitiveness and tenant companies' performance to adapt its actions. For example, this is done by seeking different company profiles, ending the collaboration with a dissatisfactory industry, or facilitating solutions outside the park premises if the composition of park industries presents a weakness (e.g. lack of diversification).

### STEP 3: Mobilize resources and ensure financial sustainability

Financial self-sustainability should be the basis of any EIP project. While an eco-industrial park may request external funds for its set up and first years of functioning, its long-term plan should be economically sustainable. Therefore, from the planning phase, it is necessary to think about the model of cost recovery envisioned for the eco-industrial park and to ensure that:

- a) The management cost of the EIP is factored in the cost-recovery strategy
- b) Tenant companies are aware of the added value of the EIP management and are willing to pay for the services offered by the EIP

Tenant companies require a perceived (and preferably documented) value for money for the services and lean management from the EIP operator. The conditions under which investors and tenants are invited may determine future willingness to pay. Nevertheless, the need to make an eco-industrial park attractive to foreign investment does not mean to systematically undermine efforts for cost-recovery. For example, while tax exemptions can be applied, exemptions can also be designed as a progressive function of turnover or profit. The different revenue streams (internal and external) that can be tapped in an eco-industrial park are shown in *Figure 8* with their condition of applicability. Private investment, government subsidies and multi/bilateral donors' support are some of the main external sources of funding for an eco-industrial park. External funding sources should be considered as a transitional or investment phase towards self-financial sustainability.

## EIP SOURCES OF REVENUE (NON-EXHAUSTIVE)

EIP operational management should aim for self-sustainability and value for money in service provision.

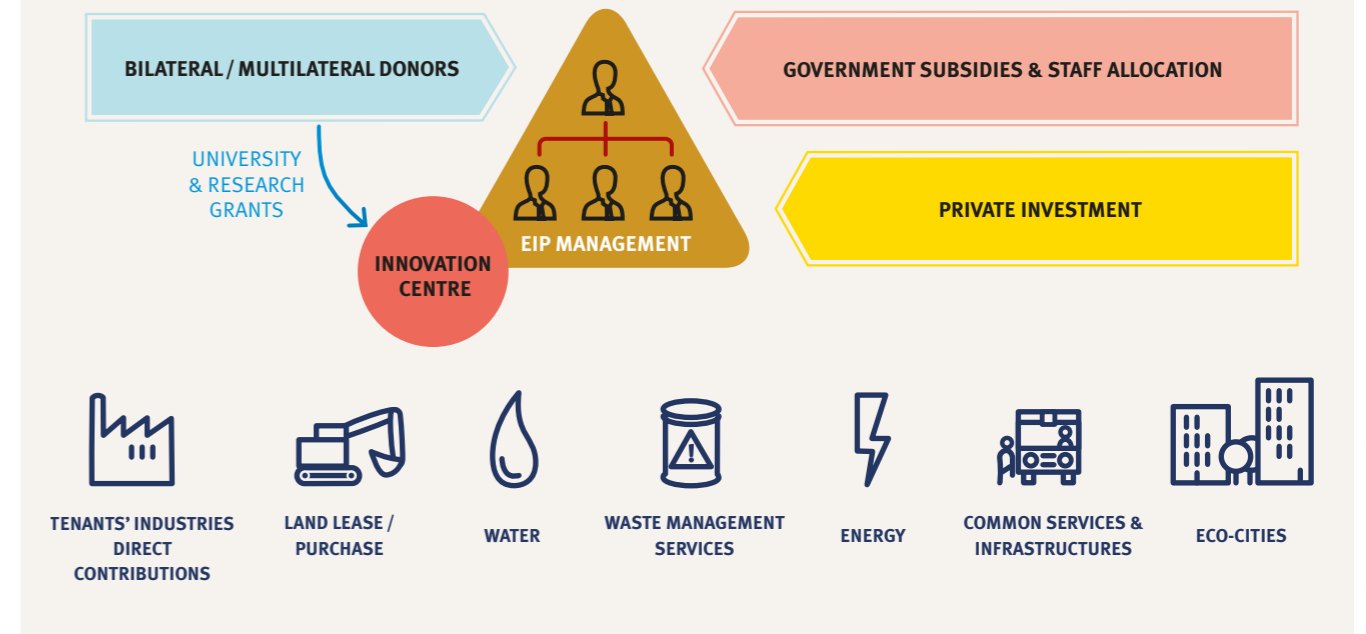


Figure 8: EIP sources of revenues

### STEP 4: Designing and rolling out EIP plans

Park management is responsible for translating the leadership vision for the eco-industrial park into actionable plans that are aligned with applicable standards. It is a participatory process with all the stakeholders and particularly the tenant companies to interpret those standards in specific contexts and identify the interventions, objectives, resource and indicators using tools common to any project management. The performance of the EIP management in upholding its duties should be part of the plan. A fundraising strategy would look into extra financial efforts, collaborations or capacity building needs to bring about innovation and additional common infrastructure and services. Based on a solid fundraising strategy, financial and human resources can be allocated and committed to implement the specific tasks outlined in the EIP plan.

### STEP 5: Adapting to change and scaling up

As mentioned before, an eco-industrial park may experience several phases that impact on its management structure. While one management model could well work for the whole EIP cycle, it is not necessarily the case. Particularly for greenfield industrial parks, EIP managers are conscious that the park management structure will evolve. For example, this is the case when a government launches a programme to boost industrialization and engages in the EIP setup and management with an exit strategy in mind (e.g. transfer to a private management contractor). At other times, EIPs grow organically and external and internal factors result in the recognition that new management instruments are needed.



## GOOD PRACTICE EXAMPLE – Park management structure and financial models:

### East London Industrial Development Zone (ELIDZ) in South Africa



#### Overview:

South Africa has a diverse range of industrial parks and allocated funds at federal, provincial and municipal levels, resulting in various greenfield and brownfield initiatives. East London Industrial Development Zone (ELIDZ) is part of South Africa's Industrial Development Zones (IDZs), established under the Department of Trade & Industry and owned by provincial and municipal governments. Such industrial development zones have been successful in attracting large scale investment and multinationals in various sectors. They represent a mix of national and international companies. ELIDZ has a transitional management through the hiring of a dedicated private team under government payroll and should be fully licensed to a private manager in the future.



#### Important considerations:

- ELIDZ is already collaborating with an industrial zone outside the park boundaries called Winsonia. This means it is possible to offer more cost-effective common training and industrial synergies tools.
- A new collaboration has been set up between NCPIC and Western Cape Industrial Symbiosis Programme (WISP). WISP offers a free service that connects companies so that they can identify and implement industrial symbiosis.
- ELIDZ is engaged in lean management and in a revision of its financial sustainability with UNIDO support.

#### Key activities:

- Park management ensures improved provision of basic services and negotiations with the municipality.
- ELIDZ has fostered several innovations and actively maintains specialized infrastructures in logistics.
- Activities to improve water provision and avoid shortage are prioritized.
- The park assists companies with environmental and social compliance.
- Coordination with authorities is particularly strong.

#### Applied tools (not all-inclusive):

- An environmental management framework was adopted. A revision of the act may be needed to align with EIP standards
- Water footprint certification
- Carbon footprint certification

#### Benefits to date:

Industrial Development Zones in South Africa are supported by government for a transition period until they can be fully privatized. The model aims to motivate park management staff to search for financial recovery solutions to achieve full financial self-sustainability.

At ELIDZ some companies are willing to participate in social corporate and philanthropic activities and requested the help of ELIDZ management to channel them. According to its 2013-2014 report, ELIDZ sponsored mobile libraries and schools in the Queenstown area, donated office space to serve as a crime reporting centre, refurbished an old age home in the Eastern Cape township of Mdantsane and supported sport development in various Eastern Cape local communities.

As climate change is causing water shortages, ELIDZ and the municipality have participated in buying additional water tanks.



Source: (East London IDZ SOC Ltd, 2017), (GreenCape, 2017), and <http://ncpc.co.za>

## GOOD PRACTICE EXAMPLE – Park management structure:

### PIMSA (Industrial Park Malambo, Barranquilla) in Colombia



#### Overview:

In Colombia, UNIDO is working with the park management of the Industrial Park of Malambo (PIMSA). The park is situated in the rapidly increasing urban metropolitan area of Barranquilla. In 2016, PIMSA has contributed 17 per cent of total exports from the Atlántico Department (Colombia). This is partially attributed to PIMSA's unique location, with proximity to the airport of Barranquilla and its own dedicated port, which will be expanded in the near future. Historically, PIMSA was a real estate agency providing customized buildings to tenant companies, but over recent years its function and services have continuously expanded. PIMSA is strongly committed to the vision of transitioning to an eco-industrial park and extending its business model towards renewable energy and resource efficiency in industry as well as social and economic community outreach activities.



#### Important considerations:

- Park management has a clear vision and commitment to implement EIP projects and initiatives with a dedicated team of approximately 50 employees.
- PIMSA's ideal location makes it an attractive investment and relocation area for companies.
- Strong local regulations seek to offset the negative impacts of industrial activities, through the creation of green spaces for the municipalities outside the industrial park.

#### Key activities:

- Park management ensures that industrial needs are given appropriate priority by providing water supply and wastewater treatment facilities, security services, sound evacuation planning, and social and economic empowerment projects.
- Park management is engaged in the RECP coordination mechanisms to ensure company support and involvement within the industrial park together with the National Cleaner Production Centre in Colombia.
- There is regular and strong coordination with local authorities. Future concrete projects include the creation of a truck terminal and a resting house for drivers.
- PIMSA has commissioned a renewable energy study for the creation of solar panels in the buffer zone, which is located between the environmentally protected area and the industrial park.

#### Applied tools (not all-inclusive):

- A detailed mandate of the role of park management is available.
- A clear step-by-step approach is in place to manage future eco-industrial park planning and concrete initiatives.
- PIMSA has a sound revenue and business model in place ensuring that essential costs for the provision of services (e.g. water supply, security) are self-sustained through the subscription of fees.

#### Benefits to date:

PIMSA has been successful in extending its services and attracting important companies to relocate to the industrial park. PIMSA, along with associated companies, is a member of a social foundation which agrees on philanthropic projects for social and economic empowerment. Finally, PIMSA ensures the preservation of a neighboring protected area, thanks to the creation of a buffer zone between the industrial park and this area. In this buffer zone, the development of environmentally friendly projects (e.g. construction of a solar farm) is assessed.

Source: [www.pimsa.com.co](http://www.pimsa.com.co)

# E) UPSCALING RESOURCE EFFICIENCY AND INDUSTRIAL SYNERGIES/SYMBIOSIS



## MAIN OBJECTIVES

- Optimize the productive use of natural resources
- Reduce impacts on environment
- Minimize risks to people and communities



## RATIONALE

Sustainable development implies utilizing material, water and energy resources as efficiently as possible. In an eco-industrial park, resource efficiency can be improved at two different levels (*Figure 9*): The first approach consists in improving resource efficiency in individual companies, for instance through the joint UNIDO-UNEP programme on Resource Efficient and Cleaner Production (RECP). This programme is a preventive and collective approach that can be applied to enhance the efficiency of any industrial process (UNIDO and UNEP, 2010). Many environmental, social and economic benefits have resulted from RECPnet, the dedicated platform of this programme (UNIDO, 2017).

The RECP approach notably applies the waste management hierarchy:

1. Avoid generation of waste and pollution at source
2. Minimize and reduce waste and pollution
3. Reuse waste and by-products
4. Recycle materials
5. Recover energy from waste
6. Proper disposal of waste

The second approach consists in increasing efficiency at industrial park level, where material, energy and water flows can be managed collectively, through concepts of industrial symbiosis and industrial synergies (UNIDO, 2016a). Four different types of industrial synergies can exist within an industrial park (expanded from (Van Beers et al., 2007)):

- **SUPPLY SYNERGIES AND CO-LOCATION OF SUPPLIERS AND CLIENTS:** Co-location and clustering of companies in the supply and value chains (e.g. producers and suppliers of raw materials, fabricators, manufacturing, business clients).
- **UTILITY SYNERGIES:** Shared use of utility infrastructure, mainly revolving around water and energy (e.g. water recovery and energy cogeneration).
- **SERVICE SYNERGIES:** Sharing of services and activities between companies (e.g. joint training of staff and sharing of maintenance contractors).
- **BY-PRODUCT SYNERGIES AND WASTE EXCHANGES (industrial symbiosis):** The use of a previously disposed waste (as solid, liquid, gas) from one facility by another facility to provide a valuable by-product.

According to this definition, industrial symbiosis is a particular kind of synergy, which “engages traditionally separate industries in a collective approach to competitive advantage involving physical exchange of materials, energy, water, and/or by-products” (Chertow, 2000).



