> International survey on eco-innovation parks

Learning from experiences on the spatial dimension of eco-innovation

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Authors
Guillaume Massard; SOFIES, Olivier Jacquat, Daniel Zürcher; Innovation Section, FOEN

With contributions from
Marie-Laure Pesch, Lucia Wagner, Daniel Hürlimann, Kevin Kohler, Ramon Wyrsch, Oliver Mathys (FOEN); Luc Jaquet, Ana Gonseth, Clément Guyot, Charlotte Thévenet, Frédéric Sciacca, Jérôme Laffely (SOFIES); Pinar Aker (TUBITAK); Suren Erkman (Lausanne University); Frank Boons, Wouter Spekkink (Erasmus University Rotterdam); Ralf Isenmann (Munich University of Applied Sciences); Leenard Baas, Mats Eklund (Linkoping University); Sabrina Brullot (Troyes University); Pauline Deutz (Hull University); Elena Romero Arozamena (Universtiy of Cantabria); Veerle Verguts (ILVO); Gijsbert Korevaar, Chris Davis (Delft University); Noel Brings Jacobsen (Roskilde University); Ines Costa (Instituto Superior Técnico)

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> Table of Contents

> Abstracts

Eco-innovation strategies have been developed during the last two decades in many regions and countries to foster economic development and reduce environmental impacts. This study presents lessons learned from experiences on eco-innovation parks, encompassing sustainable industrial and urban projects at the park or district scale. Based on a defined set of eco-criteria, different combinations of environmental measures, business models and integrated developments leading to economic, environmental and social gains for the park and its surroundings have been identified.
Best practices and success factors are analyzed for 168 eco-innovation parks detailed for 27 countries. These case studies distributed among 18 European and 9 non-European countries highlight a set of positive impacts and feedbacks from existing or planned eco-innovation parks. Lessons learned from best practices are summarized and recommendations are made to advise park developer, operators and stakeholders on how to design and manage industrial parks or urban areas towards eco-innovation.

Keywords:
eco-innovation, industrial park, industrial ecology, best practices, success factors

In den letzten zwei Jahrzehnten wurden in vielen Regionen und Ländern Öko-Innovationsstrategien erarbeitet, um die wirtschaftliche Entwicklung zu fördern und Umweltbelastungen zu reduzieren. Diese Studie enthält die Erkenntnisse aus Erfahrungen bezüglich Öko-Innovationspärken, die nachhaltige industrielle und urbane Projekte auf Park- oder Stadtteilebene umfassen. Auf der Grundlage definierter Öko-Kriterien wurden verschiedene Kombinationen von Umweltmassnahmen, Geschäftsmodellen und integrierter Entwicklung ermittelt, die zu wirtschaftlichen, ökologischen und sozialen Vorteilen für den Park und dessen Umgebung führen.
Für 168 Öko-Innovations-Pärke in 27 Ländern wurden bewährte Praktiken und Erfolgsfaktoren analysiert. Diese Fallstudien, die sich auf 18 europäische und 9 nichteuropäische Länder verteilen, heben eine Reihe von positiven Auswirkungen und Rückmeldungen für bestehende oder geplante Öko-Innovationspärke hervor. Die Erkenntnisse aus den bewährten Praktiken werden zusammengefasst, und es werden Empfehlungen abgegeben, wie Entwickler, Betreiber und Anspruchsgruppen eines Parks in Bezug auf die Gestaltung und Führung von Industriepärken oder städtischen Gebieten auf dem Weg zur Öko-Innovation beraten werden können.

Stichwörter:
Öko-Innovation, Industriepark, industrielle Ökologie, bewährte Praktiken, Erfolgsfaktoren

Au cours des vingt dernières années, des stratégies d'éco-innovation visant à favoriser le développement économique tout en réduisant les incidences sur l'environnement ont été formulées dans divers pays et régions. Cette étude présente les enseignements tirés de projets existants de parcs d'éco-innovation (projets industriels et urbains durables à l'échelle d'un parc industriel ou d'un quartier). Elle recense, sur la base d'éco-critères prédéfinis, les mesures environnementales, les modèles économiques et les développements intégrés qui génèrent des avantages économiques, environnementaux et sociaux pour les parcs considérés et les zones alentour.
L'étude analyse par ailleurs les meilleures pratiques et les facteurs de succès pour 168 parcs d'éco-innovation répartis dans 27 pays (18 pays européens et 9 pays non européens). Les cas étudiés font état d'impacts et de feedbacks positifs pour les parcs existants ou en cours de planification. Des recommandations sont enfin formulées à l'adresse des développeurs et des gestionnaires de parcs, ainsi que des parties prenantes en matière de conception et de gestion de parcs industriels/zones urbaines dans une optique d'éco-innovation.

Mots-clés:
éco-innovation, parc industriel, écologie industrielle, meilleures pratiques, facteurs de succès

Nell'ultimo ventennio, in molte regioni e Paesi sono state elaborate strategie nell'ambito delle ecoinnovazioni al fine di promuovere lo sviluppo economico e di ridurre il carico ambientale. Lo studio presenta le conoscenze acquisite sui parchi innovativi che ospitano progetti industriali e urbani ecosostenibili a livello di parco o di quartiere. In base a criteri ecologici predefiniti identifica le misure ambientali, i modelli aziendali e gli sviluppi integrati che generano vantaggi economici, ecologici e sociali per il parco esaminato e le zone adiacenti.
Lo studio analizza inoltre le migliori pratiche e i fattori di successo di 168 parchi innovativi sparsi in 27 Paesi (18 europei e 9 Paesi extra-europei). I casi analizzati evidenziano una serie di effetti e riscontri positivi per i parchi innovativi esistenti o previsti. Da qui vengono tratte raccomandazioni sulla consulenza da fornire a sviluppatori, gestori di un parco come pure a cerchie interessate in materia di pianificazione e gestione di parchi innovativi o di zone urbane dal punto di vista dell'eco-innovazione.

Parole chiave:
ecoinnovazione, parco industriale, ecologia industriale, migliori pratiche, fattori di successo

> Foreword

The ERA-Net ECO-INNOVERA, the European Research Area Network on Eco-innovation, has been launched in October 2010 and is supported by the European Commission through the 7th Framework Programme for Research and Technological Development. A key focus of ECO-INNOVERA is the support of research and development on eco-innovation and the establishment of a networking platform for researchers, enterprises, policy and society. The consortium is build up of 20 European countries and regions, whereof Switzerland is represented by the Federal Office for the Environment (FOEN).

In Switzerland, in the framework of the total revision of the Federal Act on Research and Innovation, a new article allows the Swiss Confederation to support the creation of a Swiss innovation park that represents an overriding national interest and contributes to competitiveness, resource efficiency and sustainable development (SR 420.1, Art. 32). With regard to the implementation of the new article it is important to generate a comprehensive overview on different European and worldwide initiatives as well as of the success factors of established eco-innovation parks.

Within the framework of ECO-INNOVERA, FOEN initiated an international survey on eco-innovation parks. The study describes European and non-European industrial parks implementing eco-innovation (technologies, processes and services) or industrial symbioses. Eco-innovation parks are eco-industrial parks and eco-cities containing combined zones for habitation and economic activities, optimized from an environmental point of view and open for continuous improvement through collaboration with science. More than 160 experiences are detailed in this survey following a set of twelve eco-criteria. The identification and relative importance of eight success factors of eco-innovation parks provides an important basis for the development of a future Swiss Eco-innovation Park and further initiatives worldwide.

Finally, I would like to thank all those who contributed to the final outcome of this report and the ERA-NET ECO-INNOVERA for co-financing this study.

Christine Hofmann
Deputy Director
Federal Office for the Environment (FOEN)

1 > Objectives, methodology and lessons learned from eco-innovation parks

1.1 Objectives and structure of the report

The present study is conducted within the framework of the European Research Area Network on eco-innovation (ERA-NET ECO-INNOVERA), which aims to support research, innovation, and environmental policy makers with recommendations on how to boost the implementation of eco-innovation in research and development, economy and society. With this report (work package 2.7 led by the Swiss Federal Office for the Environment), the ERA-NET ECO-INNOVERA seeks to identify and learn from international experiences on eco-innovation in industrial parks and urban areas. Within this context, specific information is gathered on current initiatives, including industrial parks and urban areas or other spatially located initiatives that develop integrated solutions to improve their environmental and socio-economic performances.

By using a set of eco-criteria, this international survey aims to

(i) present a detailed overview of spatially located eco-innovation experiences for a large selection of European and non-European countries (Tab. 1) trying to develop integrated systems and establish cooperation linkages among different partners in a defined area,
(ii) identify success factors for the creation and management of eco-innovation parks and
(iii) define key issues related to an effective development and management of spatially located eco-innovation initiatives.

The report is structured in three parts. Part 1 is dedicated to the definition of the research methodology, provides main results related to the analysis of international initiatives and synthesizes the lessons learned from experiences on the spatial dimension of eco-innovation. Section 1.2 defines eco-innovation parks and proposes a set of eco-criteria to characterize them. Section 1.3 presents success factors as described in the literature and defined in the survey. Section 1.4 details the case study descriptors and provides information describing each case study. Section 1.5 describes the methodology used to perform the survey and discusses the data sources and accuracy. Section 1.6 presents the statistical analysis of the case studies. Section 1.7 synthesizes the main lessons learned from the survey and emphasizes best practices for each eco-criterion and success factor contributing to an effective development and management. Finally, section 1.8 is dedicated to conclusions and perspectives. It summarizes lessons learned to foster the development of eco-innovation parks and includes a list of recommendations.

Part 2 describes experiences from European countries while Part 3 presents examples from non-European countries. In each section, the case studies are presented in alphabetical order (Tab. 1). For each of the 27 countries, the national framework regarding spatially located eco-innovation is described and detailed information for each identified eco-innovation park is provided.

Tab. 1 > European and non-European countries included in the survey

(alphabetical order)

European countries	Austria
	Belgium
	Bulgaria
	Denmark
	Finland
	France
	Germany
	Ireland
	Italy
	Luxembourg
	Netherlands
	Poland
	Portugal
	Slovenia
	Spain
	Sweden
	Switzerland
	Turkey
	United Kingdom
Non-European countries	Australia
	China
	United Arab Emirates
	India
	Israel
	Japan
	South Korea
	United States of America

1.2 Definition of eco-innovation parks

1.2.1 From innovation to eco-innovation

According to the definition of the Competitiveness and Innovation Framework Programme of the European Union, eco-innovation is *"any form of innovation aiming at significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment or achieving a more efficient and responsible use of natural resources, including energy"* (Union 2006).

Eco-innovation covers the research and development of quality products with minor or no impact on the environment and the implementation of environmentally friendly production processes and services, moving from a linear life cycle (extract-consume-waste) perspective to a closed-loop process (Wolf et al. 2012).

Eco-innovations such as green, environmental, sustainable or clean technologies, processes, products and services are currently considered for their increasing impact on the global competitiveness of Europe. The economical viability of such technologies is well recognized as they provide tangible benefits in terms of investments, turnover, market penetration and job creation.

At the geographic scale of an industrial park, area or estate, eco-innovation aims at hosting commercial enterprises with piloting installations and processes that incorporate environmental technologies and services, and sometimes also institutions dedicated to research and development. In Section 1.2.2, a large sample group of concepts related to eco-innovation of industrial parks, areas or estates is detailed. Combined areas including both, economic (e.g. industrial) and residential (e.g. housing) activities in a defined perimeter are also considered in this study (see Section 1.2.3).