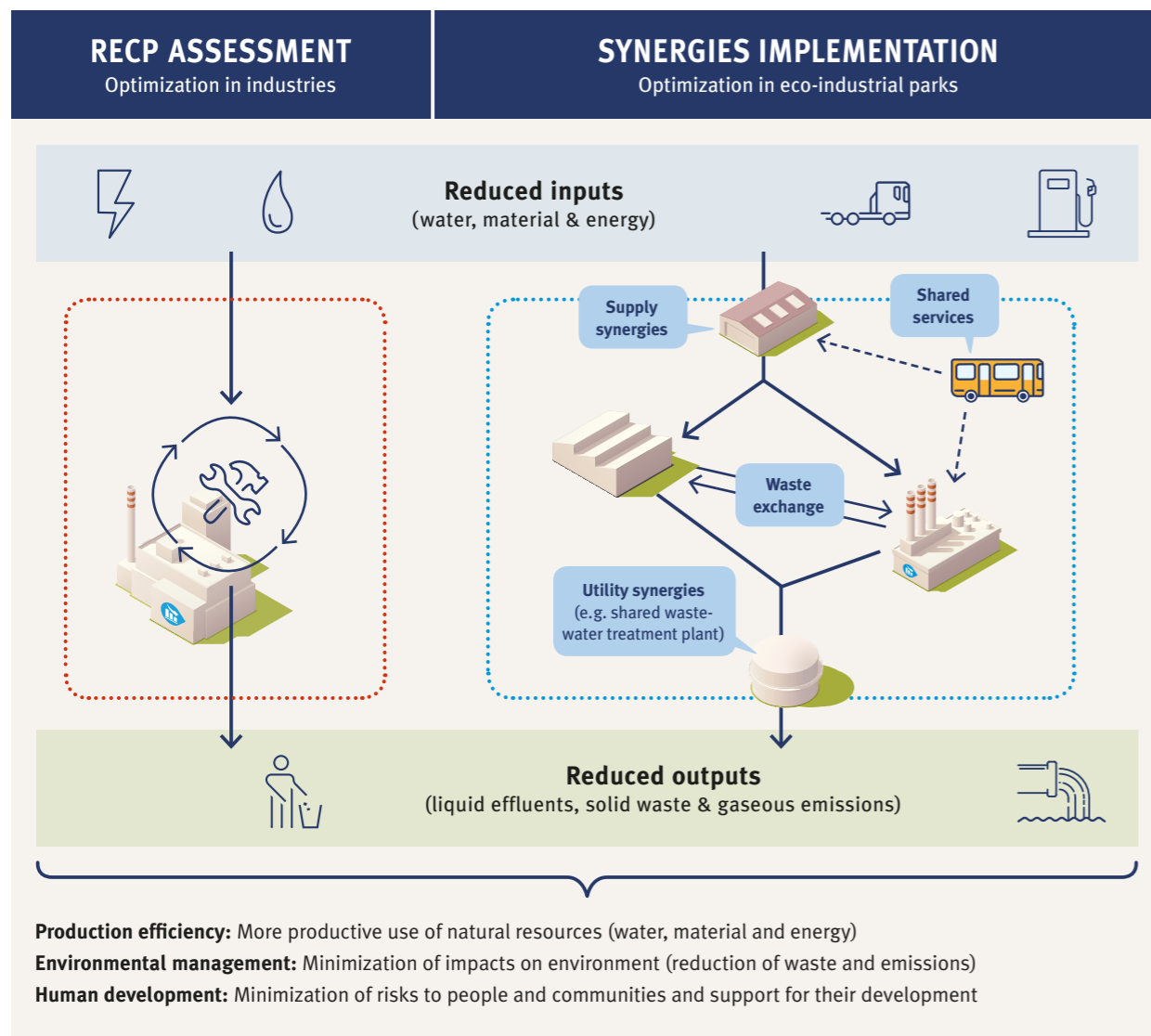


Figure 9: Illustration of RECP assessment as well as industrial and urban synergies/symbiosis

## OBJECTIVES

The aim of Resource Efficient and Cleaner Production (RECP) is to apply “preventive environmental strategies to processes, products and services to increase efficiency and reduce risks to humans and the environment” (UNIDO, 2017). Financially, RECP can help companies to save money by increasing the yield of resources conversion into useful products and services, and by reducing the costs associated with waste treatments (UNIDO and UNEP, 2010). Environmentally, the aim of RECP is to decrease impacts on eco-systems, such as air emissions or water contamination. Finally, the social dimension is addressed by decreasing risks to local communities and supporting their development.

In summary, RECP addresses the three sustainability dimensions individually and synergistically:

- **PRODUCTION EFFICIENCY:** Optimizing the productive use of natural resources (materials, energy and water)
- **ENVIRONMENTAL MANAGEMENT:** Minimizing impacts on environment and nature
- **HUMAN DEVELOPMENT:** Minimizing risk to people and communities and increasing support for their development

At a higher level, industrial synergies aim to create “a system for trading material, energy, and water by-products among companies, usually within a park, neighbourhood, or region” (Lowe, 2001). These objectives are very much aligned with the concept of eco-industrial parks.

## APPLICABILITY

RECP assessments can be undertaken with companies in every EIP configuration. Assessments can be adapted for different sectors and for companies of different size. They can focus on the whole company or on a particular process. RECP assessments are usually carried out in existing companies in a process of continuous improvement. However, because the RECP approach has a preventive feature, it is possible to use during the planning of a greenfield EIP. The procedure can be spontaneously undertaken by companies, or fostered by external parties such as park management or local authorities. Industrial synergies are a key component of eco-industrial parks, and these can be implemented both in greenfield and brownfield parks. Supply chain and by-product synergies are mostly driven by the companies themselves, while utility synergies often involve collaborations between companies, park management, utility providers and in some cases also government agencies. Service synergies are often coordinated by the park management. Therefore, this section is applicable to this wide range of stakeholder groups.

## SUCCESS FACTORS



Industrial parks vary in size, type of industries, physical and social infrastructure, which makes comparisons difficult. There is no ready-made single solution to RECP and industrial synergies that fits all. Based on international experiences, success factors for the implementation of RECP and industrial synergies are summarized below.

### Technical considerations

- **EXPERTISE:** For both RECP assessment and development of synergies, a strong know-how is required in cleaner production methodologies and industrial synergy concepts and their application to companies and industrial parks. RECP training materials are relatively well developed. Identification and evaluation of industrial synergies can be more challenging, as multidisciplinary competencies are required.
- **VIABLE TECHNOLOGY AND EQUIPMENT:** Modification and investment in technologies are often required to implement RECP solutions and industrial synergies. For instance, a by-product may need to be processed to meet technical and market requirements. Without a suitable and proven technology available to treat, convert or transport a by-product, a synergy project would be not feasible.
- **DIVERSITY OF INDUSTRIES:** Having different industrial sectors usually results in a wide variety of resource input and output flows available for inter-industry exchanges. Similarly, having companies of different sizes (including SMEs) can facilitate the development of symbiosis, by offering opportunities for valorizing different volume streams.
- **FEASIBLE DISTANCES:** This is generally a key success factor as transportation can make up a significant proportion of the costs to enable an industrial synergy. A clear distinction must be made between synergies inside and outside an industrial park (e.g. material exported for road construction). Obviously, this latter case is more sensitive to transportation issues (Van Beers, 2009).

### Economic aspects

- **RETURN ON INVESTMENT:** The implementation of RECP solutions and industrial synergies need a favorable return on investment and so-called low-hanging fruit

for the beneficiaries, as often the decision on their investment is competing with investments in other areas.

- **Recognize full set of benefits:** The benefits of RECP and industrial synergies often go beyond return-on-investment, as the benefits can also cover risk mitigation, improved productivity, and improved environmental and social performance. Investment decisions must account for the full set of economic, environmental and social benefits.
- **ACCESS TO FINANCE:** Investments can sometimes be significant to implement industrial synergies. This is particularly the case for utility synergies and shared infrastructures in industrial parks. Financial incentives can help decreasing the payback period. As cleaner production and industrial synergies require a substantial investment, the availability of financing solutions is clearly a key factor for successful implementation (WBG, 2016).

### Socio-political context

- **SOCIAL LICENSE TO OPERATE:** Policy and regulations can help improve resource efficiencies at company and industrial park levels (Moreau et al., 2017). In some countries, regulations can also be a barrier to the development of industrial synergies, because by-products are usually considered to be waste, and are constrained by stringent regulations to avoid illegal disposal of contaminated material. The less tangible or ‘softer’ benefits of RECP and industrial synergies can be a strong driver for change and are usually much more difficult to control than associated technologies. If, for instance, a local community believes that an industry has undesirable impacts on lifestyle through waste or emissions disposal practices, this could affect the company’s “social license to operate”, even if the company is satisfying the government regulations (Van Berkel, 2006).
- **TRUST AND ENABLING ENVIRONMENT:** Obviously, RECP solutions and industrial synergies cannot be developed without the participation of companies and park management. Depending on their corporate cultures, tenant companies may or may not be enthusiastic to allow RECP assessments by external experts or to get involved in industrial synergies. Therefore, an environment of mutual trust is a very

important success factor for RECP and industrial symbiosis development. The absence of exacerbated competition between companies in the park usually allows the creation of such an environment, as well as developed contacts between companies (networking). Interestingly, it has been demonstrated that specific employees of companies within industrial parks can have a significant influence on the development of EIP strategies. These “industry champions” (e.g. environmental managers) can motivate industry partners from their network to participate in the project (Hewes and Lyons, 2008; Van Beers, 2009).

## IMPLEMENTATION STEPS



Figure 10 presents the methodology frameworks used to develop RECP assessments and implement industrial synergies. The approach is relatively similar in greenfield and brownfield eco-industrial parks, except that RECP assessments cannot be performed in operating industries during the first phases of a greenfield EIP development. In this case, theoretical training can be given on cleaner production. Both RECP and industrial synergies can be considered complementary processes, which can be developed in parallel.

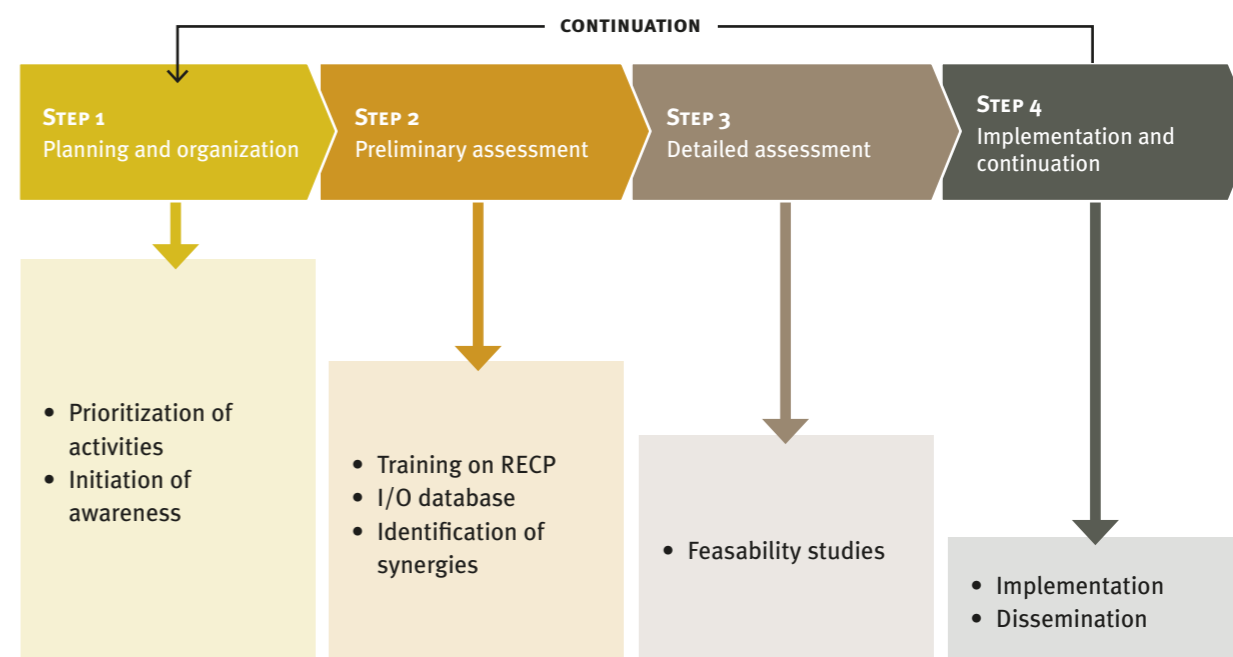


Figure 10: The UNIDO implementation approach for technical development of industrial parks

## STEP 1: Planning and organization

The first activity is to analyze the local context for RECP and industrial synergy development, and assess to what extent the success factors are met.

This allows strategically setting out the types of RECP and industrial synergies assessments in the next steps. Typically, it is suggested to start RECP and synergy assessments with companies where specific opportunities have already been identified or where management has already indicated a significant interest and commitment to the project. This increases the chances of capturing “low hanging fruit” opportunities which can be promoted to other companies in the industrial park to generate their interests. Other success factors such as the “social license to operate” or access to viable technologies and equipment should be carefully examined, since these also influence the detailed approaches in next steps. For example, if a company is perceived as polluting by local communities or legislative agencies, it would be better to start its RECP assessment in the early stages.

The first step is devoted to obtaining management and funding commitment and allocating tasks and responsibilities for the project. In addition, it is very important to initiate awareness raising on RECP and industrial synergies early in the process. Therefore, workshops and visits to companies should be organized to explain the concepts, ensure the involvement of industries and set up confidentiality agreements (if necessary) to guarantee discretion when companies communicate their materials, energy and water consumption, as well as their emissions and discharges.

## STEP 2: Preliminary assessment and opportunity identification

The objective of the preliminary assessment is to collect baseline data from companies and industrial parks and generate a list of potential RECP and industrial synergy opportunities. RECP assessments can be initiated at this step (planning and organization should have already been accomplished). The assessments usually focus on data collection and option generation. Checklists can be used for collecting data from companies. The data can cover the following (UNIDO, 2008):

- Material input (raw material, process material, other)
- Energy carrier (coal, oil, gas)
- Energy (mass free, i.e. electricity, heat)
- Products (including by-products)
- Material emissions (e.g. solid wastes, wastewater, gases)
- Energetic emissions (e.g. waste heat)

After this step, a database can be created, for instance with a tabulator. Material and energy flows can be analyzed and visualized through a Sankey diagram. Supporting software can be used, for instance STAN (Cencic and Rechberger, 2008) or Umberto® (Institut für Umweltinformatik, 2017). According to the result, RECP options can be generated in order to increase the efficiency of production inside companies.

A relatively similar process can be accomplished at the park level to identify industrial synergies. The data generated during RECP assessments can be reused for the companies which have been assessed. For others, data can be collected through questionnaires to gather the necessary information. These questionnaires can be completed by a visit to the industries to explain the intentions and ensure data quality.

A database must also be established to manage the inputs/outputs data at park level. Using software is advised to draw material flows and stocks, because industrial parks can be relatively complex structures. Based on the material flow analysis, the identification of industrial synergy opportunities in industrial parks can be identified through the following means:

- Discussions with staff working at companies and park management unit (bilateral meetings or in workshop setting).
- Matching inputs (e.g. raw materials use, water and energy demands) and outputs (e.g. wastes and by-products, effluent streams, waste heat) from companies within the industrial park, and outside the industrial park where possible.
- Review of international experiences, good practices and case studies in industrial synergies.
- Analysis of existing and potential new park management, utility services and common infrastructures.

The activities outlined above are applicable to brown-field industrial parks. For greenfield industrial parks, preventive trainings may substitute for RECP and industrial synergies assessments. For example, companies

locating to industrial parks can use the RECP approach to assist in their process design. In parallel, their resource inputs/outputs can be forecasted to assist in determining the optimal location in the park, for instance, close to synergistic companies and required infrastructure and utility services (spatial zoning).

## STEP 3: Detailed assessments

The overall aim of this step is to evaluate promising RECP and synergy opportunities which have the potential to result in significant sustainability and business benefits for the industries involved and the industrial park as a whole.

Not all identified potential RECP solutions and industrial synergies from the previous step will be feasible or provide significant benefits to the companies or the park. Therefore, a prioritization exercise is normally undertaken to highlight opportunities which are of interest to undertake a detailed feasibility study, as well as eliminating opportunities that can readily be identified as unfeasible or without significant benefits.

This step includes in-depth feasibility studies of promising and prioritized RECP and industrial synergy opportunities. These studies may include techno-economic analysis, impact assessment, social feasibility and business risk evaluation. The objective is to establish if the options identified are technically, socially and economically feasible, and what consequences (positive or negative) can be expected from their implementation. The level of detail of this step will depend on the option proposed (e.g. simple operational modification, use of alternative materials, replacement of process equipment, extensions of capacity of an installation, etc.). Of course in cases of larger infrastructure developments, more detailed environmental and social impact assessments have to be conducted.

## STEP 4: Implementation and continuation

To make a positive impact, a critical condition is the actual implementation of RECP and synergy opportunities in industrial parks. On one hand, it is important to note that it is eventually up to individual companies to decide on the implementation of feasible and attractive RECP solutions. On the other hand, multiple parties are involved in the development and implementation of industrial synergies. For their implementation, it is crucial that all involved parties perceive benefits (direct or indirect) to make the efforts worthwhile for them. RECP measures and industrial synergies must be continuously improved by the companies and the eco-industrial parks. Any eco-industrial park is in constant evolution. Changes can include new companies in the park, changing priorities of park management over time, increased community and government pressure on specific local issues, and specific resources (e.g. water, energy, raw materials) becoming scarcer and thus more expensive. Further, new production lines can be implemented in companies, and new technologies to revalorize or process wastes can emerge on the market. Given these continuous changes – and recognizing that RECP and industrial synergies are based on continuous improvement processes – it is valuable to repeat the steps described here periodically.



### GOOD PRACTICE EXAMPLE – Technical support in RECP:

Resource Efficient and Cleaner Production (RECP) pilot project to foster eco-industrial development in Colombia



#### Overview:

UNIDO has commissioned Colombia's National Cleaner Production Centre (CNPML) to support the promotion of RECP and eco-industrial parks in Colombia. After a baseline assessment, two brownfield industrial parks were selected, namely Ciudadela Industrial Sabaneta (Medellín) and Parque Industrial Malambo S.A. – PIMSA (Barranquilla). As part of the project, companies in the two industrial parks are invited to participate in onsite RECP assessments. The project has a specific focus on SMEs of the manufacturing sectors, due to their importance to the economy as well as their potential to improve environmental performance. More than 20 companies participate in the RECP assessment.



#### Important considerations:

- The motivation of companies to participate in the project and their commitment to RECP has been carefully examined to maximize chances that identified RECP measures will be implemented.

#### Key activities:

- Selection and recruitment of companies (based on technical, social and environmental criteria as well as company motivation)
- Delivery of RECP training to participating companies (with specific focus on energy efficiency and chemical substances management)
- Support for the undertaking of RECP assessments with the companies

#### Applied tools (not all-inclusive):

- Customized training material on chemical substance management and energy efficiency
- Existing RECP tools and manuals for onsite company assessments
- Industrial symbiosis training conducted by UNIDO international expert

#### Benefits to date:

The project started in 2017, and has already generated promising results. RECP assessments have been conducted in approximately ten companies to date, and 14 additional assessments should be completed by the end of the year. First results demonstrate the utility of the process from different perspectives. For instance, leakages of compressed air have been identified in a company, caused by an inadequate distribution system. Basic ameliorations (e.g. replacement of pipes, shorter connections) will save electricity and avoid investing in a new stronger pump. Finally, data collected during RECP assessments has already led to identified opportunities for industrial symbiosis.

Source: (CNPML, 2017)

### GOOD PRACTICE EXAMPLE – Technical support in industrial synergies:

Resource Efficient and Cleaner Production (RECP) pilot project to foster eco-industrial development in Gujarat, India



#### Overview:

The Indian state of Gujarat is one of the most industrialized states in India. It contains a number of industries (SMEs and large international companies) from diverse sectors (e.g. chemical, textile, etc.). This significant industrial activity obviously causes environmental challenges, even if end-of-pipe actions have been taken to curb pollution. In 2016, UNIDO commissioned the Gujarat Cleaner Production Centre (GCPC) to undertake a pilot project to foster EIP-related initiatives in two industrial parks, namely Nandesari Industrial Estate (NIE) and Dahej Petroleum, Chemicals and Petrochemicals Investment Region (Dahej PCPIR). These two parks have a relatively similar management model (industrial association), but are different in size and type of industries (Dahej is very large and houses both SMEs and international companies, whereas Nandesari is much smaller and houses mainly SMEs).



#### Important considerations:

- Important efforts have been devoted to raise awareness of companies
- Very trusting and enabling environments exist in the pilot parks for the development of industrial synergies (e.g. the parks are managed by industrial associations representing the companies in the parks)

#### Key activities:

- Undertaking RECP assessments with approximately 20 companies in the two parks (these assessments are used as basis for awareness raising on EIP approaches)
- Evaluation of existing and potential new common infrastructures (e.g. wastewater treatment plant) to assess their improvement potential
- Facilitation of meetings and workshops to create awareness and support networking and collaborations between companies
- Data collection on inputs/outputs from companies in industrial parks through questionnaires and establishment of supporting database
- Identification of potential industrial synergies in industrial parks
- Support for the evaluation and implementation of promising synergy opportunities

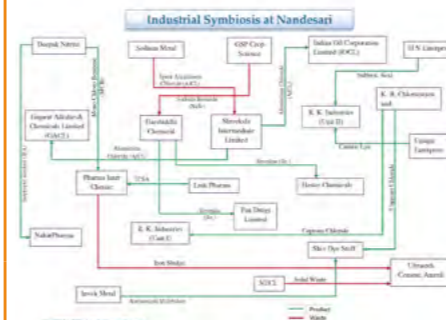
#### Applied tools (not all-inclusive):

- Customized awareness raising materials and approaches (e.g. presentations, seminars, workshops)
- Questionnaire to collect input/output data from companies
- I/O database

#### Benefits to date:

The project is ongoing, and preliminary results are encouraging. A network of 25 companies has been established in Dahej to contribute to the creation of the I/O database. The total of waste landfilled is decreasing, whereas the amount of material being sent to different industries for co-processing has increased. For instance, a cement producer is interested in buying waste with high calorific value. In addition, less tangible benefits such as improved relations between companies have been observed.

Source: (GCPC, 2017)



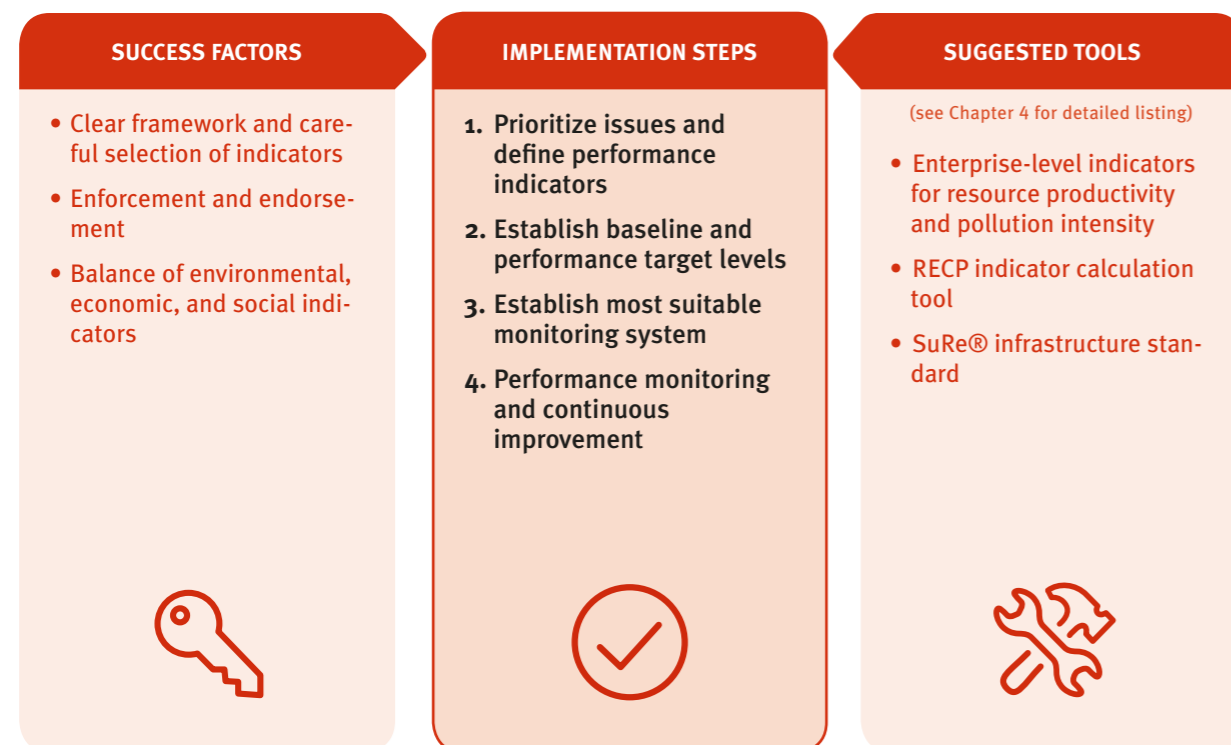


# F) PERFORMANCE MONITORING AND BENCHMARKING



## MAIN OBJECTIVES

- Measure and improve EIP performances
- Give material for reporting and communication
- Allocate funding and contribute to attract new companies in the EIP



## RATIONALE

Monitoring is an important mechanism to track progress against set objectives as well as demonstrate and report on environmental, economic and social outcomes in an efficient, transparent and accountable manner. Performance indicators should allow industrial parks and their tenant companies to quantify their resource efficiency and pollution intensity at any point in time and to track the results of eco-industrial parks over time. Indicators translate complex data into relevant knowledge that can be used to initiate, focus and sustain EIP activities.