1.2.2 Concepts, methodologies and procedures for the management of industrial parks

Scarcity of non-renewable resources, emissions to the environment, climate change, land use and loss of biodiversity, all contributing to lowering human health and wealth are identified as the main environmental impacts and economic risks for the current industrial economic system (Erkman 2001). Since the middle of the 19th century, industrial activities are grouped in specific areas in order to isolate them from both, housing and agricultural areas. These locations are called industrial area, estate or park, depending on their geographic scale. The number of industrial parks is steadily increasing worldwide, especially in industrializing countries. Many of these industrial parks are still being planned, built and managed with little concern for resource efficiency and their impact on the environment. Environmental damage results from the demand of the parks' tenants for raw materials and energy, from their activities generating industrial discharges, as well as from the products they produce. As a result, an industrial park manager is in charge of a broad range of environmental issues associated with both, the development and the operation of the park.

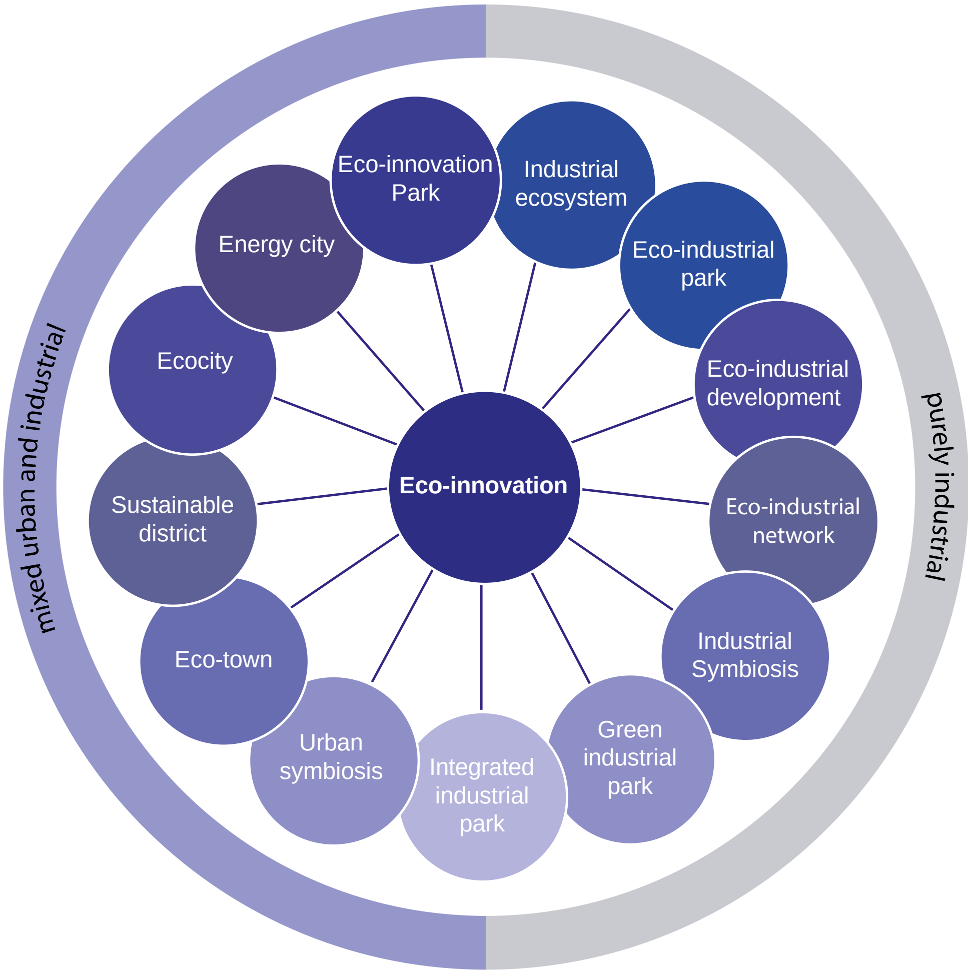
Nevertheless, economic activities rarely organize themselves efficiently in a sustainable way without any external influence (support or pressure) like regulation, policies or resource scarcity. An urgent need for waste management, the lack of recycling industry, the lack of industry modernization, the need of environmental remediation or missing regional development engagement are factors that force regions to become environmentally active (Van Berkel et al. 2009b). Many countries still do not possess basic end-of-pipe technologies at the company or the park level, as e.g., waste water treatment infrastructure or waste sorting and recycling technologies.

The last two decades have seen a sharp decline in many of the traditional industries in Europe, a region with mature end-of pipe infrastructures (as e.g., coal mining, ship building, and car manufacturing). As a consequence, industrial areas need to evolve and to reinvent themselves. In addition, strict environmental regulations and increasing market variability force economies to be innovative and to create new production models. Industrial areas are still underpinning economic development in many countries and can, thus, provide leadership in the area of environmental performance and resource efficiency (Erkman 2001) by providing a fertile ground for the introduction of better environmental practices because of their provision of common infrastructure or their links with government institutions or by influencing the local suppliers due to their position in the global supply chain.

Several concepts have been developed during the last two decades. As an example, existing industrial parks may create collaborative patterns when corporations are motivated by environmental policy or specific problems such as waste management (Pakarinen et al. 2010). Collaborations between economic players within an industrial area may also develop spontaneously, as in Kalundborg (Denmark). Each business connection in the Kalundborg industrial system has, however, an economic background and was negotiated as an independent business deal (Ehrenfeld et al. 1997; Jacobsen et al. 2004). Collaborative patterns in industrial areas, also known as eco-industrial networks, industrial symbioses or industrial ecosystems, are only one type of eco-innovation applicable at the scale of an industrial park.

Tab. 2 and Fig. 1 define some concepts, methodologies and procedures that may be considered as eco-innovation when applied to an industrial or combined (i.e. urban and industrial) area.

Fig. 1 > Concepts related to the spatial dimension of eco-innovation



Tab. 2 > Terms and definitions of concepts related to the spatial dimension of eco-innovation

Terminology	Definition and main specificities
General concept	
Eco-innovation	Eco-innovation is any form of innovation aiming at significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment or achieving a more efficient and responsible use of natural resources, including energy. Collaboration among project partners (private and academia) for research and development is an important element for eco-innovation. In the present study, the presence of R&D collaboration is considered as a central and key aspect.
Industrial ecology	Industrial ecology explores the assumption that the industrial system can be seen as an ecosystem. Industrial systems, just as natural ecosystems, can be described as a particular distribution of materials, energy, and information flows. Furthermore, the entire industrial system relies on resources and services provided by the biosphere, from which it cannot be dissociated. Industrial ecology suggests to use the design of natural ecosystems to guide the redesign of industrial systems and offers opportunities and solutions to turn industrial parks into eco-industrial parks (see definition below) (Erkman 1997; Frosch et al. 1989; Tibbs 1993).
Industrial area (including a mix of industrial activities or business clusters)	
Industrial ecosystem	The broadest application of industrial ecology's analogical approach is to describe manufacturing complexes as "industrial ecosystems". This idea suggests a web of interaction among companies such that the residuals of one facility become feedstock for another. Industrial ecosystems aim to minimize inefficiencies and the amount of waste created by mimicking natural ecosystems in industrial systems (Côté et al. 1995; Lowe et al. 1995).
Eco-industrial park	An eco-industrial park is a community of manufacturing and service businesses seeking enhanced environmental and economic performance through collaboration in managing environmental and resource issues including energy, water, and materials. By working together, the community of businesses seeks a collective benefit that is greater than the sum of the individual benefits each company would realize if it optimized its individual performance only (Côté et al. 1998; Erkman 2001; Lowe 1997; Lowe et al. 1996).
Eco-industrial development	Eco-industrial development is one way to implement a local sustainable economic development by anchoring companies in their local environment, reducing environmental impact, developing employment, and providing safe working conditions. Therefore, eco-industrial development links economic and regional development with resource efficiency and environmental protection (Cohen Rosenthal 2003; Deutz et al. 2004).
Eco-industrial network	The term eco-industrial network, describes a resource exchange network at the regional scale that does not strictly require geographical proximity (Ruth et al. 2009) and is often used as a synonym to industrial symbiosis (see below).
Industrial symbiosis	Industrial symbiosis (IS), as part of the industrial ecology research field, focuses on the flow of materials and energy from local and regional economies. Industrial symbiosis traditionally engages separate industries in a collective approach to a competitive advantage involving physical exchange of materials, energy, water, and/or by-products as well as services and infrastructures shared at the industrial park scale to reduce environmental impact and overall production cost (Massard 2011; Pakarinen et al. 2010) The key factors for industrial symbiosis are collaboration among actors and the synergistic possibilities offered by geographic proximity (Chertow 2000).
Green industrial park	Green industrial park is a concept focusing on resource efficiency at the park scale. Typical attributes include building construction with sustainable and/or recyclable materials, energy-efficient design and heating and cooling systems, "green" landscaping, and strict environmental guidelines for tenant companies. It is sometimes used as a synonym for eco-industrial park (Roberts 2004).
Integrated eco-industrial park	Integrated eco-industrial parks may be considered as a synonym for eco-industrial park. Integrated refers to cogeneration, energy cascading and recycling opportunities through inter-firms collaborative patterns (Côté et al. 1998). According to Roberts (2004), integrated also refers to the development of industrial ecology solutions centered on industrial clusters.
Combined area (including residential area combined with economic activities)	
Urban symbiosis	The term urban symbiosis is used here as an extension to the concept of industrial symbiosis. It refers to the use of by-products (waste, energy) from cities (or urban areas) as alternatives in industrial operations. Similar to industrial symbiosis, urban symbiosis is based on synergistic opportunities leading to the transfer of physical resources for environmental and economic benefits (Van Berkel et al. 2009a; Van Berkel et al. 2009b).
Eco-town	The eco-town concept, developed in Japan as a national program, expands the focus of industrial environmental management initiatives from site-specific initiatives (typically resource efficiency), to Industrial Symbiosis and Urban Symbiosis (Van Berkel et al. 2009a; Van Berkel et al. 2009b).
Sustainable district (or eco-district)	The concept of sustainable district aims at implementing dense and mixed urban districts that deeply match sustainability objectives. It encompasses dimensions like urban density, sustainable mobility, high environmental quality for building and infrastructures, intergenerational and social representation, well being, social interaction, participative processes and cost control (Rey 2011).
Ecocity	The concept refers to an urban environmental system in which input (of resources) and output (of waste) are minimized (Register 2002).
Energy city	The Energy city label certifies municipalities conducting sustainable energy policies. The label promotes the development of renewable energy vectors, sustainable mobility and the efficient use of natural resources (www.citedelenergie.ch/label.php).
Eco-innovation park	In this survey, the term eco-innovation park is used to define both, eco-industrial parks and eco-innovative areas combining residential and industrial activities, such as ecocities and eco-towns. Eco-innovation parks are optimized from an environmental point of view (e.g., piloting installations and processes that incorporate environmental technologies and services) and are open for continuous improvement (e.g., collaboration with institutions dedicated to research and development).

1.2.3 Eco-innovation at the park, area or district scale

An eco-industrial park is defined as a community of manufacturing and service businesses seeking enhanced environmental and economic performance through collaboration (collective benefit) in managing environmental and resource issues including energy, water, materials, infrastructure and natural habitats (Lowe et al. 1995).

The following dimensions were originally considered in the development of eco-industrial parks (Lowe et al. 1996):

1. Single by-product exchange pattern or network of exchanges (Industrial Symbiosis)
2. Recycling business cluster (resource recovery or recycling companies)
3. Collection of environmental technology companies
4. Collection of companies making green products
5. Industrial park designed around a single environmental theme (e.g. a solar energy driven park)
6. Park with an environment-friendly infrastructure or construction
7. Mixed-use development (industrial, commercial, and residential)

Recent projects, however, focus on the first two points.

Eco-industrial parks show different states of evolution that range from undeveloped linear system processes without feedback flows, through limited feedback flows to almost cyclical material flows (Pakarinen et al. 2010). Additionally, eco-industrial parks are spatially limited. Geographical boundaries are defined for individual firms or plants (micro scale), industrial parks, area or district (meso scale), and regional or wider networks (macro scale).

Definition of eco-innovation park

This survey mainly considers meso scale experiences as well as a few macro scale case studies when regional programs and policies also significantly influence the meso scale. No standardized definition exists for eco-innovation parks. However, most term reference from the literature considers eco-innovation park as a synonym for eco-industrial park (Lowe 1997; Roberts 2004; Tudor et al. 2007). In this survey, the term eco-innovation park is used in a broader sense to define both eco-industrial parks (EIP) and eco-innovative areas combining residential and industrial activities, such as ecocities or eco-towns. Eco-innovation parks are optimized from an environmental point of view (e.g., piloting installations and processes that incorporate environmental technologies and services) and are open for continuous improvement (e.g., collaboration with institutions dedicated to research and development).

1.2.4 Limits of the survey scope

Parks applying a single clean technology or eco-innovation are not considered in this survey. Only the combination of at least two measures (Fig. 8), leading to economic and environmental gains is considered. These measures are described in Section 1.2.5 as eco-criteria.

Collections of companies producing environmental technologies, i.e. cleantech clusters, and eco-industries incubators without on-site environmental policies and/or activities at the park scale are excluded from the survey.

Experiences at a regional scale are presented if they have a significant added-value. Particularly, innovative cases of urban and combined (industrial-urban) parks are listed. However, urban case studies are limited to a few experiences including innovative resource management and some industrial activities. Urban districts and, specifically, sustainable districts are generally not included in this study. Due to the large amount of such initiatives it was choosen to report exclusively on cities or large urban cases.

Some cases of innovative experiences in terms of efficient energy production and distribution systems are presented in Annex A1.

1.2.5 Eco-criteria to recognize a park as an eco-innovation park

The approaches applied to develop an eco-innovation park are very diverse. Cultural, institutional and political frameworks are influencing the actions initiated in different countries or regions (Boons et al. 2009).

Some parks focus only on a few activities such as waste management and recycling, while others try to cluster and interact in order to get close to cyclical material and energy flows. A study analyzing 33 eco-industrial parks showed that 70% of the examined cases use the term of eco-industrial park just because the parks are green constructed or develop projects relative to environmental sciences and technologies. The majority of these parks do not seem to develop or implement exchanges or partnerships (Adamides et al. 2009).

The present study, therefore, focuses on identifying the environmental dimensions of eco-innovation parks. The actions undertaken at the scale of parks, areas or districts to foster a transition to a long-term viable industrial system are defined by a set of eco-criteria (Tab. 3).

Progress in terms of eco-innovation can generally not be assessed in the same way in transition, emerging or developed countries. Some measures may be considered as related to eco-innovation in a given context, while they may be assessed as basic standard in another one. For each country, a description of the national context in relation to eco-innovation is thus provided (Part 2 and 3).

Tab. 3 > List of eco-criteria

Energy efficiency	Optimization or reduction of energy use, including energy needed for buildings and other infrastructure as well as for industrial production
Renewable energy sources	Use of and/or onsite production of renewable energy. This includes solar energy, wind energy, hydropower, combined heat and power (CHP), energy production based on waste, geothermal energy, tidal/wave generated energy, biofuels
Waste management	Onsite collection, transport, onsite or external processing and recycling or disposal of waste
Water management	Onsite wastewater treatment, reduction/optimization of water use for infrastructure and production
Material/chemical flow	Synergies, exchange of materials (chemicals, waste, etc) among companies, inter-firm collaborations. Input-output scheme as theoretically defined by industrial symbiosis
Biodiversity	Biodiversity conservation or revitalization of ecosystems in the industrial/urban and surrounding area
Mobility, transportation	Efficient viable transport of goods or person with low environmental impact (e.g. public transport, electric vehicles, plug-in hybrids, carpooling systems)
Land use	Optimization/reduction of land use for industrial/urban infrastructure, revitalization of derelict land
Air pollution prevention	Reduction in pollutant emissions through cleaner production processes or implementation of end-of-pipe technologies
Noise prevention	Reduction in noise emissions through cleaner production processes or implementation of end-of-pipe technologies
Environmental management systems	Certification and labels with environmental standards at the park scale such as ISO 14 000 or EMAS
Cultural, social, health and safety	Cultural aspects include the preservation of cultural diversities and valorization of local specificities; Social aspects include gender equity, professional reintegration, child care, integration of disabled persons; Health and safety aspects include a safe and clean natural and working environment in the industrial/urban and surrounding area

1.3 Success factors of eco-innovation parks

During the last decade, several eco-industrial parks and industrial ecosystems at the regional scale were analyzed in order to identify success factors that may facilitate the emergence of new experiences (Adamides et al. 2009; Cohen Rosenthal 2003; Costa et al. 2010a; Côté et al. 1998; Ehrenfeld et al. 1997; Erkman 2001; Gibbs et al. 2005; Gibbs et al. 2007; Mirata 2004; Sakr et al. 2011; Tibbs 1993; Tudor et al. 2007).

First, business interests in reducing expenses and increasing profit are identified as strong motivations for companies to develop eco-industrial parks and eco-innovation strategies (Jacobsen 2006; Karlsson et al. 2008). This primary motivation is summarized as the economic value added (*value added*) in the set of predefined success factor in this study (Tab. 4).

The involvement of governmental authorities in the park development and operation and the existence of environmental legislation facilitating eco-innovation projects in industrial/urban zone are also of major importance (Gibbs et al. 2007; Mirata 2004). To complement, financial incentives may help to overcome economic barriers and support planning and/or implementation of eco-innovation through rent reduction or development grant. For these reasons, the policy and regulation frameworks (*policy*) and the financial incentives (*incentives*) are defined as success factors for this study.

Also, the involvement of economic players was identified as being one of the most important element since the development of resource efficiency strategies in the nineties (Allenby 1999; Van Berkel et al. 1997). The intensity and the quality of the cooperation between economics players and local stakeholders is a crucial indicator to assess the potential for change in companies and inter-firms collaborations, as industrial symbiosis (Heeres et al. 2004). In addition, Roberts (2004) underlines the need to gain community and business support to develop successful industrial ecosystems. Therefore, openness, communication and mutual trust between economic players are of major importance for inter-firms collaborations (Baas et al. 2004; Chertow 2007). For these reasons, firms with decision-making powers on-site are assets. As cooperation, communication and coordination aspects are important prerequisites, they are summarized as success factor under organizational and institutional setups (*coordinators*).

At the level of the regional framework, access to advanced technologies and knowledge through cooperation with academia and research institutes permits to foster industrial synergies and lower environmental impacts (Costa et al. 2010a; Costa et al. 2010b). Cooperation with science and technology institutions (*cooperation S&T*) is, thus, also accounted for in the case studies analysis.

Furthermore, the location of a park close to major conurbations/cities or nearby specific resource extraction or importation sites is an asset (Jensen et al. 2012). In addition, the diversity of industrial sectors and economic activities increases the opportunity to create new sets of feedback flows (Fiksel 2003; Korhonen et al. 2005). Also, eco-industrial parks built upon existing interchanges (e.g. waste and energy) at a wider spatial scale are more fruitful (Gibbs et al. 2007). For these reasons, the geographical factors and regional infrastructure (*location*), as well as the local diversity of economic activities (*diversity*) are defined as success factors for this survey.

During the last decade, at both park and regional scale, eco-innovation and eco-industrial development have become a strategy for regional development and marketing (Deutz et al. 2004; Potts 2010). The differentiation between eco-innovation parks and others parks becomes a criterion of differentiation and promotion of the site. Therefore, the clear designation of a park as an eco-innovation park benefits to both promotion services and companies settled in those parks in terms of public image. In addition, independent bodies (universities, research centers, consultants) helping the park managers with the generation and dissemination of information regarding the environmental benefits of different scenarios also contribute to the park image and credibility. Lastly, the clear designation of the park as eco-innovation park (*Eco-Innovation Park*) is, therefore, considered as a success factor in this survey.

As for the eco-criteria, success factors are similarly attributed for every country with the specific national context considered.

Tab. 4 > Description of success factors of eco-innovation parks

Success factor	Description/example	Short name
Economic value added	Direct business interests of companies in reducing expenses and/or in increasing profit by implementing synergies with other companies in the park (implementation, development, perpetuation).	Value added
Policy & regulation frameworks	Legislation enhancing eco-innovation, sustainable development, public-private partnerships, industrial symbiosis and eco-industrial development strategies through local and regional policy action for implementation and regulatory instruments combined with innovative models.	Policy
Financial incentives	e.g. tax reduction and/or financial support for companies committing to sustainable practices	Incentives
Organizational and institutional setups	Organization and setups for the operation of the park. Coordination bodies, e.g. trust companies in charge of the coordination and services for stakeholders (e.g. environmental services, risk analysis, information and training, marketing and communication, help for getting permits, “plug and play” services) and providing a platform for cooperation among stakeholder Monitoring through independent authorities and management of common mutualized infrastructures	Coordinators
Cooperation with Science and Technology institutions	Cooperation with e.g. universities, science and technology enterprises and research centers, knowledge sharing	Coop. S&T
Geographical factors and regional infrastructure	Location (close to seaport, airport, highway, urban centers, historical and natural conditions), Infrastructure, size, potential for expansion	Location
Local diversity of economic activities	Large opportunity to create sets of feedback flows due to the diversity of economic activities. Companies on site with activities in different sectors (e.g. wood industry, heat power generation, chemical operations and paper manufacturing	Diversity
Clear designation of the park as eco-innovation park	Clear commitment, clear definition and differentiation from other parks (self-declaration must be reviewed) as marketing and communication standards.	Eco-Innovation Park

1.4 Case study descriptors

The literature regarding case studies of eco-industrial parks and eco-innovation parks is at the same time very abundant and very scarce. The field of industrial ecology mostly describes existing and planned experiences. Only few studies at the park scale provide significant data on implemented eco-innovation strategies and feedbacks on technical, economic and social issues.

The information provided in this study is organized in a way that readers can easily identify interesting cases using a set of descriptors, eco-criteria and success factors and find the corresponding references. The followings sections detail how the survey is presented in 2 and Part 3 of the English version.

1.4.1 Country description

Each country section in 2 and 3 begins with general information on legislation and policies supporting eco-innovation at the national level. A short description of the history and the main programs promoting eco-innovation is presented. Finally, industrial parks for which no significant or relevant data could be found are not detailed as case studies and are listed as *non-detailed* is the statistical analysis (Section 1.6).

1.4.2 General information on case studies

In order to provide similar general information for every case study, all experiences are summarized according to a defined structure. First information concerning the organization of the park is given and include (i) type of park (industrial, urban or combined), (ii) size of park (ha), (iii) number of companies or industrial sectors, (iv) number of jobs and (v) number of inhabitants (in urban/combined parks)

Identified eco-criteria (see description section 1.2.5) are then listed for each case study. Strikethrough formatting is applied for irrelevant eco-criteria. Following, the current status of the experiences is described as (i) planned, (ii) under construction, (iii) in use or (iv) stopped.

To complement, the project leadership defines the main type of initiator and/or park manager in charge of the project management. A distinction is made between (i) public, (ii) private, and (iii) public-private partnership (PPP)

The above-mentioned information is presented in a table as an introduction to each case study described in 2 and 3. The table also lists references (publications and internet links) used to describe the case study.