There are benefits to industrial park stakeholders starting to standardize and align on eco-industrial parks. This can help foster improved performance and provide clarity on minimum performance expectations for eco-industrial parks. Various good practice reviews and guidance notes have been developed in different forms to date. Further, over the past decade some initiatives have been established by local and international organizations and certification programmes to formulate standards and benchmarks which are directly and indirectly related to the EIP concept.

- Green Growth Indicators (OECD)
- Guidelines for Sustainable Industrial Areas (GIZ)
- Global Reporting Initiative (GRI)

## OBJECTIVES

Specific objectives of EIP performance monitoring and benchmarking can be summarized as follows:

- **PERFORMANCE MEASUREMENT AND IMPROVEMENT:** Assist to bring together operators, industry tenants and stakeholders in industrial parks to discuss how to improve their processes and operations. Performance monitoring compares park performance over time and facilitates the review of progress in achieving key park objectives
- **REPORTING AND COMMUNICATION:** Encourage meaningful stakeholder dialogue and streamline reporting on EIP performance to key stakeholders within and outside the park.
- **ALLOCATE FUNDING:** Help financial sectors and funding agencies to allocate financial support to EIPs.
- **REPUTATIONAL BENEFITS:** Communicate the economic, environmental, and social performance of the EIP to attract industrial development and maintain good relations between stakeholders.

## APPLICABILITY

The applicability of EIP performance monitoring and benchmarking to targeted stakeholders of this handbook is summarized in the table below. The suggestions below are not an exhaustive list, but rather

present a general overview. The importance of specific stakeholders depends on the particular situation of the country concerned and the scope of EIP performance monitoring and benchmarking.

Targeted stakeholders of this handbook	Illustrative examples of stakeholder contribution and relation to EIP performance monitoring and benchmarking
Park operators and management	<ul style="list-style-type: none"> <li>Use EIP performance monitoring to identify improvement opportunities in their industrial parks</li> <li>Set up and maintain effective monitoring systems and support data collection and decision-making processes</li> <li>Use EIP performance monitoring to build market profile of industrial park</li> </ul>
Park tenants (industries & business)	<ul style="list-style-type: none"> <li>Use EIP performance monitoring to identify economic, environmental and social improvement opportunities</li> <li>Collect and provide data for industrial park level management and monitoring systems</li> <li>Use EIP performance monitoring to increase company reputation among shareholders and consumers</li> </ul>
Private sector organizations in industrial land development	<ul style="list-style-type: none"> <li>Use EIP performance monitoring to access subsidies or funding for industrial park(s), and market the industrial park(s) to potential investors</li> </ul>
Governments and regulators	<ul style="list-style-type: none"> <li>Use EIP performance monitoring to support and prioritize policy decisions on sustainable industrial development and potential incentive mechanisms</li> <li>Help government bodies to form a shared vision on the meaning and objectives of EIPs, and thereby contribute to improved policy coherence</li> </ul>
Financial sector and funding agencies	<ul style="list-style-type: none"> <li>Support investment decisions in existing and new industrial parks (e.g. go/no go decision on park development)</li> </ul>
International support organizations and support organizations (e.g. consultancies, Cleaner Production Centres)	<ul style="list-style-type: none"> <li>Provide customized support on EIP performance monitoring processes, building on international experiences and learnings</li> <li>Promote international good practices on EIP performance monitoring through demonstration projects</li> <li>Develop practical EIP monitoring tools</li> <li>Support capacity building processes</li> </ul>
Educational institutions	<ul style="list-style-type: none"> <li>Support capacity building processes</li> <li>Develop good practice case studies on performance monitoring and benchmarking</li> </ul>

TABLE 6: Stakeholder applicability of EIP performance monitoring and benchmarking

## SUCCESS FACTORS



Based on various sources (PAGE, 2016b; UNEP, 2008, 2001; UNIDO and UNEP, 2010), the following success factors apply when working on EIP performance monitoring and related indicators in practice:

- HAVE A CLEAR FRAMEWORK, INCLUDING STRUCTURED SCREENING AND SELECTION PROCESS:** Organizing the indicators within a clear framework is important in assisting meaningful performance review. The identification of relevant indicators should be undertaken as part of a careful screening and selection process to ensure that indicators are selected based on context-specific conditions.
- ALLOCATE CLEAR RESPONSIBILITIES:** There needs to be an institution with coordinating responsibility for the park monitoring and performance monitoring system. This is most often the park management unit. Changes in park performance need to be clearly documented and communicated to relevant stakeholders inside and outside the industrial park. If an indicator is not based on information generated by the regular statistics system, it may be necessary to develop new routines for data collection and reporting.
- ENFORCEMENT AND ENDORSEMENT:** To assess the successful development of an EIP, monitoring needs to be regulated and enforced. Try to get the indicator set approved at the highest management and political level. Endorsement from the political level gives indicators extra weight, and makes it easier to engage all governmental agencies.
- BE FLEXIBLE AND PREPARED TO REVISE:** Working with performance indicators is and should be a continuous learning and improvement process. There is value in observing the same indicators over several years, but there is also a need to review and revise indicator frameworks regularly to properly reflect emerging issues and new priorities. It is important to strike a balance between continuity and renewal.
- SOLID BASELINE:** It is important to perform baseline audits to assess the current state of the industrial system and surveys (e.g. water, energy, material flows, social issues), and establish indicators based on records with development over years (see Section a).

- LINK TO EXISTING INDICATOR SETS USED BY OTHER STAKEHOLDERS:** Indicators selected to measure the progress towards EIPs should be in line with already existing indicator and monitoring systems (e.g. OH&S or quality management system operated by park management) to avoid the creation of duplicative or competing (and thereby ineffective) systems.
- RECOGNIZE LIMITATIONS:** It is valuable to provide detailed explanations for each performance indicator to ensure that they are not misunderstood or used inappropriately. It is also important to be clear about the potential limitations and uncertainties of the different indicators for the EIP. It is important that all indicators are clearly justified, and can be monitored and managed by the park management or companies.
- BALANCED FOCUS ON ECONOMIC, ENVIRONMENTAL AND SOCIAL IMPACTS:** The concept and definition of EIPs reflects an equal importance given the three pillars of sustainable development (environment, social, economic), and therefore the performance monitoring and indicators should also strike this balance in accordance with the specific priorities of industrial parks in their local/national context.
- LEARNING AND BENCHMARKING:** Learn from other countries' experiences and share lessons learned with others. Collaborate in international networks and platforms. In the context of this handbook, good practice benchmarking is a process in which industrial parks evaluate various aspects of their processes in relation to other industrial parks and industry standards. This then allows parks to develop plans on how to make improvements or adapt specific best practices.

## IMPLEMENTATION STEPS



### STEP 1: Prioritize issues and define performance indicators

A key first step for the EIP monitoring and management system is the selection of highest priority issues to address and define performance measures. The prioritization of issues and performance measures should cover both the companies in the industrial park and park management. This is crucial to achieve the objectives of eco-industrial parks, community involvement and business success.

Care should be taken to develop a performance monitoring system that is suited to EIP needs and available capabilities. In the initial stages, it may be more beneficial to design a simple robust system that is easy to integrate into accounting routines, rather than to create a complex system that requires significant investments in the form of time, advanced measurement systems and comprehensive changes in accounting and information management procedures.

Many environmental and social priority issues are captured by local, national and international regulatory/policy frameworks applicable to an industrial park. Compliance with national and local regulations is a requirement for all industrial parks, and therefore a key priority for park management and tenant companies to address and monitor. It is noted that service providers and tenant companies in industrial parks remain responsible for meeting the regulations applicable to their operations, including any required monitoring and compliance reporting.

Regulatory compliance and community concerns are important factors which influence the issues industrial parks and their tenant companies report. The experiences of UNIDO show that this is often the case with monitoring and public reporting of air and water quality in clearly defined locations within and surrounding industrial parks. Whether this reporting is voluntary or compulsory is very much dependent on the local context and existing regulatory frameworks in place.

Illustrative examples of important topics for eco-industrial parks to monitor their performance (not all-inclusive): **PARK MANAGEMENT:** Park management services, monitoring and enforcement, planning and zoning.

- **ENVIRONMENTAL PERFORMANCE:** Environmental management and monitoring, energy, water, waste and materials use, natural environment.
- **SOCIAL PERFORMANCE:** Social management system, social infrastructure, local community outreach.
- **ECONOMIC PERFORMANCE:** Employment generation, local business and SME promotion, economic value creation.

When considering topics (e.g. waste recycling, energy efficiency and community outreach) for managing and monitoring the performances of eco-industrial parks, priority should be given to topics and indicators that can be implemented and aligned with real-life practices. In some countries, it is already a challenge and complex process for companies to comply with local and national regulations. Following the recommendation of UNEP (2015), the following criteria should be considered when developing indicators:

- Easy to understand and communicate even to non-experts
- Reflects a widely recognized and significant environmental, social, economic impact or benefit which can be influenced at the company and/or park level
- Based on reliable, available or easily obtainable data that is updated regularly
- Possible to construct time-series to observe trends
- Sensitive enough to detect changes over the short or mid-term
- Be SMART (Specific, Measurable, Attainable, Relevant and Timebound)

Overall, it is important that the implemented indicator set should cover all critical aspects of eco-industrial parks and provide decision makers with an adequate understanding of whether the industrial park is on the right track towards achieving desired environmental, economic and social impact. A key step in any monitoring system is to set the system's boundaries. For eco-industrial parks, the boundaries are most often the physical boundaries of the park itself.

There are various types of indicators that can be utilized to measure and monitor change, including absolute and relative indicators and productivity and intensity ratios. It is recommended that any EIP indicator system includes a balanced set of different indicator types supported by headline indicators along with some more detailed sub-indicators.

### STEP 2: Establish baseline, benchmarks and performance target levels

A proper baseline assessment (see also Section a) is the starting point for the effective implementation of the indicator system. The baseline comprises data that define the situation before specific measures have been implemented. It is basically the result of the first-time application of the indicator set, including the collection of data through measurement, estimation and calculation. It is used as a point of reference for tracking changes and improvements over time. The baseline should ideally be based on data for one complete year. Shorter periods of time can be subject to fluctuations owing to various circumstances, such as seasonal variations, and may not provide a sufficiently representative picture. The following measurements would then typically be made after the implementation of the first set of EIP opportunities and at fixed time intervals. Each industrial park is unique in terms of its characteristics and different geographical, socio-political, economical and historical contexts in which it operates. It is therefore important to recognize the opportunities but also the limitations of benchmarking and comparing different industrial parks. Further, it is important that the same boundaries and measurement protocols are used to compare the performance of eco-industrial parks.

### STEP 3: Establish most suitable performance monitoring and management system

There are various tools and frameworks that could be used by park management, industries and policy makers to plan, implement and monitor EIP activities. These are highlighted in Chapter 4 of this handbook. Sector-specific manuals on indicators and management systems may provide valuable guidance on procedures and systems that are relevant to an industrial park with a specific sectoral focus.

An important step in implementing any indicator system is to determine where and how to obtain the data. In some cases, the information may not yet have the desired level of detail and reliability, but this is something that could be addressed over time (e.g. by installing metering devices or improving procedures for data collection). Controlling data accuracy and procedures is crucial to ensure that the monitoring system functions well and that the results are valid and useable. Further, clear guidelines and data-collection procedures will save time and resources and ensure that the methods used for indicator construction, data collection and data processing are clear, transparent and replicable.

To ensure effective and efficient implementation, it is important for EIP performance monitoring and management systems to be embedded as much as possible into existing industrial park processes rather than developing entirely new systems. Although it may require an expansion of existing systems, integration with and expansion of existing indicator systems may be most efficient, since many of the necessary routines and approaches are already in place.

#### STEP 4: Performance monitoring and continuous improvement

---

Building on the outcomes of previous steps, the actual process of performance monitoring is initiated in this step (e.g. collection, validation, and processing of required data to feed established monitoring and management system). Performance monitoring alone does not lead to improvements. Performance improvement is possible through the application of EIP and RECP methods, practices and technologies. Implementation needs to be guided by data on the industrial park's economic, environmental and social performance.

Once industrial parks have started working with the monitoring system, there may be a need for more specific data for some indicators or to develop some new indicators. It may be that the indicator system does not sufficiently reflect improvements made by the industrial park(s). Another reason for expanding the monitoring system may be new demands from authorities or local communities to demonstrate efforts to decrease an industrial park's impact on the environment. To retain relevance and effectiveness, the monitoring system must be periodically reviewed to determine whether it is still adequate for measuring and improving the economic, environmental and social performance of the eco-industrial park and its tenant companies.

During formulation and implementation stages of EIP-related policies, a review framework needs to be set in place. Whilst administrative monitoring is important, industrial parks and governments may wish to broaden the scope of monitoring over time to include multi-stakeholder interests and organize the monitoring process in a more participatory manner to favor longer-term industrial development over short-term programme efficiency and outcomes. Ultimately, performance monitoring should inform future interventions in eco-industrial parks regarding whether to (adapted from (UNEP, 2015):

- a) Discontinue the EIP intervention because the problem has been satisfactorily resolved.
- b) Continue with similar interventions because they appear to be working although the problem remains and goals have not yet been fully achieved.
- c) Substantially redesign EIP interventions to address failure to achieve the goals.
- d) Redefine the challenges in light of experiences gained to date.