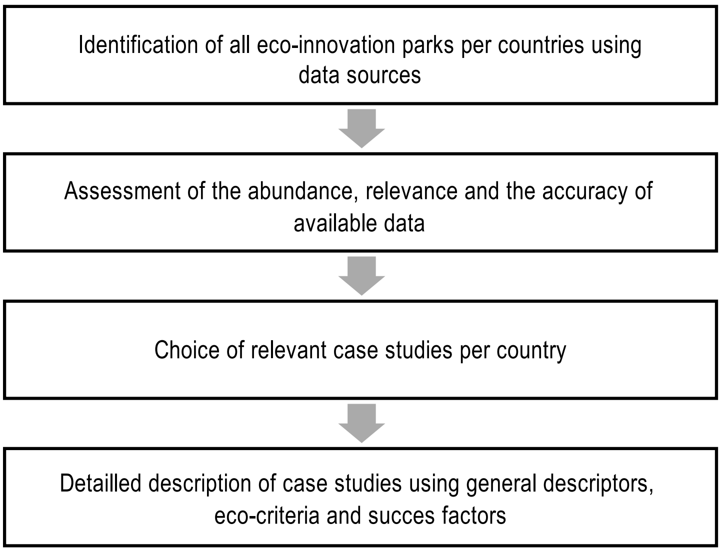
1.4.3 Objectives of the eco-innovation strategy and detailed eco-criteria

After providing general information in a table, each case study is detailed in four paragraphs including information on the *origin* of the initiative, the *objectives* of the eco-innovation strategy, the identification of *success factors* (see description section 1.3) and future *perspectives* regarding park development.

1.5 Data sources

The data collection methodology is detailed in Fig. 2. This survey uses peer-review research journals as information basis, such as the Journal of Industrial Ecology, Environmental Science and Technology, Journal of Cleaner Production, Resource, Conservation and Recycling, Progress in Industrial Ecology, Business and the Environment, Ecological Economics. Reports as well as books describing eco-innovation parks are also considered (Lowe 2001; OECD 2009; Outters 2006; Siam 2005; Siemens 2009).

Fig. 2 > Data collection methodology



Finally, content from the Internet is also used as data source to gather detailed and recent information on case studies. Some websites also provide lists of case studies, mostly due to research initiatives (non-exhaustive list):

> Mediterranean Eco Industrial development: *www.medmeid.eu/*
> EU Siam Project: *www.siamproject.it/*
> EU Project ECOPADEV: *www.ec.europa.eu/research/environment/print.cfm?file=/comm/research/environment/newsanddoc/article_3892_en.htm*
> EU Project ECOSIND: *www.gencat.cat/mediamb/sosten/ecosind/*
> Interreg IIIC: *www.interreg3c.net/sixcms/detail.php?id=605#item²0*
> CSRP Global Synergy Database: *www.csrp.com.au/database/index.html*
> EU Project SymNet: *www.projectsymnet.eu/*

Direct contacts with public institutions or academic organizations were also initiated for specific cases to learn about recent developments and the stage of implementation of eco-innovation strategies. Due to the large number of case studies described, direct contacts could not be established in all countries and for each case study.

1.6 Statistical analysis of case studies and general trends for eco-innovation parks

The total number of eco-innovation parks identified in this survey is 302. According to the previously described methodology, a number of cases are not detailed in the next parts if no significant or relevant data was found to allow for an accurate application of the descriptors. The number of detailed eco-innovation case studies is 168 out of 302. The 134 non-detailed cases are mentioned in the country descriptions only (see main report in English).

Tab. 5 details the number of parks per country and the type of park. A large majority of case studies are strictly industrial parks (131/168). The rest are a combination of industrial and residential (28/168) or strictly urban activities (9/168).

Tab. 5 > International repartition of case studies by type of park

		Identified	Non-detailed	Detailed as case study			
		total	total	**total**	industrial	combined	urban
European countries	Austria	4	1	**3**	2	0	1
	Belgium	10	3	**7**	6	1	0
	Bulgaria	2	1	**1**	1	0	0
	Denmark	5	2	**3**	0	2	1
	Finland	9	4	**5**	5	0	0
	France	19	5	**14**	13	0	1
	Germany	40	15	**25**	24	1	0
	Ireland	2	2	**0**	0	0	0
	Italy	18	9	**9**	7	2	0
	Luxembourg	2	0	**2**	0	1	1
	Netherlands	16	9	**7**	7	0	0
	Poland	6	1	**5**	4	1	0
	Portugal	7	5	**2**	1	1	0
	Slovenia	1	0	**1**	1	0	0
	Spain	15	3	**12**	9	3	0
	Sweden	11	4	**7**	1	5	1
	Switzerland	22	15	**7**	6	1	0
	Turkey	3	2	**1**	1	0	0
	United Kingdom	14	9	**5**	4	1	0
Non-European countries	Australia	8	4	**4**	4	0	0
	China	20	7	**13**	7	6	0
	India	12	6	**6**	6	0	0
	Israel	2	1	**1**	1	0	0
	Japan	28	20	**8**	8	0	0
	South Korea	7	0	**7**	6	0	1
	United Arab Emirates	2	0	**2**	0	0	2
	United States of America	17	6	**11**	7	3	1
TOTAL		**302**	**134**	**168**	**131**	**28**	**9**
							168

1.6.1 Statistical analysis of eco-innovation parks status

Out of 168 detailed case studies, 131 eco-innovation parks are already in use or operational, at least partly as they may be simultaneously under further development. Few parks were described as being under construction (21) or in planification (12), respectively. Due to the lack of detailed publication materials at such stage of development, a significant part of planned initiatives, however, may have not been identified. New strategic orientation, budget consumption or lack of available materials for industrial symbiosis explains the status of the stopped initiatives.

Fig. 3 > Status of eco-innovation parks detailed as case studies

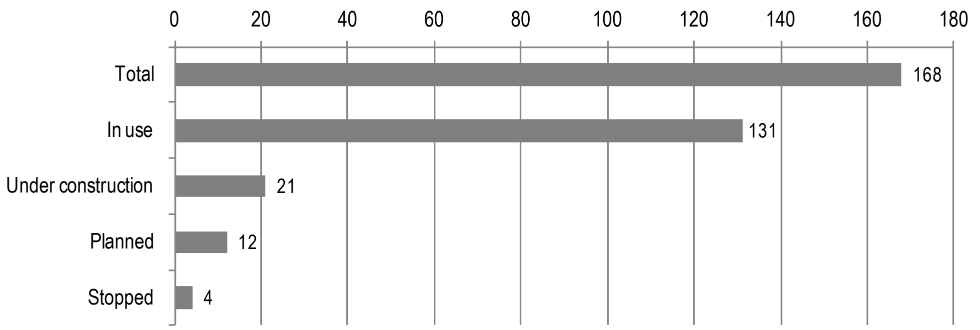


Fig. 4 > Map of European eco-innovation parks (see Annex A2 for details)

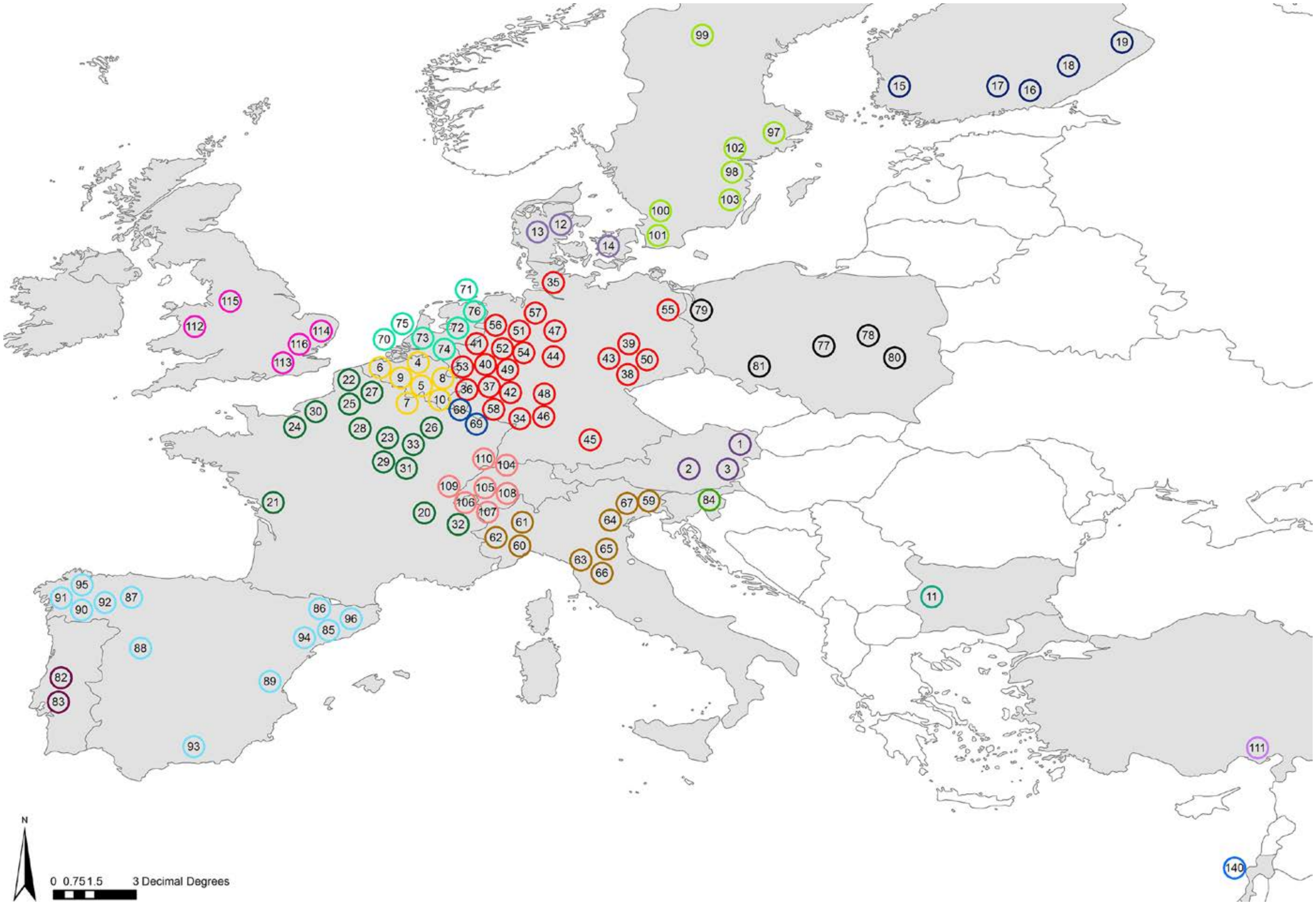
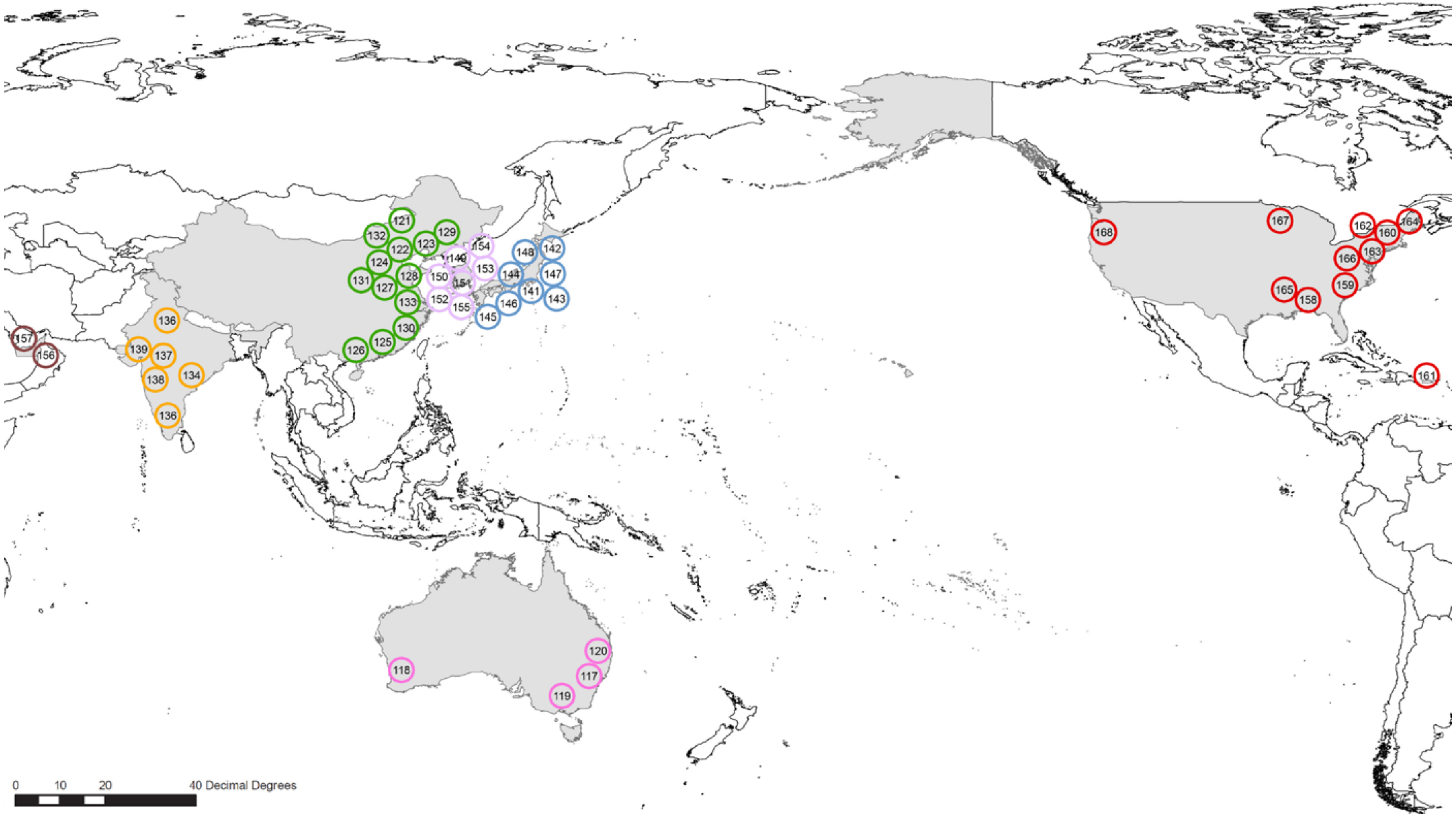