## GOOD PRACTICE EXAMPLE – International benchmarking:

Benchmarking of 33 industrial parks in 12 emerging and developing countries



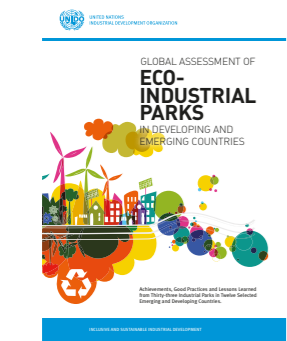
### Overview:

UNIDO documented and benchmarked 33 examples of industrial parks in 12 developing and emerging economies in a comparable manner, including their policy context. The relevant countries are Cambodia, China, Colombia, Costa Rica, Egypt, El Salvador, India, Morocco, Peru, South Africa, Tunisia and Viet Nam. The aim was to provide an in-depth comparative analysis of the results of the country case studies to better understand their environmental, social and economic benefits and associated performance levels.



### Important considerations:

The results show considerable variety among different cases, due to location, industry mix, ownership and various other factors. This variety reflects the wide range of conditions in which EIP development and monitoring takes place, and shows that it is challenging to benchmark the performance of industrial parks against each other. Further, governments have different approaches and different standards for eco-industrial parks. Not all parks designated as EIPs showed sufficient evidence that the minimum key features of EIPs were in place, including performance monitoring.



### Key activities:

- Evaluation of national policies: UNIDO documented and compared the national policy context of the industrial parks.
- Assessment of EIP components: UNIDO analyzed the key components and activities to transform these parks towards EIPs (e.g. park management and policy support).
- Assessment of the monitoring process in the 33 case studies: About half of the industrial parks investigated are currently monitoring their performance, and the other half will either take up monitoring responsibilities in future, subject to new regulations, or will not perform any monitoring tasks.

### Applied tools (not all-inclusive):

China has advanced on the use of monitoring and benchmarking indicators and tools for EIPs. For example:

- Shanghai Chemical Industry Economic and Technology Development Park monitors its achievements every year according to the National Standard for Sector-based Eco-Industrial Park, and reports to the Ministry of Environmental Protection (MEP). A voluntary yearly environmental report addressed to the residents surrounding the park and the employees improves the transparency, the involvement and supervision of the public.
- Dalian Development Area and Shenyang Development Area in China follow EIP guidelines set up under both environmental policy and circular economy policy. With part-overlapping and part-competing sets of indicators, it is not clear which goals to focus on. The underlying issue is that the responsible agencies have not yet coordinated and aligned their frameworks and indicators.

### Benefits to date:

The UNIDO study provided the following insights from the international benchmarking of industrial parks:

- Demonstrated environmental, economic, and social benefits achieved by industrial parks through EIP-related initiatives
- Provided a better understanding of common drivers and barriers faced by industrial parks in different countries
- Highlighted the role of governance, management and monitoring in development, implementation and ongoing operations of industrial parks
- Identified gaps and provided recommendations for EIP development and implementation in developing and transition countries

Source: UNIDO (2016a) and www.recipnet.org

## GOOD PRACTICE EXAMPLE – Performance monitoring:

Monitoring and impact assessments of the Kwinana Industrial Area



### Overview:

The Kwinana Industrial Area, located 40 km south of Perth, is one of Australia's largest strategic heavy industrial areas. The area is part of the Western Trade Coast which is a significant state asset in economic, environmental and social terms. The Kwinana Industries Council (KIC) and its member companies are committed to providing a high level of protection for the regional environment to ensure the health and safety of employees and the general community. Existing industrial synergies in Kwinana go well beyond business-as-usual and place Kwinana as a leading international example of industrial synergy development.



### Important considerations:

The Kwinana Industrial Area is located on the shore of the Cockburn Sound, a sensitive marine environment and recreational area for local residents. In addition to industrial sources of air emissions, there are other large sources of air contaminants from non-industrial emissions. It is therefore important that government, industry and the community work together to continue monitoring air quality in the region.

### Key activities:

- The original purpose of the KIC was to organize the required air and water monitoring collectively for the industries, in response to increased community pressure to manage industrial air- and watersheds, and to minimize harm to the sensitive marine environment in the adjacent Cockburn Sound.
- The KIC now addresses a far broader range of issues common to its members, and seeks to foster positive interactions between industry and the broader community.

### Applied tools (not all-inclusive):

The KIC and its industry members apply the following tools and approaches:

- Manage and report the air and water monitoring in the area through a network of monitoring stations
- Assess the environmental, social, and economic performance of the industrial area through detailed impact studies (e.g. 1990, 2002, 2007, 2014)
- Dedicated KIC committees address strategic issues (e.g. workforce and education, public affairs, public safety and emergency response, resource efficiency, planning and environment)

### Benefits to date:

The integrated assessment of the environmental, social and economic impacts (SKM and REU, 2013) highlight the benefits of the Kwinana Industrial Area and Western Trade Coast. These benefits include employment of 11,362 people directly (of which 64 per cent live locally), payment in A\$953 million in salaries, and significant contribution to the economy with direct sales of A\$14.7 billion per year.

Environmental issues (e.g. noise, air quality, societal risk, groundwater, marine environment) in and around the Kwinana Industrial Area are precisely monitored and well-managed. There is an extensive and highly integrated network of industrial synergies, with approximately 158 synergies between industries. The benchmarking of industrial synergies in the Kwinana Industrial Area shows that the area compares favorably with renowned international examples in terms of the current level and maturity of industry involvement and collaboration, and the commitment to further explore industrial synergies (Van Beers et al., 2007). New tenant companies are keen to participate in the industrial synergies.

Source: www.kic.org.au and (SKM and REU, 2013)

# G) CAPACITY BUILDING (cross-cutting activity)

The activities described until now must be accomplished by respecting a given schedule and following distinctive implementation steps. In contrast, capacity building requires a constant effort throughout the development of an eco-industrial park.

It is of key importance to upgrade technical and non-technical capacities of all stakeholders to successfully develop and implement EIP strategies. Capacity building measures may be as simple as making people aware of more efficient techniques, but others can require complex multi-stakeholder processes to work at the value chain or at the industrial park level. It is very important that women and other under-represented groups, such as youth, are given the opportunity to participate in and benefit from capacity building activities. Moreover, skills profiles within existing occupations are changing and capacity building must therefore adapt, for instance by accounting for innovative concepts and technological solutions such as industry 4.0 or circular economy. A combination of knowledge and skills are required to develop eco-industrial parks, including:

- **TRANSFORMATIONAL COMPETENCIES:** This is the ability to analyze complex and interdisciplinary systems across different domains and scales. Transformational competencies are key for almost all sustainable development strategies (and in particular EIP implementation).
- **TECHNICAL COMPETENCIES:** Technical knowledge and skills are obviously required to implement specific EIP approaches.

- **MANAGEMENT COMPETENCIES:** People with management skills can oversee the effective implementation of sustainable activities. They are able to build an enabling environment for change and also ensure that results are monitored and evaluated.

- **PARTICIPATORY COMPETENCIES:** These skills are required to promote and sustain cooperation, ownership and action. A person with participatory skills is able to create a welcoming and engaging environment that brings people and organizations together, encourages individuals to express diverse views, creates consensus and builds ownership over decisions made. The management of an EIP requires particularly high participatory competencies.

Depending on the competence required and the local context, capacity building can be organized by international organizations such as UNIDO or other organizations, consulting firms or academic institutions. Peer-to-peer learning is also an interesting option. A (non-exhaustive) list of the key capacities required by the principal stakeholders responsible for implementing EIPs can be found in Table 7.

Stakeholders	Capacity required	Type of competence
<b>Park operators and management</b>	Facilitation skills, as park management often plays a key coordination role in EIPs	Participatory and management competence
	Awareness of economic, environmental and social challenges and opportunities affecting industrial parks	Management and participatory competence
	Competence to ensure financial self-sustainability and raise funding for project implementation	Technical competence
	Stakeholder engagement and communication skills to represent the interests of the park (and of tenant companies) before other stakeholders	Participatory and technical competence
	Basic knowledge of RECP, community outreach and industrial synergies (assuming that another service provider has been mandated for leading the assessment)	Transformational and technical competence
	Basic competence in data collection and processing (e.g. through company input/output database), continuous improvement and learning processes for RECP solutions and industrial synergies	Transformational and technical competence
	Leadership skills to set up and maintain industrial park level performance monitoring systems	Management competence
	Set up and maintenance of best practices within company, including corrective actions and continuous improvement processes	Management competence

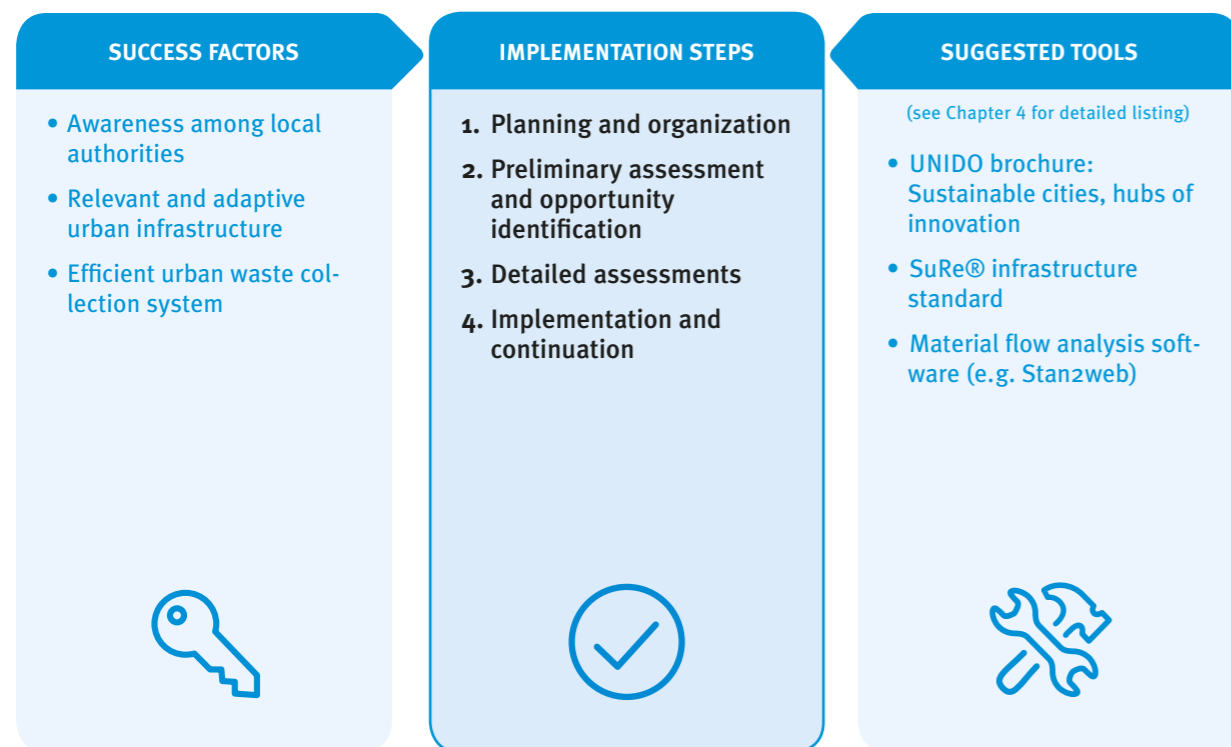
Stakeholders	Capacity required	Type of competence
<b>Park tenants</b> (industries & business)	Basic knowledge of economic, environmental and social benefits and issues of EIPs	Transformational and participatory competence
	Ability to calculate inputs and outputs of processes (materials, wastes, energy, water)	Technical competence
	Knowledge of industrial synergies in order to be able to participate in their assessment and implementation	Technical and participatory competence
	Ability and leadership skills to set up and maintain performance monitoring systems in the company	Technical and management competence
<b>Governments and regulators</b>	Engagement skills with key stakeholders in private and public sectors, including between different government agencies	Transformational and participatory competence
	Knowledge of local industrial and urban context, as well as existing and planned infrastructure (e.g. wastewater treatment plant). This is required to create connections between EIPs and sustainable cities (See Chapter 3)	Transformational and technical competence
	Leadership skills to set up and maintain performance monitoring systems in (eco-) industrial parks	Management competence
	Basic knowledge of EIP features and implications (particularly when regulatory aspects are concerned)	Management and technical competence
<b>Service providers</b> (operating shared infrastructure and performing RECP and industrial synergies assessment)	Facilitation and communication skills	Management and participatory competence
	Specific advanced technical knowledge (e.g. mechanical, electrical, chemical engineering), subject to selected focus areas of RECP and industrial synergy assessments	Technical competence
	Awareness of new and innovative technologies	Technical competence
	Multidisciplinary skills (technical, economic and social) to apprehend different aspects of cleaner production and to work jointly with other specialists. The evaluation of industrial synergies also requires knowledge in different industrial sectors.	Transformational and participatory competence

TABLE 7: Key capacity needs for EIP development (not all-inclusive)

# 3) CONTRIBUTION OF EIPs TO SUSTAINABLE CITIES

## MAIN OBJECTIVES

- Increase the profitability and efficiency of shared infrastructure
- Increase resource efficiency of municipalities and industries
- Increase well-being of local population



## RATIONALE

Environmental concerns are far from being limited to industrial activities. For instance, cities consume large amounts of energy and resources, and are responsible for approximately 75 per cent of CO<sub>2</sub> emissions (UNEP, 2011). Because of rapid urbanization, particularly in developing countries, it is expected that almost two-thirds of the world's population will live in cities by 2030 (UNIDO, 2016b). Cities allow decreasing environmental impacts per capita thanks to more efficient shared services, infrastructures, and resource supply and recycling systems (UN HABITAT, 2015). This is relatively similar to the effect of eco-industrial parks, which also reduce environmental impacts and increase resource efficiency of the industrial sector through supply chain, utility, by-product and service synergies (see Section e).