Fig. 5 > Map of non-European eco-innovation parks (see Annex A2 for details)

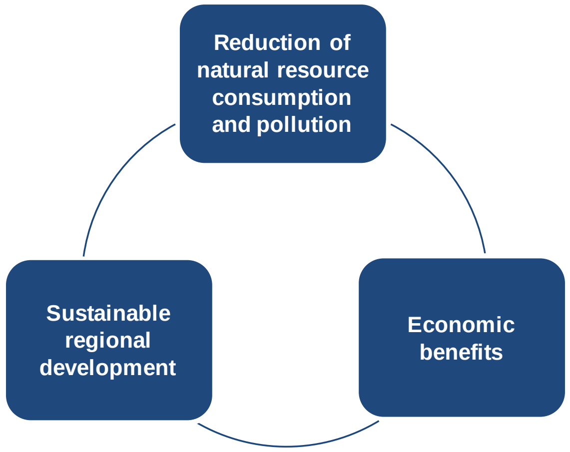


1.7 Lessons learned for the development of eco-innovation parks

1.7.1 Benefits arising from eco-innovation parks

Industrial parks play a central role in natural resource consumption and environmental issues for every country analyzed in this survey. Industrial parks can have major consequences for the system as a whole, impacting several material/energy flows. The case studies highlight a set of positive impacts and feedbacks from eco-innovation parks. These parks are described attaching importance to resource consumption, pollution discharges, economic benefits and regional development (Fig. 6).

Fig. 6 > Three main categories of benefits from eco-innovation parks



Reduction of natural resource consumption and pollution

1. Reduction of energy and material inputs at the plant and the park scale
2. Increased material productivity for economic players
3. Reduction of waste and emissions to the environment at the plant and the park scale
4. Within the value chain, eco-innovation strategies reduce costs and create synergies between production and distribution

Economic benefits

1. Resource efficiency generates additive revenue for economic players and provide cost savings (energy, materials, waste management, compliance with environmental legislation)
2. Resource efficiency reduces the market dependence to non renewable and imported resources
3. Eco-innovation strategies reduce liabilities and risks in terms of health and safety
4. Participation in eco-innovation projects give businesses a competitive edge on the growing green market
5. Eco-innovation park dynamic management may enhance businesses' adaptability and flexibility to regulatory changes
6. Public image of each company and of the park as a whole is improved

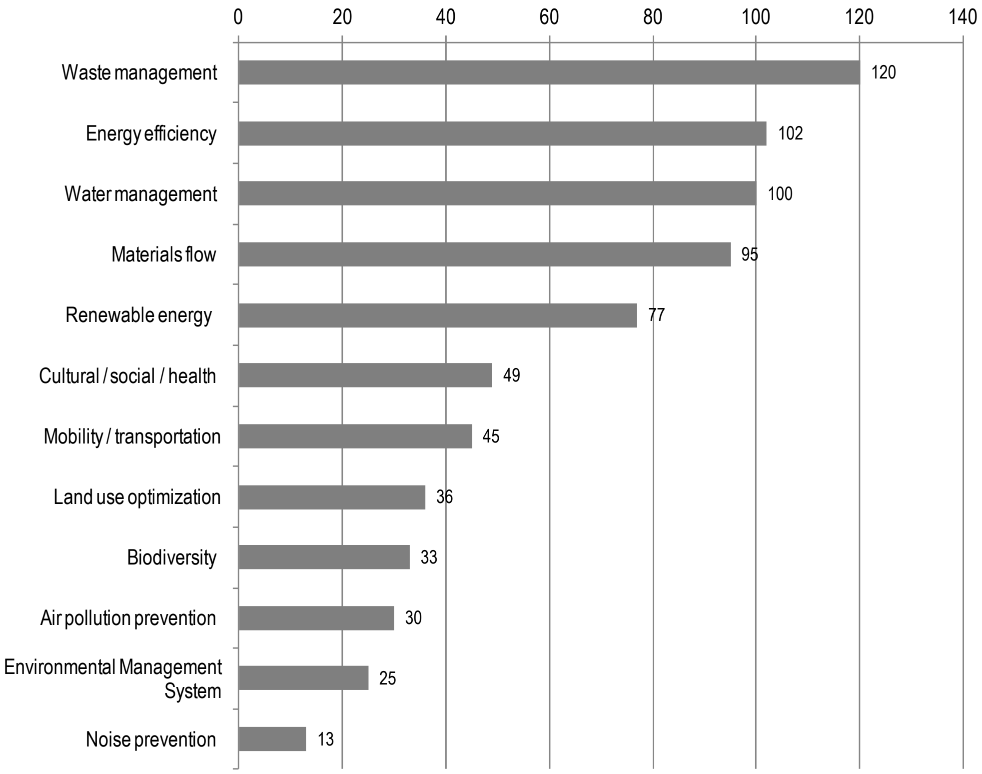
Sustainable regional development

1. Eco-innovation parks contribute to the strength of regional economies by fostering innovation and diversity at local and regional scales
2. Eco-innovation strategies reduce the region dependency to non-renewable resources and thus increase its resilience to shortage in supply

1.7.2 Eco-criteria: Analysis and Models of excellence

Among all case studies presented in this study, current trends, best practices and tendencies for further development among each eco-criterion were identified and are illustrated here through a series of particularly innovative and effective examples. Fig. 7 presents the occurrence of eco-criteria implemented in the 168 parks identified in the survey.

Fig. 7 > Occurrence of eco-criteria among case studies



Planned or implemented eco-innovative solutions in parks are principally linked to materials, energy and water issues as reflected by the occurrence of the first five eco-criteria (Fig. 7).

With the exception of material flow, these criteria are also usually considered as common strategies for conventional industrial park development and management. As the innovative component is sometimes unclear from the available information, the concomitant occurrence of these eco-criteria may only partly reflect an innovative resource management for every case.

A crucial aspect of such statistics is the availability of information for the characterization of each case study. For example, the criterion waste management appears for 120 cases out of 168 detailed cases (Fig. 7). Thus, 48 cases have little or no activity related to waste management. However, this may also be related to the lack of relevant information at the time of this study.

Eco-criterion 1: Waste management

Waste management is the eco-criterion with the highest occurrence (occurrence: 120 over 168 Eco-innovation parks hereafter abbreviated as 120/168) reflecting that a majority of eco-innovation parks have an onsite collection and onsite and/or external processing (recycling) or disposal of waste. Such infrastructures include public or private waste management facilities or recycling clusters such as the innovative example of the Eco World Styria (Austria, Park no. 2). Further good example is Deux Synthe Industrial Park (France, Park no. 22), where companies share services for ordinary and hazardous waste collection, leading to substantial economies of scale.

Chemical parks also show successful experiences of waste management. Due to the nature of their industrial activities generating potentially hazardous waste, such parks often need to treat and organize disposal of special waste directly on-site. Infrapark Baselland (Switzerland, Park no. 110) set up a comprehensive waste management program that includes on-site waste incineration and wastewater pre-treatment plants, drum cleaning, regeneration of solvents, and a retention basin. The incineration plant disposes of 14 000–16 000 tons per year of special and industrial waste (gaseous, liquid and solid) and generates from it 400–450 TJ of heat in the form of steam, high temperature water and hot water. The wastewater pre-treatment plant can treat water heavily loaded with toxic organic compounds and heavy metals. Infrapark Baselland offers this service not only to its tenants, but also to chemical companies all over Europe. Similar systems are found in other chemical parks, often managed by specialized service companies that also foster synergies between companies and contribute to reduce their operating costs. Good examples are the german chemical parks of Dormagen (Park no. 40), Krefeld Uerdingen (Park no. 41) and Leverkusen (Park no. 42), Industriepark Höchst (Park no. 48), Marl Chemical Park (Park no. 51) and swiss parks such as Basel Industrial Area (Park no. 104) or Cimo – Monthey Chemical Park (Park no. 107).

With the international recognition of the "Polluter-Pays Principe" in the legislation, industries must act to control their discharges. Yet, waste management systems are very costly to implement for a single company. Thus a real interest exists for intercompany platforms offering shared waste management services that aim for substantial savings and optimized logistics systems.

Eco-criterion 2: Energy efficiency

The second most frequent criterion is energy efficiency (102/168). Energy efficiency is an essential goal for most industries, as it allows achieving significant savings, especially in times of increasing energy prices. Closely linked to several other eco-criteria, energy efficiency is often – at the park scale – a consequence of waste recovery schemes, industrial symbioses, or improved transportation and logistics systems with the additional effect of decreasing emissions of air pollutants. It is also an important attribute of environmental management systems.

There are several ways to improve energy efficiency at the park scale. Individual measures applied by the parks' tenants include energy efficient buildings or efficient production processes combined with consumption monitoring. Integrative approaches may however offer better results, even if they are sometimes complex to implement. In various European countries centralized and/or interlinked energy production and distribution systems – at the park or urban district scale – incorporating alternative energy sources are observed. The BASF company developed for example an integrative and performant energy efficiency system for the chemical industry, called the Verbund. This system links production facilities and fosters the emergence of synergies. Six Verbund sites have been developed so far, including the BASF Verbund site in Ludwigshafen (Germany) detailed in this study (Germany, Park no. 34), allowing of saving up to 1.5 million tons of oil equivalent per year or a reduction in CO_2 emissions of 3.4 million tons per year (BASF 2013b).

Eco-criterion 3: Water management

Water management (100/168) including the treatment of wastewater or the reduction of water use on site adds to the principal solutions related to waste and energy.

Most industrial activities need water, but the pressure exerted on water resources depends greatly on the geographic location (resource abundance and infrastructures) and the quality and quantity of water feeding industrial processes and coming out of them.

In terms of water consumption, effective and innovative systems for water recovery and cascading were identified. For example, in Kalundborg – Sustainable city (Denmark, Park no. 14), 3 million m³ of water are saved each year through industrial symbioses (Kalundborg Symbiosis 2013). The Port Melbourne Industrial Area (Australia, Park no. 119) is focusing on water recycling due to local scarcity of freshwater. Between 2001 and 2009, Port Melbourne has already achieved mains water savings of almost 24% (Enviroehub 2013) and is currently working on new storm water recovery and industrial water reuse and treatment schemes. Also, non-drinkable water networks (filtrated, but not treated river water) are designed for industrial activities like in the Havre Industrial-Harbour Park (France, Park no. 24).

As for wastewater management, the most effective solutions are upstream measures taken to reduce chemicals and other inputs that will eventually be evacuated with wastewater discharges as well as the separation of by-products such as chemicals at the source to favor reuse or specific treatment.

For optimal results, these measures must be combined with an onsite centralized pretreatment plant. The more effective the upstream measures, the more efficient the treatment plant. For instance, in Les Sohettes Bio-refinery (France, Park no. 26), condensates recovery systems and wastewater treatment pooling are successfully implemented.

Besides, water is also an energy vector used for heat and cold networks, as illustrated in various parks that implement industrial symbioses like material flow exchanges (see also Annex A1).

Eco-criterion 4: Material/chemical flow

In association with waste management, another frequent eco-criterion related to innovative and efficient material management at the park scale is material flow optimization (95/168). Material flow exchanges (or industrial symbioses) generally encompass other eco-criteria, in particular energy efficiency, waste management and water management. When several inter-firm collaborations are created on one site, significant resource savings are often achieved through spontaneously developed material flow exchanges. In the Harjavalta Industrial Eco-Park (Finland, Park no. 15) or in the Uimaharju Industrial Area (Finland, Park no. 19), smelters, chemical and energy plants or a wood industry cluster continuously built exchange networks over more than half a century. Sometimes informal systems in developing countries also tend to foster material exchanges and recovery, for instance in the Nanjangud Industrial Area (India, Park no. 135). In Kalundborg – Sustainable city (Denmark, Park no. 14), the first symbioses were also self-developed and became progressively collectively managed. Today, 30 successful symbioses are implemented. Since 2000, the tendency toward planned and facilitated industrial symbioses is widely observed in industrialized and even some emerging countries like India or China. Many of private and government-led experiences are intending to facilitate interfirm collaborations, as illustrated below. In Switzerland, the strong political support fostered the establishment of a policy framework for material, water and energy exchanges within the city of Geneva (Ecosite Workgroup, Switzerland, Park no. 109). In the United Kingdom, the National Industrial Symbiosis Program (NISP) (UK, Park no. 114) also supports companies in diverting waste from landfills by facilitating the emergence of collaborations. In the Kwinana Industrial Area (Australia, Park no. 118), a public-private partnership organization contributes to the implementation of 47 linkages since 2007. The government-led Ulsan EIP Project (South Korea, Park no. 153) is another successful example of optimized material flow exchanges. This initiative is part of a national eco-industrial park program that fosters such synergies; a similar program is also developed in China.

Eco-criterion 5: Renewable energy sources

The high occurrence of energy efficient activities as well as renewable energy (77/168) indicates that energy issues are a principal component of eco-innovation park strategies.

Industrial and urban areas with large settings and business sectors show great potentials in terms of renewable energy production. The main challenge is to ensure a safe and regular supply of renewable energy without compromising competitiveness. In this regard, the best solutions generally consist of sharing infrastructures at the park scale or to recover energy from waste and by-products (combined heat and power production) thereby also generating new potential incomes.

For instance, the renewable energy cluster established on the Händelö Island (Sweden, Park no. 98) uses an optimal combination of waste-to-energy and biofuels technologies. The on-site power plant is fuelled by biomass (53%), municipal waste (43%), coal (4%) and small amounts of oil during peak loads. It produces 1.1 TWh of heat delivered to the urban district heating network and steam supplied to the nearby ethanol production plant, as well as 300 GWh of electricity injected to the grid. Similar synergies involving bioenergy industries have been successfully developed in the Biopark Terneuzen in the Netherlands (Netherlands, Park no. 70).

In the Dezhou solar valley (China, Park no. 124) solar technologies are exclusively used to power building, street lighting, transportation and desalination or air conditioning. Those solutions are mostly adapted to the service industry and to administrative buildings in business parks. With the exception of biomass powered plants (like in the finish wood industry clusters, e.g. Park no. 18 and 19) or the Dezhou solar valley, large projects of renewable energy production centralized at the park scale are quite uncommon. Even if large shared energy infrastructures are generally more efficient and economically viable at the park scale, they are also more difficult to handle and often require third-party companies to manage them. Nevertheless, a clear trend towards the production of renewable energy within industrial parks, but limited to small size pilot projects, especially for wind and solar power, is observed. This may be the starting point for a coherent combination of small-scale renewable energy productions (including wind, solar, biomass, etc.) that provide significant amounts of thermal and electric energy used by the surrounding industries and/or residential areas.

Eco-criterion 6: Cultural, social, health and safety

This eco-criterion does not appear as prominent in the survey (49/168). If various parks mention on-site cultural and/or social facilities (childcare, entertainment, sport), few of them developed an integrative approach. There are nonetheless some notable exceptions, like the Dyfi Eco Park (UK, Park no. 112), where “sustainable community regeneration” is conducted in the region through the promotion of local cultural and environmental assets. In this perspective, many community organizations participate in the sustainable development of industrial activities in the valley, with priority given to sustainable farming and tourism. Their fields of action also include the promotion of fair trade, affordable and sustainable housing, local cultural and social events, as well as educational programs for adults and children (Ecodyfi 2013). Another example is the BASF Verbund site Ludwigshafen (Germany, Park no. 34), which plans to develop a work-life management center by the end of 2013. This center will offer diverse activities in the areas of “career and family”, sports, promotion of healthy living, social and nursing care counseling, as well as day care facilities (BASF 2013a). Also at Prato 1st Industrial Macrolotto (Italy, Park no. 66), an innovative integrative social approach is followed. The onsite nursery provides free services as child care and the run of errands (laundry or shopping list) to support family life.

As for health and safety, good working conditions are often a consequence of industrial park’s environmental covenants. These aspects are also included in most Environmental management system (EMS) certifications (see also eco-criterion 10).

Eco-criterion 7: Mobility, transportation

Several different ways to improve the performance of transportation and logistics at the park and the urban district scale were observed (45/168). First, integrative systems are being designed to increase the use of alternative energies to fuel vehicles. The swedish city of Linköping (Sweden, Park no. 102) with about 100 000 inhabitants locally produces biogas to fuel most public transports and taxis. Launched in 2001 by the municipality, collection and processing of waste from canteens and restaurants allowed to cut the yearly volume of waste sent for incineration by 3422 tons and to produce 1 334 580 m³ of biogas or 12.65 GWh, as well as biofertilizer.

Moreover, a good public transportation network is beneficial for industrial areas, in terms of competitiveness and environmental impact. Industrial parks established near urban centers generally benefit from these advantages. To complement the public transportation services, there is a trend for increasing car-pooling schemes organized at the park scale in various countries.

In addition, logistic centers are sometimes included in European industrial parks and offer various services to the park tenants, for example in the BASF Verbund site Ludwigshafen (Germany, Park no. 34), the Polígono As Gándaras (Spain, Park no. 92), or in the Synergy industrial Park (Australia, Park no. 120), where a shared warehouse has been built to centralize logistics and optimize transportation. In Els Pedregals (Spain, Park no. 87), an automated logistic center is planned.

Eco-criterion 8: Land use optimization

For some parks (36/168), the revitalization of brownfields or the optimization of land use was also an important objective. In the optic of land use optimization, several parks developed on derelict areas. For example, CAMP CO_2-Zero (Germany, Park no. 36) and Devens planned community (USA, Park no. 160) established on former military bases and the London Sustainable Industries Park (UK, Park no. 116) is designed to revitalize an industrial wasteland and establish synergies with its urban surroundings.

Other initiatives intend to decontaminate and redevelop severely polluted industrial brownfields. This is the case of the Shenyang Tiexi Eco-industrial Park (China, Park no. 129) and the Keystone Industrial Port Complex (USA, Park no. 163), both established on former steel industry sites. Another prominent case is the Royal Phoenix Redevelopment Project (USA, Park no. 166) based on a former textile industry site, characterized by heavy soil and water pollution. This project is part of the US EPA's Superfund Redevelopment Initiative (SRI), a national program to redevelop former hazardous waste sites (EPA 2013).

Besides, the 22@Barcelona (Spain, Park no. 85) is an illustrative example of successful land use development at the urban district scale, as it regenerate an obsolete industrial area inside the city with innovative land planning and economic development schemes. A tendency toward land use optimization and densification of industrial areas is thus ongoing.

Eco-criterion 9: Biodiversity

In contrast to the above-described eco-criteria, biodiversity conservation or natural revitalization of the park area was rarely identified (33/168). Green spaces are though increasingly included in the design of new eco-innovation parks in order to enhance the working environment. In contrast, comprehensive and effective measures that intend to preserve biodiversity or revitalize areas in existing eco-innovation parks are still uncommon.

A few parks developed specific measures related to biodiversity. For example, the Parque tecnológico y logístico de Vigo (Spain, Park no. 91) designed a specific program to restore forest areas within the site and surrounding areas. The Polígono As Gándaras (Spain, Park no. 92) also included in its environmental plans the conservation of surrounding wetlands and lagoon. In Japan, the Eco-Town Kitakyushu (Japan, Park no. 144) was included in 2011 in Japan's "Future City" initiative due to its "City

Forest" or "Forest-in-town" projects fostering green spaces within the industrial area and the city.

An interesting initiative was developed in Switzerland by the Nature and Economy Foundation (Natur und Wirtschaft 2013). The foundation provides services to companies in industrial parks to create natural areas around the industrial facilities. A total of 23 Mio. m² of land distributed among 300 companies has been revitalized this way.

Eco-criterion 10: Air pollution prevention

Air pollution standards at the national or supra-national scale are defined for all countries included in this survey. Thus, additional activities at the park scale rarely exist (30/168). In many cases, air pollution prevention and abatement is a consequence of resource efficiency or industrial symbioses, when the reduction of inputs diminishes the production of polluting outputs or when former discharges are recovered and injected in the productive system. Specific measures targeting air pollution reduction are often "end-of-pipe" solutions, generally less cost-effective and with a lower overall impact on environmental performance than preventive measures like cleaner production actions targeting efficient production processes.