Work on eco-industrial parks may be extended beyond their physical boundaries to interact with neighboring industries, other industrial parks and municipalities/cities. Over the next decade, these linkages are likely to become even stronger through the expansion of cities and new industrial trends (e.g. circular economy, industry 4.0). Different terminology can be used to describe “sustainable cities”, with different nuances; “eco-town”, “eco-cities” “green cities” or “smart sustainable cities” are only a few examples (de Jong et al., 2015). To avoid confusion, this handbook uses the term “sustainable cities”, while recognizing that different terminology is used throughout the world.

The development and implementation of sustainable cities covers many facets (e.g. transportation networks and mobility, buildings, food systems, lifestyle, city planning, etc). Within the scope of this handbook, this chapter describes the possible contribution of eco-industrial parks to sustainable cities.

If “a sustainable city serves the best interest of industries” (UNIDO, 2016b), eco-industrial parks contribute largely to the development of such cities by providing joint infrastructures and industrial urban synergy options. Key contributions of eco-industrial parks to sustainable cities include:

- a) Common infrastructures and utilities servicing both residential and industrial developments (e.g. wastewater treatment plant, power supply, waste collection).
- b) Processing, recovery and recycling of the city's waste by industries (e.g. old tires as alternative fuel in cement plants, reprocessing of electronic waste).
- c) Use of reprocessed products (e.g. recycled wooden products, processed compost) and by-products from industries by surrounding municipalities (e.g. waste heat).



The term “urban industrial synergies” is used to describe these interlinkages between industries and cities/municipalities (see Figure 11).

An often published and well-known example of urban industrial synergies is found in Kalundborg, Denmark (Kalundborg Symbiosis, 2017). This example covers

many synergies, including the use of low temperature steam from a coal-fired power plant for district heating in the municipality (Sun et al., 2017). In addition to Denmark, other examples of urban industrial synergies can be found in Japan (Ohnishi et al., 2016; Van Berkel et al., 2009), Puerto Rico and China (Sun et al., 2017).

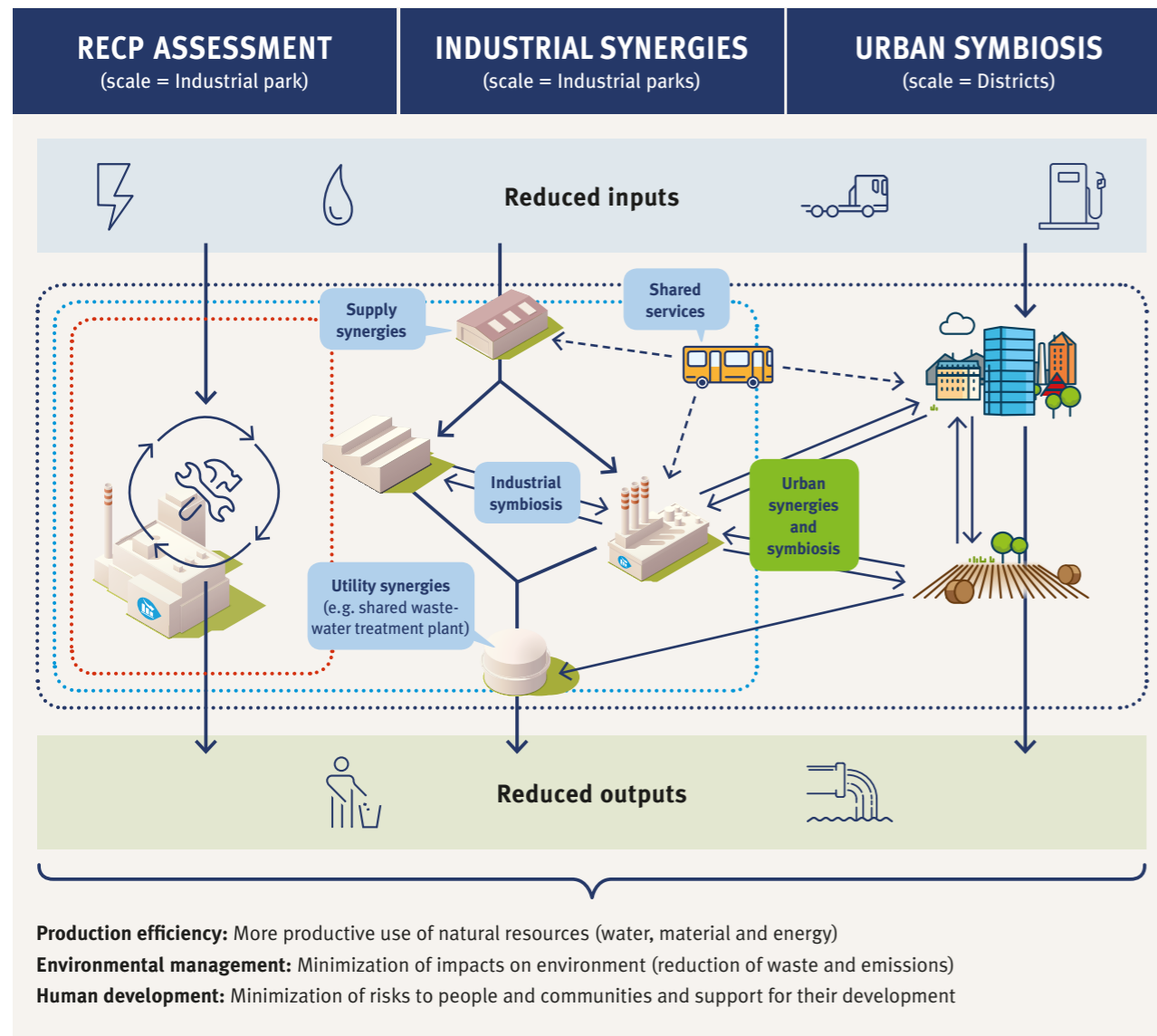


Figure 11: Integration of companies, industrial parks and cities

## OBJECTIVES

Both industrial parks and cities can benefit from collaboration. The objectives of extending EIP strategies to cities can be summarized as follows:

- Increase the profitability and efficiency of shared infrastructure, notably through economies of scale
- Increase resource efficiency and decrease the environmental impact of municipalities and industries through urban industrial synergies
- Increase well-being of local population and public acceptance of industrial development through optimized infrastructures, utility services and increased linkages between industries and cities

## APPLICABILITY

The contribution of eco-industrial parks (both greenfield and brownfield) to (sustainable) cities is of interest for park managers, individual companies, and utility service providers. The services offered by an eco-industrial park to a city (e.g. processing of city waste, sharing common infrastructures) can represent additional income revenues or reduce costs. The environmental and social benefits resulting from urban industrial synergies can also increase support from local communities. In addition to cities, industrial park managers may also be interested to create connections with neighboring industries (outside the park) and other industrial parks (if any). In addition, this chapter is particularly important for urban developers, local communities and authorities, especially municipalities and public service providers. Collaboration with an eco-industrial park can represent substantial opportunities for a city to develop more effective and efficient infrastructure and services.

## SUCCESS FACTORS

The development of urban industrial synergies is closely linked to the development of industrial synergies within an industrial park. Therefore, the success factors outlined in Section e are applicable to this chapter as well:

- **TECHNICAL:** Expertise, viable technology and equipment, diversity of industries, feasible distances.
- **ECONOMIC:** Return on investment, recognize full set of benefits, access to finance.
- **SOCIO-POLITICAL:** “License to operate”, trust and enabling environment.

Specific success factors for eco-industrial parks’ contribution to (sustainable) cities are:

- **AWARENESS AMONG LOCAL AUTHORITIES AND COMMUNITIES:** Awareness raising is crucial because local authorities will probably make the final decision to develop urban industrial synergies according to citizen support. It is very important to involve communities to ensure that they will use services offered by the EIP. In addition, the behavior of the population can have a significant influence on the success of urban industrial synergies, notably when waste must be (correctly) separated at source, in households. Therefore, diverse activities (e.g. conferences, workshops, distribution of flyers, etc.) should be accomplished during the whole lifecycle of the project to ensure that every stakeholder underpins urban industrial synergies.
- **RELEVANT AND ADAPTIVE URBAN INFRASTRUCTURE:** Planning of urban infrastructures must be flexible enough to accommodate urban industrial synergies. For example, when waste processing facilities are designed to handle large quantities of materials, there may be resistance to innovative recycling solutions that will reduce the “feedstock” of these facilities.
- **EFFICIENT URBAN WASTE COLLECTION SYSTEM AND WASTE CHARACTERIZATION:** An efficient collection system of wastes generated in a city is an important success factor to enable effective urban industrial synergy solutions. Further, the population has a strong influence on waste quality through source separation. Therefore, the characterization of municipal waste streams (e.g. organic wastes, recyclables, mixed municipal solid waste, domestic effluent streams) is essential to allow revalorization in industrial parks (Dong et al., 2013).

## IMPLEMENTATION STEPS



As highlighted earlier in this chapter, key contributions of eco-industrial parks to sustainable cities relate to urban industrial synergies, including common infrastructures and utilities servicing both residential and industrial developments, processing, recovery and recycling of city waste by industries and use of (by-) products from industries by surrounding municipalities. Within the scope of this handbook, the implementation steps for EIP contributions to sustainable cities are therefore very similar to the steps to develop industrial synergies as presented in Section e.

### Step 1: Planning and organization

The first step is devoted to obtaining management and funding commitments, and allocating tasks and responsibilities for the project to explore EIP contributions to (sustainable) cities. It is important to review the success factors in their local context. International experiences indicate that industrial parks (e.g. park managers, industries) and cities are not always aware of their potential to create partnerships to develop urban industrial synergies together. Therefore, awareness should be raised to secure the interest and commitment of the relevant stakeholders.

### Step 2: Preliminary assessment and opportunity identification

The objective of the preliminary assessment is to collect base data from the city, the industrial park(s) and tenant companies as well as generate a list of potential opportunities for urban industrial synergies and other contributions the industrial park could possibly make to the (sustainable) city.

As part of the preliminary assessment of urban industrial symbiosis opportunities, the data collection should cover the following (not all-inclusive list):

City:

- Capacities of available and planned infrastructures and utility services (e.g. logistics and transportation, water supply and treatment, waste collection and processing, energy supply)

- Current and projected quantities and composition of different waste types generated in the city (specified by key geographic locations)
- Current and projected city demands for water, energy, and industrial (by-) products (specified by geographic locations and urban planning)
- Current and projected demands for community services (e.g. skills development, science and research centres, occupational health care and child care)

#### Industrial park and companies:

- Capacities of available and planned infrastructures and utility services in industrial park
- Current and projected needs of industries for materials, energy and water
- Current and projected generated quantities and qualities of industry outputs (e.g. effluents, waste heat, by-products)

Based on the collected preliminary data outlined above, the identification of urban industrial synergies can be identified through the following means:

- Discussions with representatives of local authorities (responsible for city infrastructure) and possibly park managers, industries and those responsible for the park infrastructures (bilateral meetings or in workshop setting)
- Matching inputs (e.g. raw materials use, water and energy demands) and outputs (e.g. wastes and by-products, effluent streams, waste heat) from companies within the industrial park and the city
- Review of international experiences, good practices and case studies in urban industrial synergies
- Analysis of existing and potential utility services and common infrastructures, taking a holistic view of the area where the industrial park and city are located

### Step 3: Detailed assessments

Not all identified potential EIP contributions to (sustainable) cities from the previous step will be feasible or provide significant benefits to the companies or the city. Therefore, a consolidation and prioritization exercise is normally undertaken to arrive at concrete opportunities, after which a detailed feasibility study can eliminate any “blue sky” opportunities which are not

realistic and feasible from the start.

The involvement of a city implies expanding the social components of these assessments to evaluate the positive and potential negative impacts of interventions on the city population. As opportunities become more concrete in this step, it is important to engage the local communities to obtain their views and address concerns they may have regarding the implementation. It is likely that communities will have practical suggestions to further enhance the development and implementation of the initiative.