Notable exceptions with specific measures to reduce air pollution include the Chemical Industrial Park Knapsack (Germany, Park no. 37). There, a central department for water and air has been established in 1961 to continuously improve the environmental performance of the park. In Infrapark Baselland (Switzerland, Park no. 110), the manufacture of special chemicals and agrochemicals generate exhaust air contaminated with organic substances. This exhaust air is recovered, pretreated, and used in place of fresh air in the on-site Energy Center for the incineration of solid and/or liquid industrial and special waste. Besides, the Chempark Krefeld Uerdingen (Germany, Park no. 41) mentions the use of many technologies to control air pollution, including an innovative filter system. Similarly, the Schwedt Industrial Park (Germany, Park no. 55) developed specific infrastructures to reduce hydrocarbon emissions and implemented a monitoring system for polluting emissions.

Eco-criterion 11: Environmental management systems (EMS)

The absence of any eco-industrial park normative standard and the low application of norms like ISO 14 000 at the park scale likely explain the low occurrence of the environmental management system criterion (25/168). While EMS certifications is not directly related to the implementation of innovative clean technologies or the development of complex integrated schemes, they oblige industrial parks to be proactive regarding many environmental performance aspects. Consequently, identified eco-innovation parks with environmental management system generally encompass further eco-criteria.

Even if it is still more common to find individual companies certified with international environmental standards like ISO 14 001 or the Eco-Management and Audit Scheme (EMAS) developed by the European Commission, these certifications are nowadays increasingly applied at the industrial park scale. Several case studies in the survey illustrate this tendency. Some of them claim to be pioneers in Europe, like the Plaine de l'Ain Industrial Park (France, Park no. 29) or the Parque Tecnológico Galicia Tecnópole (Spain, Park no. 90), both certified ISO 14 001 and EMAS. This phenomenon is though not limited to European countries, with China having an ISO 14 000 National Demonstration Zone Program since the end of 1990s. If most parks are certified based on their performance at the level of the operational management, EMS can also be applied in the planning phase. For instance, the public park developer of the Croix-Fort Artisanal Park (France, Park no. 21) has been certified ISO 14001 for the design, execution and marketing of the project. Also, an industrial park's utility and service provider can be certified (e.g. Pharma und Chemiepark Wuppertal, Germany, Park no. 54) and have an impact on all tenants' activities.

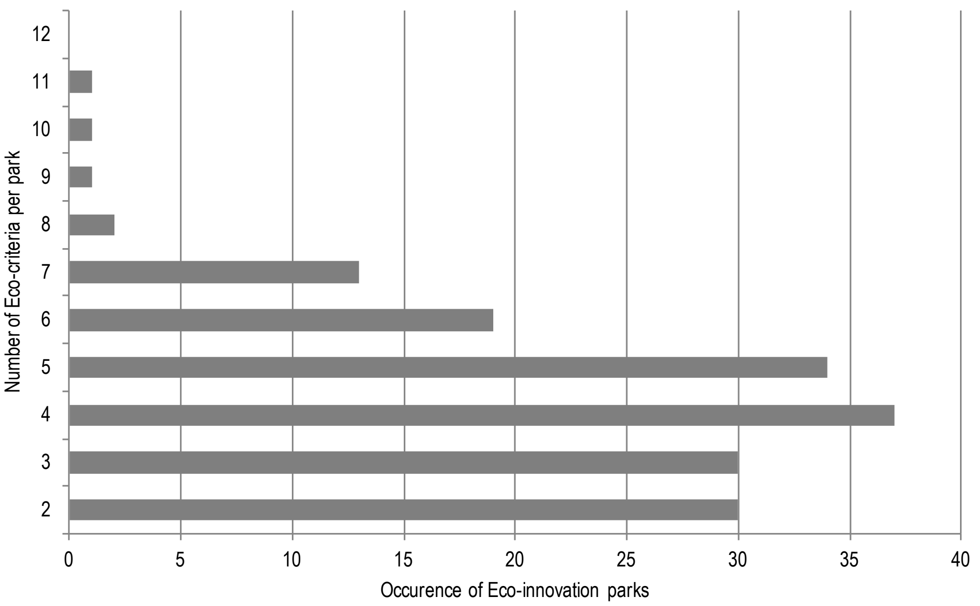
Besides ISO 14001 and EMAS, other specific types of environmental certifications at the park scale were identified. In Dezhou Solar Valley (China, Park no. 124) a pilot Energy Management System (EnMS) has been recently introduced. The brownfield redevelopment project in the port of Moerdijk (Netherlands, Park no. 73) is certified Ecoports, a European EMS certification specifically designed for ports. As for eco-industrial parks, several countries launched their own initiatives, like the national label of Environmental Equipped Industrial Area (EEIA) in Italy, or the certification system developed by China based on a set of indicators to evaluate eco-industrial parks. However, an internationally recognized label is still lacking.

Eco-criterion 12: Noise prevention

Integrative measures to prevent noise at the park scale are not common, and largely left to individual implementation at the firm scale (13/168). Yet, an industrial park can enforce specific covenants to foster noise reduction among its tenants, like in the Ecopark Hong-Kong (China, Park no. 125). Park managers can establish acoustic maps to pinpoint the sources and propose targeted solutions. Several European parks that participated in the Ecomark project (Ecomark 2013) have been encouraged to take noise prevention measures and designed acoustic maps (see Park no. 90, 92, 94 and 95).

Other examples of measures taken at the park scale include the development of incorporated green areas to reduce noises and air pollution emissions like in the Padova Industrial Park (Italy, Park no. 64).

Fig. 8 > Distribution of Eco-innovation parks among eco-criteria



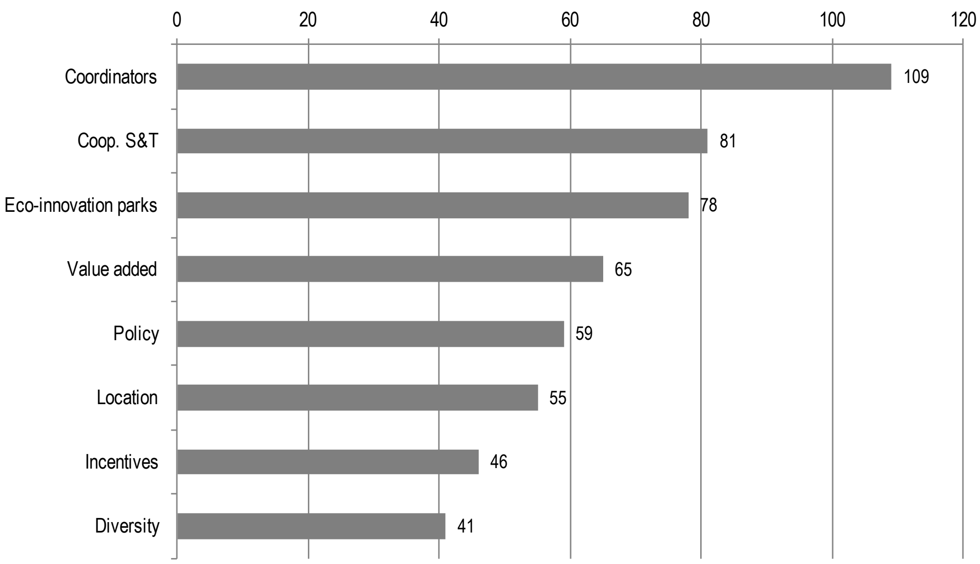
The majority of identified eco-innovation parks have activities related to 2 to 5 eco-criteria. Only few already follow a holistic approach, with the identification of 8 or more eco-criteria. This includes the London Sustainable Industries Park (8 eco-criteria, Park no. 116, United Kingdom), Masdar city (8 eco-criteria, Park no. 157, United Arab Emirates), the Organic City (9 eco-criteria, Park no. 69, Luxembourg), the Tianjin Eco-city (10 eco-criteria, Park no. 131, China) or the Malmö Cleantech city (11 eco-criteria, Park no. 101, Sweden). Such initiatives are mainly found in urban area but are partly completed or still in the development phase. An existing and fully operational eco-innovation park including the multiple eco-innovation dimensions is thus still missing.

1.7.3 Success factors for eco-innovation parks and the management of industrial areas

The successful development and operation of eco-innovation parks is identified to be principally linked to the availability of human power to coordinate operational activities as well as perform research and development. The clear designation of a park as an Eco-Innovation Park and the willingness of businesses to substantially improve their economic status are also key success factors.

Fig. 9 shows the statistical analysis based on 168 detailed experiences (See section 1.3 for success factors description).

Fig. 9 > Occurrence of success factors among case studies



Success factor 1: Organizational and institutional setups (*Coordinators*)

The success factor with the highest occurrence is related to the organizational and the institutional setup of eco-innovation parks (Coordinators, Occurrence: 109 over 168 eco-innovation parks, hereafter abbreviated as 109/168). Many successful experiences integrate some form of coordination body contributing to inter-firm contacts and collaborations either as a platform for trust and dialogue or as a management center for joint infrastructures and/or services. At the first stage of any project, the major role of the coordinators consists in recruiting participating firms, motivating the involvement of private sector firms by supporting cost-benefit analysis, providing political and managerial support, educational services and information and supporting project development. Unfortunately, such projects tend to stop when their budget is depleted. To foster the implementation of identified opportunities, the entity willing to initiate eco-innovation activities should appoint or set up an efficient and legitimate coordination body to act as a facilitator. The presence of an effective coordination body on the site is confirmed as the main success factor in this study as it contributes to foster trust and dialogue among stakeholders.

Coordination bodies described in the case studies are mainly of two kinds with (i) private or public-private partnership (PPP) entities active as facilitators at the industrial park scale (utility providers, service providers, anchor tenants of the park such as energy producer and associations of economic players) or (ii) public institutions active at broader geographic scale but developing incentives and policies for industrial or urban areas or a group of industrial areas around a city.

Both solutions can be effective, depending on pre-existing structures as well as institutional and cultural contexts. If public policies are clearly oriented to favor resource efficiency and innovative solutions, service and utility provision in industrial areas may be reinforced.

In mature eco-innovation parks, services of coordination bodies potentially include:

- Development of business models
- Project development and management
- Risk control mechanisms
- Communication, awareness raising and social networking
- Interaction with public administration
- Management of shared infrastructures and services
- Economic promotion and place promotion
- Assistance for the settlement of firms

If the coordination body integrates communication and information technologies, it may in addition facilitate the identification of feasible opportunities for eco-innovation and monitor the performance of the network over time (Grant et al. 2010). In any case, specific skills are needed to ensure the dialogue between company management and engineers. For a broad overview of services that may be provided by such entity, see parks managed by Infraserv (Germany, Park no. 37 and 48) or Cimo – Monthey Chemical Park, (Switzerland, Park no. 107).

Success factor 2: Cooperation with Science and Technology institutions (*Coop. S&T*)

In addition to the organizational setup, eco-innovation at the industrial park scale often requires to develop or adapt new technologies and systems to a specific context. Another important aspect at the tenant's level is the possibility for firms to jointly develop new products with a scientific partner. Cooperation with science and technology institutions**,** speeding up the adaptation and the implementation of eco-innovative solutions, was the second most relevant success factor identified (81/168). As an example, the Centre for Sustainable Resource Processing (CSRP) at Curtin University in Australia supported the Kwinana Industrial Association (KIA) in identifying potential industrial symbiosis between economic players (refer to Park no. 118). Such collaborations also reinforce educational programs and contribute to train a new generation of professionals.

While these programs are habitually oriented towards technical and engineering or environmental protection issues, organizational and economic knowledge related to eco-innovation parks should also be consider in engineering as well as in business schools.

Success factor 3: Clear designation of the park as eco-innovation park (*Eco-Innovation Park*)

The clear designation of industrial parks as eco-innovation or eco-industrial park mostly serves economic promotion and regional development purposes (78/168). Still, the goal of most economic promotion services is centered on attracting companies rather than promoting eco-innovation. The new trend lies in the design of incentive strategies to develop common infrastructures in order to reduce investment costs for companies and to promote resource efficiency and renewable energy vectors as an argument to promote regional economic resilience.