Below are some illustrative examples of potential EIP contributions to (sustainable) cities.

#### Utility synergies between industrial park and city:

- **WASTE PROCESSING AND TREATMENT:** Instead of investing in the construction of a (costly) waste incinerator, cities can benefit from the presence of industries to valorize the energy content of their waste, because industries are often equipped with furnaces and facilities for exhaust gas treatment (Fujii et al., 2016).
- **WASTEWATER TREATMENT:** Industrial parks and cities can benefit from shared wastewater treatment systems. Arrangements should be in place to monitor the water quality feeding in and out of the treatment plant. There may be opportunities to reuse the processed effluent from these shared facilities for industrial processes, irrigation, or groundwater recharge.
- **TRANSPORTATION:** Industrial parks and cities could collaborate to optimize existing transportation systems.
- **EMERGENCY RESPONSE SERVICES:** Cities can benefit from emergency services and facilities present in industrial parks.
- **SOCIAL INFRASTRUCTURE AND SERVICES:** Provision of critical social infrastructure workers in industrial parks as well as people living in local municipalities (e.g. medical services, lavatories, day-care, local shops, banking facilities, education centres).

#### By-product and waste synergies between industrial park and city:

- **ORGANIC WASTE:** Organic waste collected from households and industrial parks can be processed collectively (e.g. biogas production, composting).
- **RECYCLABLES:** Separation and processing of recy-

clables (e.g. plastics, metals, glass, electronic waste, and paper) collected from households in nearby industrial parks.

- **COMBUSTIBLE WASTES:** Reuse of combustible waste (e.g. end-of-life tires, spent solvent, etc.) as alternative fuel in cement plants.
- **WASTE HEAT:** Power plants and other companies with combustion processes may have excess waste heat which could be used by municipalities for district heating.

#### Social and community initiatives between industrial park and community/city:

Eco-industrial parks also have positive impacts through the provision of extended services and local initiatives to neighboring communities and/or cities. Such initiatives are important to create a truly inclusive environment that also generates social cohesion and benefits. In this regard, park management in cooperation with tenant companies should prioritize some programmes that support local communities living near the park surroundings (e.g. day care facilities; support of local cultural events). Some additional examples are listed below:

- **SOCIAL MANAGEMENT SYSTEMS:** Locally specific management systems are required at the park level to address relevant social aspects and impacts, such as operational health and safety or grievance management inside and outside the industrial park. These systems should be based on a continuous improvement process approach and can be jointly managed by the park unit and local authorities.
- **EDUCATION:** Provision of vocational training and skills development centres for city inhabitants, customized to the needs of nearby industrial parks to facilitate local jobs.
- **RESEARCH CENTRES:** Nearby industrial parks highly benefit from a research centre or university informing them of current trends and future developments.
- **SECURITY AND CRIME:** Collaboration between the city and the industrial park can improve security and address crime in the region.

• **Step 4: Implementation and continuation**

The implementation of urban industrial synergies is often a complex matter which needs to be carefully assessed from economic, environmental and social perspectives. The participation of local authorities in the development of common infrastructures generally reduces the risks to investors.

Implementing urban industrial synergies is subject to government approval processes and often community consultation as well, in particular when large investments are involved. These processes must be carefully managed to avoid unrealistic expectations and ensure successful implementation.

The implementation of urban industrial synergies and EIP contributions to sustainable cities need to be reviewed periodically and optimized when/where needed, as any city and industrial park is in constant evolution. For example, cities and industrial parks can expand; rapid technology developments influence investment decisions; priorities of government, industries and people change over time; and specific resources (e.g. water, energy, raw materials) can become scarcer and thereby more expensive. The urbanization trend in the area must be carefully monitored and predicted, in order to avoid unwelcome surprises and properly adapt the capacity of shared infrastructure. For instance, the planning of a shared wastewater treatment plant should account for an expected increase of the density of local population and increasing number of companies in the industrial park.

**GOOD PRACTICE EXAMPLE – Contribution of EIPs to sustainable cities:**



**Resource Efficient and Cleaner Production (RECP) pilot project to foster eco-industrial development in Morocco: Zenata Eco-City project**

**Overview:**

Zenata is an area of approximately 1,830 acres located near Casablanca, the economic capital of Morocco. The construction of a sustainable city in Zenata started in 2006, when a dedicated company (Société d'Aménagement Zenata or SAZ) was set up to conceptualize, plan and implement the Zenata Eco-City project.

In this project, UNIDO focuses on two industrial parks located near Zenata, namely Zenata Industrial Park (an area designed to host existing industries previously scattered in the area) and Zenata Cyclopolis - Benichou area (greenfield park reserved for future industrial activities). Zenata Cyclopolis - Benichou area is particularly well-positioned to create a hub of recycling industries which allows urban industrial synergies with Zenata Eco-City.



**Important considerations:**

Morocco has experienced significant demographic and urbanization growth during recent decades. To address sustainability-related issues from this trend, Morocco has established various urban planning programmes. These programmes include the establishment of new cities in the country, including Zenata. To offer a good quality of life for inhabitants, Zenata has been designed as an eco-city to manage environmental impacts while addressing socio-economic issues.

**Key activities:**

- Meetings, presentations and workshops, raising awareness about advantages of RECP and the EIP approach
- Evaluation of companies currently scattered in the area on their potential for urban industrial synergies
- Estimation of projected inputs and outputs for Zenata Eco-City (e.g. the amount of municipal solid waste that will be generated by the city)
- Assistance for the development of Zenata Industrial Park, including strategic advice on infrastructure options, park management models and addressing social issues

**Applied tools (not all-inclusive):**

- Customized materials for awareness raising on eco-industrial parks and RECP strategies (both for the existing and future industrial parks)
- Customized methodology for identification of urban industrial synergies

**Benefits to date:**

The Zenata Industrial Park is now (in 2017) ready for industries to move to the park. Shared infrastructure (e.g. roads, energy distribution, sewerage systems) has been built and will enhance the competitiveness of companies. Zenata Cyclopolis - Benichou area is currently in planning and design phase. Awareness raising activities have created an interest from park stakeholders to develop environmentally friendly technologies.

Source: (SAZ, 2017)



# 4) IMPLEMENTATION TOOLS



Building on the approaches discussed in previous chapters, the table below presents a set of publicly available tools to assist with the implementation of eco-industrial parks, including website links for direct access.



Scoping EIP interventions	EIP awareness raising	EIP policy support	Park management models	Upscaling resource efficiency & industrial synergies/ symbiosis	Performance monitoring & benchmarking	Contribution of EIPs to sustainable cities
---------------------------	-----------------------	--------------------	------------------------	---	---------------------------------------	--

Manuals & guidelines	Short description of tool	How can the tool assist?						Reference
Enterprise-level indicators for resource productivity and pollution intensity: A primer for small and medium-sized enterprises	Primer provides a transparent framework for documenting enterprise-level RECP results that is widely applicable to SMEs in developing and transition countries. The primer provides a core set of indicators for enterprise-level resource productivity and pollution intensity, and explains how these indicators can be applied and how they can be used to initiate RECP and document its results.		✓			✓	✓	(UNIDO and UNEP, 2010) <a href="http://www.recpnet.org">www.recpnet.org</a>
Practitioner's guide to strategic green industrial policy	Guide provides decision makers with the necessary tools and information to steer through this very necessary transition, and develop a strategic green industrial policy (SGIP) that reflects their country's own unique ecological, economic and social context as well as aspirations.		✓	✓				(PAGE, 2016a) including UNIDO, UNEP, ILO, UNDP, UNITAR; <a href="http://www.un-page.org/practitionersguide">www.un-page.org/practitionersguide</a>
Technical note on growth identification and facilitation for industrial upgrading and diversification (GIFIUD)	Technical note to assist governments in lower income developing countries with systematic industrial sector targeting and focused public policy and programmes to support targeted sectors to help developing countries accelerate industrialization.	✓		✓				(UNIDO, 2015) <a href="http://isid.unido.org">isid.unido.org</a>
Sustainable consumption and production: A handbook for policymakers – Global edition	Handbook to assist policymakers to develop, implement, monitor and evaluate policies that support the transition towards sustainable consumption and production. It details specific thematic opportunities for policy development including cleaner and safer production, sustainable lifestyles, sustainable cities and sustainable public procurement.		✓	✓		✓	✓	(UNEP, 2015) <a href="http://sustainabledevelopment.un.org">sustainabledevelopment.un.org</a>
Promoting resource efficiency in small and medium sized enterprises (PRE-SME)	Industrial training handbook and resource kit for enhancing developing countries' capacities to assist SMEs to develop and implement cleaner, safer and resource efficient production programmes that will result in reduced manufacturing costs, lower pollution and improved health and safety performance.					✓		(UNEP, 2010) <a href="http://www.stenum.at">www.stenum.at</a>





Scoping EIP interventions	EIP awareness raising	EIP policy support	Park management models	Upscaling resource efficiency & industrial synergies/symbiosis	Performance monitoring & benchmarking	Contribution of EIPs to sustainable cities
---------------------------	-----------------------	--------------------	------------------------	--	---------------------------------------	--

Specific tools & software	Short description of tool	How can the tool assist?						Reference	
CII-Sohrabji Godrej Green Business Centre methodology for pre-assessment of industrial parks	Evaluation methodology including checklist to rate parks on diverse parameters and thus compare parks or prioritize intervention.	✓						(UNIDO, 2017). Available upon request. See contact details under “Questions or need support?” (CII – Godrej GBC, 2016) <a href="http://www.greenbusinesscentre.com">www.greenbusinesscentre.com</a>	
EIP development planning	The development plan of an eco-industrial park will be a table (usually Excel) listing the activities undertaken by management and allocating budget, responsibilities and timeline. It should provide indicators or milestone for each activity.	✓			✓		✓	Tool example: (Tools4Dev, 2017) <a href="http://www.tools4dev.org">www.tools4dev.org</a>	
Financial sustainability planning	This tool allows EIP management to plan the allocation of resources (e.g. finance, human resources, materials). It can be in the form of a separate tool, usually an Excel table such as Fintool, or be integrated in a robust accountancy programme.				✓		✓	Tool example: (CimArk SA, 2014) <a href="https://fintool.ch/">https://fintool.ch/</a> <a href="http://www.cfcaq.ch/fintool/">www.cfcaq.ch/fintool/</a> <a href="http://www.cimark.ch/en/">www.cimark.ch/en/</a>	
Business planning	Business plan that sets out systematically and clearly how EIP management business ideas will be implemented, what resources will be required, and what results can be expected by when. It is an essential planning tool for acquiring future business partners such as investors, employees, suppliers or banks. It is informed by other tools such as development, market segmentation and financial sustainability plans.				✓			Tool examples: (Crédit Suisse, 2017) <a href="https://business-easy.credit-suisse.com">https://business-easy.credit-suisse.com</a> (Business Development Bank of Canada, 2017) <a href="https://www.bdc.ca">https://www.bdc.ca</a>	
RECP indicator calculation tool	Tool enables companies to track their performance, calculate results and present their RECP profiles.					✓	✓	(UNIDO and UNEP, 2010) <a href="http://www.unido.org/cp">www.unido.org/cp</a>	
Eco-industrial development toolbox	Eco-industrial development (EID) is a strategy to promote sustainable industrial development, tackling environmental, economic and social aspects in a balanced manner. Toolbox covers new industrial parks, industrial area transformation, company improvement, management structures and climate change.	✓	✓		✓	✓	✓	(GIZ, 2017) <a href="http://www2.giz.de">http://www2.giz.de</a>	
SuRe® infrastructure standard	This standard is focused on sustainable and resilient infrastructure. The tool relies on independent verification and certification by third parties.	✓				✓	✓	(Global Infrastructure Basel, 2017) <a href="http://www.gib-foundation.org/sure-standard/">www.gib-foundation.org/sure-standard/</a>	
Cleaner production toolkit	Train the trainer toolkit to support trainers in the field of cleaner production by providing technical support and trainings on the UNIDO holistic and sectoral CP strategy.					✓		(UNIDO, 2008) <a href="http://www.unido.org">www.unido.org</a>	
Stanzweb	Software to map resources flows/stocks (material flow analysis)	✓				✓		✓	(Cencic and Rechberger, 2008) <a href="http://www.stanzweb.net/">http://www.stanzweb.net/</a>
Umberto®	Software to analyze resource and material flows/stocks. Different packages exist, including: carbon footprint, life-cycle assessment and efficiency software.	✓				✓	✓	✓	(Institut für Umweltinformatik, 2017) <a href="https://www.ifu.com/en/umberto/">https://www.ifu.com/en/umberto/</a>



Scoping EIP interventions	EIP awareness raising	EIP policy support	Park management models	Upscaling resource efficiency & industrial synergies/symbiosis	Performance monitoring & benchmarking	Contribution of EIPs to sustainable cities
---------------------------	-----------------------	--------------------	------------------------	--	---------------------------------------	--

Overall approaches	Short description of tool	How can the tool assist?						Reference
Lean management	The transformation from the old way to lean thinking can be supported by a range of tools from diagrams, charts, tables addressing processes, work planning, root cause diagrams, etc. Lean thinking changes the focus of management from optimizing separate technologies, assets, and vertical departments to optimizing the flow of products and services through entire value streams that flow horizontally across technologies, assets, and departments to customers (Lean Enterprise Institute, 2017).				✓			(SmartDraw, 2017) <a href="http://www.smartdraw.com/lean/">www.smartdraw.com/lean/</a> (Lean Enterprise Institute, 2017) <a href="https://www.lean.org/WhatsLean/">https://www.lean.org/WhatsLean/</a>
Project management and programme management	This e-book presents various concepts and instruments for project/business management that are applicable to EIP management.				✓			(Wallace, 2017) <a href="http://www.epmbook.com">www.epmbook.com</a>
Management approach for global reporting	International standards including general requirements and disclosures for reporting the management approach for material topics. These standards are designed to be used by organizations to report their impacts on the economy, environment, and society.					✓		(GRI, 2016) <a href="http://www.globalreporting.org/">www.globalreporting.org/</a>



Information materials	Short description of tool	How can the tool assist?						Reference
Eco-industrial park: Creating shared prosperity and safeguarding the environment	Pocketbook. Concise information (e.g. definition, presentation of case studies) about EIPs, and the UNIDO programme.		✓					
Presentation of eco-industrial parks: Case studies	Power Point presentation. Useful for raising awareness (e.g. park managers, official government).		✓					
Environment live	Online database provides open access to information and knowledge on the environment at the global, regional and national levels. It includes resource efficiency indicators, featuring 26 countries in the Asia-Pacific region and 40 years of resource use.					✓		(UNEP, 2017) <a href="http://uneplive.unep.org">http://uneplive.unep.org</a>
Sustainable cities: Hubs of innovation, low carbon industrialization and climate action	Brochure presenting the UNIDO programme for sustainable cities. Useful for framing possible UNIDO interventions (e.g. enabling policy and institutional mechanisms, innovation and technology transformation, etc.)						✓	(UNIDO, 2016b) <a href="https://www.unido.org/">https://www.unido.org/</a>

## QUESTIONS OR NEED SUPPORT?

Support and advice on the development and implementation of eco-industrial parks is available from UNIDO. The types and intensity of support will depend on the specific local needs and the local context of the industrial park. UNIDO welcomes the opportunity to discuss options and available support on eco-industrial parks with interested stakeholders.

UNIDO and UNEP-supported National Cleaner Production Centres are present in many countries. You can find the contact details of these centres at the following link: [www.recpnet.org](http://www.recpnet.org)

For questions and technical advice on the implementation of eco-industrial parks, feel to get in touch with us:

**Smail Alhilali**  
Programme Manager  
Department of Environment  
UNIDO, Vienna, Austria  
[s.alhilali@unido.org](mailto:s.alhilali@unido.org)  
[www.unido.org](http://www.unido.org)



## REFERENCES

- Business Development Bank of Canada, 2017.** Business plan template for entrepreneurs. Available from [www.bdc.ca/en/articles-tools/entrepreneur-toolkit/templates-business-guides/pages/business-plan-template.aspx](http://www.bdc.ca/en/articles-tools/entrepreneur-toolkit/templates-business-guides/pages/business-plan-template.aspx). Accessed 12 July 2017.
- Cencic, O., Rechberger, H., 2008.** Material flow analysis with software STAN. *J. Environ. Eng. Manag.* 18, 3.
- Chertow, M.R., 2000.** Industrial symbiosis: literature and taxonomy. *Annu. Rev. Energy Environ.* 25, 313–337.
- CII – Godrej GBC, 2016.** RECP pilot project to foster eco-industrial development in eco-industrial parks in India. Confederation of Indian Industry.
- CimArk SA, 2014.** Fintool V8.1. Available from <https://fintool.ch/>. Accessed 11 July 17.
- CNPML, 2017.** Centro Nacional de Producción Más Limpia. Available from [www.cnpml.org/](http://www.cnpml.org/). Accessed 5 July 2017.
- Crédit Suisse, 2017.** Business plan: Business easy. Available from [https://business-easy.credit-suisse.com/en/starting-a-company/preparation/business-plan?aa\\_cmp=psrc\\_pbch\\_ch\\_na\\_na\\_buinesseasy\\_yp\\_cpc\\_goog\\_textlink\\_eng\\_genbudplan\\_y00176&gclid=CPSOhv2W8tQCFQ8TGwodhboEOg](https://business-easy.credit-suisse.com/en/starting-a-company/preparation/business-plan?aa_cmp=psrc_pbch_ch_na_na_buinesseasy_yp_cpc_goog_textlink_eng_genbudplan_y00176&gclid=CPSOhv2W8tQCFQ8TGwodhboEOg). Accessed 12 July 2017.
- de Jong, M., Joss, S., Schraven, D., Zhan, C., Weijnen, M., 2015.** Sustainable smart resilient low carbon eco-knowledge cities: Making sense of a multitude of concepts promoting sustainable urbanization. *Spec. Issue Regen. Sustain. Paradigm Built Environ. Vis. Real.* 109, 25–38. doi:10.1016/j.jclepro.2015.02.004
- Dong, L., Fujita, T., Zhang, H., Dai, M., Fujii, M., Ohnishi, S., Geng, Y., Liu, Z., 2013.** Promoting low-carbon city through industrial symbiosis: A case in China by applying HPIMO model. *Energy Policy* 61, 864–873. doi:10.1016/j.enpol.2013.06.084.
- East London IDZ SOC Ltd, 2017.** East London IDZ SOC Ltd. Available from [www.elidz.co.za/](http://www.elidz.co.za/). Accessed 6 July 2017.
- Francis, C., Erkman, S., 2001.** Environmental management for industrial estates: Information and training resources. Paris Fr. U. N. Environ. Program Div. Technol. Ind. Econ.
- Fujii, M., Fujita, T., Dong, L., Lu, C., Geng, Y., Behera, S.K., Park, H.-S., Chiu, A.S.F., 2016.** Possibility of developing low-carbon industries through urban symbiosis in Asian cities. *Post Foss. Carbon Soc. Regen. Prev. Eco-Ind. Dev.* 114, 376–386. doi:10.1016/j.jclepro.2015.04.027.
- GCPC, 2017.** RECP pilot project to foster eco-industrial development in eco-industrial parks in India at Dahej. Gujarat Cleaner Production Centre.
- GIZ, 2017.** Eco-industrial development toolbox.
- GIZ, 2015.** Guidelines for sustainable industrial areas, Version 1.0 (October). Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Eschborn, Germany.
- Global Infrastructure Basel, 2017.** SuRe@: Standard for sustainable and resilient Infrastructure. Available from [www.gib-foundation.org/sure-standard/](http://www.gib-foundation.org/sure-standard/). Accessed 13 July 2017.
- GreenCape, 2017.** Western Cape Industrial Symbiosis Programme. Available from <http://greencape.co.za/wisp/>. Accessed 6 July 2017.
- GRI, 2016.** Management approach for global reporting.
- Gujarat Government, 2017.** Business: Industrial parks. Available from [www.gujaratindia.com/business/indus-parks.htm](http://www.gujaratindia.com/business/indus-parks.htm). Accessed 13 July 2017.
- Hewes, A.K., Lyons, D.I., 2008.** The humanistic side of eco-industrial parks: Champions and the role of trust. *Reg. Stud.* 42, 1329–1342. doi:10.1080/00343400701654079.
- Institut für Umweltinformatik, 2017.** Sustainable engineering with Umberto. Available from [www.ifu.com/en/umberto/](http://www.ifu.com/en/umberto/). Accessed 19 May 2017.
- Kalundborg Symbiosis, 2017.** Kalundborg symbiosis. Available from [www.symbiosis.dk/en](http://www.symbiosis.dk/en). Accessed 12 June 2017.
- Lean Enterprise Institute, 2017.** What is lean?. Available from [www.lean.org/WhatsLean/](http://www.lean.org/WhatsLean/). Accessed 13 July 2017.
- Lowe, E.A., 2001.** Eco-industrial parks: A handbook. Asian Development Bank, Manila, Philippines.
- Massard, G., Jacquat, O., Zürcher, D., 2014.** International survey on eco-innovation parks: Learning from experiences on the spatial dimension of eco-innovation. FOEN.
- McKinsey, 2014.** The lean management enterprise: A system for daily progress, meaningful purpose, and lasting value.
- Moreau, V., Sahakian, M., van Griethuysen, P., Vuille, F., 2017.** Coming full circle: Why social and institutional dimensions matter for the circular economy. *J. Ind. Ecol.* 21, 497–506. doi:10.1111/jiec.12598.
- Ohnishi, S., Fujii, M., Fujita, T., Matsumoto, T., Dong, L., Akiyama, H., Dong, H., 2016.** Comparative analysis of recycling industry development in Japan following the Eco-Town programme for eco-industrial development. *J. Clean. Prod.* 114, 95–102.
- PAGE, 2016a.** Partnership for action on green economy: Practitioner's guide to strategic green industrial policy.
- PAGE, 2016b.** Partnership for action on green economy: Guidance note on learning for an inclusive green economy.
- SAZ, 2017.** Eco-Cité Zenata (Société d'Aménagement Zenata). Available from <http://www.zenataecocity.ma/>. Accessed 7 July 2017.
- SKM, REU, 2013.** Western Trade Coast integrated assessment: Environmental, social, and economic impact.
- SmartDraw, 2017.** Lean methodology diagrams and templates. Available from [www.smartdraw.com/lean/](http://www.smartdraw.com/lean/). Accessed 12 July 2017.
- Sun, L., Li, H., Dong, L., Fang, K., Ren, J., Geng, Y., Fujii, M., Zhang, W., Zhang, N., Liu, Z., 2017.** Eco-benefits assessment on urban industrial symbiosis based on material flows analysis and emergy evaluation approach: a case of Liuzhou city, China. *Resour. Conserv. Recycl.* 119, 78–88.
- Tools4Dev, 2017.** Practical tools for international development: Work plan template. Available from [www.tools4dev.org/resources/work-plan-template/](http://www.tools4dev.org/resources/work-plan-template/). Accessed 12 July 2017.
- UN HABITAT, 2015.** Habitat III issue papers: 16: Urban ecosystems and resource management.
- UNEP, 2017.** Environment Live. Available from <http://uneplive.unep.org>.
- UNEP, 2015.** Sustainable consumption and production (Global edition): A handbook for policy makers.
- UNEP, 2011.** Green economy report. Chapter 12 on Cities, in Green Economy Report. United Nations Environment Programme.
- UNEP, 2010.** PRE-SME: Promoting resource efficiency in small and medium sized enterprises: Industrial training handbook.
- UNEP, 2008.** SCP indicators for developing countries: A guidance framework.
- UNEP, 2001.** Environmental management of industrial estates in China. Environmental Planning Institute for UNEP and SEPA, China.
- UNIDO, 2017.** Resource Efficient and Cleaner Production. Available from <https://www.unido.org/cp/05153.html>. Accessed 30 June 2017.
- UNIDO, 2016a.** Global assessment of eco-industrial parks in developing and emerging countries: Achievements, good practices and lessons learned from thirty-three industrial parks in twelve selected emerging and developing countries. United Nations Industrial Development Organization, Vienna, Austria.
- UNIDO, 2016b.** Sustainable cities: Hubs of innovation, low carbon industrialization and climate action.
- UNIDO, 2015.** Technical note on the analytical framework of GIFUOD (Growth identification and facilitation for industrial upgrading and diversification).
- UNIDO, 2008.** Cleaner production toolkit.
- UNIDO, UNEP, 2010.** Enterprise-level indicators for resource productivity and pollution intensity: A primer for small and medium-sized enterprises.



**Van Beers, D., 2009.** Application of the cleaner production framework to the development of regional synergies in heavy industrial areas: a case study of Kwinana (Western Australia). Curtin University of Technology, Perth, Australia.

**Van Beers, D., Corder, G., Bossilkov, A., van Berkel, R., 2007.** Industrial symbiosis in the Australian minerals industry: The cases of Kwinana and Gladstone. *J. Ind. Ecol.* 11.

**Van Berkel, R., 2006.** Regional resource synergies for sustainable development in heavy industrial areas: An overview of opportunities and experiences. Curtin University of Technology, Perth, Australia.

**Van Berkel, R., Fujita, T., Hashimoto, S., Fujii, M., 2009.** Quantitative assessment of urban and industrial symbiosis in Kawasaki, Japan.

**Wallace, S., 2017.** Project management and programme management. Available from [www.epmbook.com/](http://www.epmbook.com/). Accessed 23 June 2017.

**WBG, 2016.** Mainstreaming eco-industrial parks. World Bank Group, Washington, USA.

**WBG, 2014.** Low-carbon zones: A practitioner's handbook. World Bank Group, Investment Climate Department, Washington, USA.