Success factor 4: Economic value added (*Value added*)

Another major reason for firms to settle down in an industrial park appears to be the economic value added (65/168) of the common interfirm activities aiming to reduce expenses and/or increase profit. Because eco-innovation often focuses on providing efficient technical solutions for resource efficient management, investment costs are often seen as a hurdle. The challenge consists in providing economically viable solutions for companies. Either provided by a coordination body or by a consultant, cost-benefit analysis plays a central role to foster eco-friendly and economically-sound decisions by companies. The presence of companies may attract companies with complementary activities (see also success factor 8: Diversity)

Success factor 5: Policy & regulation frameworks (*Policy*)

Legal, policy and institutional support to companies provided by state and local government also contribute to foster eco-innovation and seem to be slightly more important than financial incentives as success factor (59/168 versus 46/168).

A large range of policies may be developed to create a dynamic of change leading to the success of an eco-innovation park. Public authorities play a crucial role by setting up regulatory measures and controlling environmental impact. As an example, the polluter-pays principle clearly contributed to the development of the recycling industry and to the first cases of industrial symbiosis in Europe, namely the Kalundborg – Sustainable City (Denmark, Park no. 14).

Control procedures are not the only purpose of public policies. During the last decade, many European countries developed incentive measures aiming at initiating and supporting change among companies. However, pilot projects supporting resource efficiency at the park scale are very often limited in time. In order to drive change in the long run, those activities should be included in the mission statements of public services.

Success factor 6: Geographical factors and regional infrastructure (*Location*)

Many regional development strategies focus on economic and employment issues. Within this context, the location of a park and the regional infrastructure may influence the implementation of eco-innovation. Together with the choice of industrial sectors, the selection of an adequate location may already happen during the regional development procedures and discussions about land use issues and the location of the new park (Jensen et al. 2012). Such park design influences the companies supply chain, commercialization and access to qualified resources. Locally, the selection of industrial land directly influences resource efficiency in later stages of development (55/168). Thus planning new industrial areas entails to consider issues like material and energy flow management from the beginning of the regional development strategy.

Success factor 7: Financial incentives (*Incentives*)

Financial incentives may also play a central role to initiate change towards implementation of eco-innovation with the help of innovative funding models (e.g. public-private partnerships) (Sakr et al. 2011; Van Berkel et al. 2009a). Mechanisms to undertake financial risk, like temporary loans with zero-rate interests, may significantly increase the rate of success and shorten the project development period by contributing to secure funding. Incentives can also be provided as technical or organizational support to companies. As an example, the National Symbiosis Programme in the UK (refer to 2.19) provides free consulting services for companies to develop business models in order to divert waste from landfill. Their service is sponsored by the national government based on the benefits of the escalator landfill tax. The survey however suggests that financial incentives are of second importance (46/168).

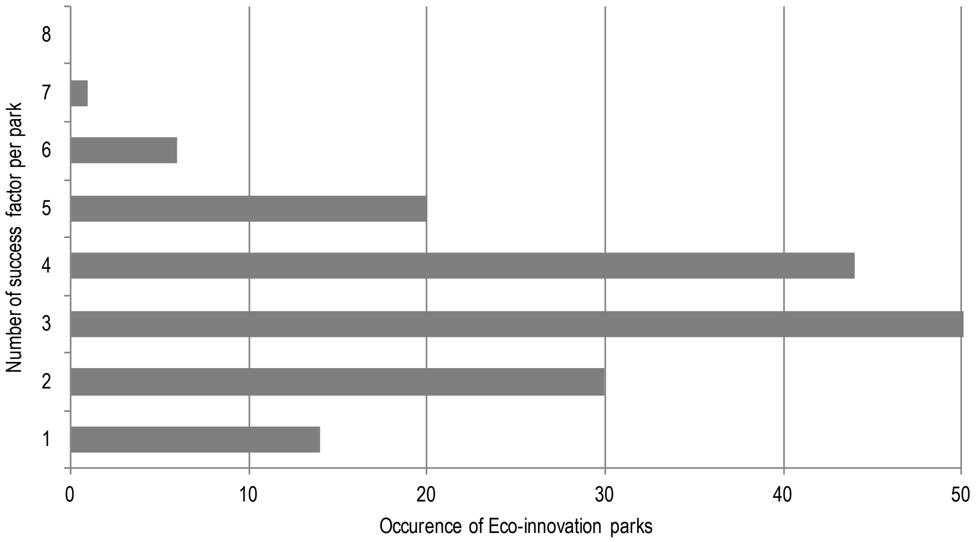
Success factor 8: Local diversity of economic activities (*Diversity*)

Introducing the eco-innovation park concept in regional development strategies contributes to business diversification and to the emergence of new industries. At the same time, it helps to achieve significant operational savings for the companies. As a consequence, fostered sustainable design, architecture and construction, cooperation and innovation, together with novel technologies and knowledge sharing among business within a park (Deutz et al. 2004; Gibbs et al. 2007).

Innovative inter-firm collaborative networks are more likely to develop if various economic activities are already present in the park with the capacity and the power of commitment to recover waste and exchange material and energy flows with a long-term perspective. Likely, because collaborative networks can continuously be optimized with new firm implementation, the diversity of businesses on-site shows little occurrence as success factor (41/168).

Concerns could come up in the case of closure or relocation of firms when an interdependent network has been established in a park. Eco-innovation parks, like other parks have to respond to changes in economic circumstances. The existence of an active coordination body plays a major role in driving change successfully and contributes to sustain eco-innovation in industrial park.

Fig. 10 > Distribution of success factors among Eco-innovation parks



For almost all identified eco-innovation parks a combination of success factors is identified (Fig. 10), confirming multiple-level approach as a prerequisite to favor successful development and implementation of eco-innovation. The Mipo and Onsan EIPs (South Korea, Park no. 153) show the highest number of success factors.

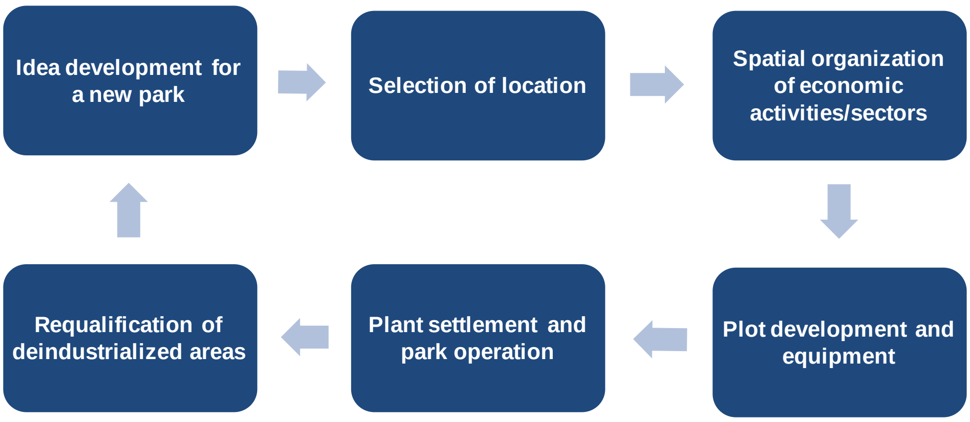
The main question regarding the successful transition to eco-innovation parks is: who is taking care of the system? In many case studies, limited knowledge about the potential or benefit of technical and organizational innovation and uncertainty among firms were identified as prominent barriers for the implementation of eco-innovation projects. There is a huge need to spread information on successful eco-innovation parks in order to gain more support from community and private sector.

In this perspective, the trend in most countries running eco-innovation and eco-industrial park programs in the framework of national strategies (like Korea, China, and USA) consists of gradually expanding actions starting with pilot projects. Successful experiments can be used as communication material to replicate best practices and spread them throughout cities and regions (Chertow 2007; Mathews et al. 2011; Park et al. 2008; Shi et al. 2012).

1.8 Conclusion: Perspectives for the creation and management of eco-innovation parks

The spreading of eco-innovation requires a consideration of each of the six life cycle stages of an industrial park as an opportunity for action (Fig. 11). Public and private stakeholders in charge of environmental protection, land use and economic development strategies should jointly develop activities and guidelines to foster innovative organizational and economic models for the planning, design, construction, operational and requalification phases of industrial development. Innovative and sustainable industrial development should be achieved at each phase by balancing governance, ecological, resource, economic and community issues. As perspectives, this chapter presents methodological elements and tools to plan new industrial areas and to turn existing areas into eco-innovation parks.

Fig. 11 > Life cycle of an industrial park



1.8.1 Planning an eco-innovation park

Several case studies in this study reveal a positive trend in the consideration of eco-innovation during the planning phase, prior to company settlement (Nogen Industrial Bassin, France, Park no. 28; Chablais eco-industrial region, Switzerland, Park no. 106; El Pedregals, Spain, Park no. 87; Hunter industrial ecology park, Australia, Park no. 117). Designing and planning an eco-innovation park requires the consideration of eco-innovation in the different steps of the project development:

1. Zoning concept and development of a masterplan
2. Validation by public authorities
3. Land use control and optimization
4. Setting up of the zone governance bodies
5. Establishment of detailed sectorial, equipment and plot allocation plans (infrastructure design)
6. Consultation by state services
7. Public inquiry

The implementation of eco-innovation should be particularly considered during the zoning concept (step 1) and the governance and infrastructure design (steps 4 and 5). First, the zoning concept is the core document to introduce guidelines and covenants for resource efficiency, specific environmental measures or logistics. In addition to economic development goals, the zoning concept may specify environmental standards at the park scale (e.g. eco-industrial park or zero-emission park). Many European countries introduce Strategic Environmental Impact Assessment procedures to foster collaboration between planners and environmental experts. This allows to consider environmental issues during the planning, development and validation phases of projects and programmes (FOEN 2013). Current trends include extending the panel of experts to largely cover most possible eco-innovation competences (i.e. eco-criteria as defined in this study):

- Industrial ecology to provide a systemic view of economic activities
- Industrial symbiosis to develop interfirm collaboration
- Territorial energy planning to favor renewable energy, energy cascading, and energy efficiency
- Water management
- Waste management
- Mobility, freight transportation and logistics
- Landscape and biodiversity conservation
- Noise prevention
- Air protection
- Industrial risk management

Applying material flow analysis on planned activities may lead to the identification of solutions to foster resource efficiency prior to the settlement of the parks' tenants. Incorporating such industrial symbiosis opportunities in the planning phase may highlight geographical proximities that provide economic and environmental value added. Proximity between complementary firms helps to reduce transportation, while clustering facilitates shared access to information and knowledge networks, business synergies and partnerships, markets, resources and support institutions. The cluster concept focuses on the functional linkages and interdependencies among actors in value chains. In this sense, clustering stimulates innovation.

Innovative governance structures are also needed to provide and extend services to companies in order to incorporate eco-innovation measures at the park scale (1.7.3). While the specific type of coordination body may be identified during the Strategic Environmental Impact Assessment procedure, the setting up of the coordination activities, however, has to be distinctively managed in a further step.

Finally, concrete opportunities detailed in the planning phase should be turned into viable business models in the equipment plans. Shared infrastructures and networks are designed, including space reserve for further networks development. Planning common infrastructures leads to lower investment costs for the parks' new tenants and contributes to reduce financial risks. The objectives here are to stimulate change by setting up incentives and developing a strong collaboration framework that motivates companies as well as to reduce risks due to isolated actions.

1.8.2 Turning an existing industrial area into an eco-innovation park

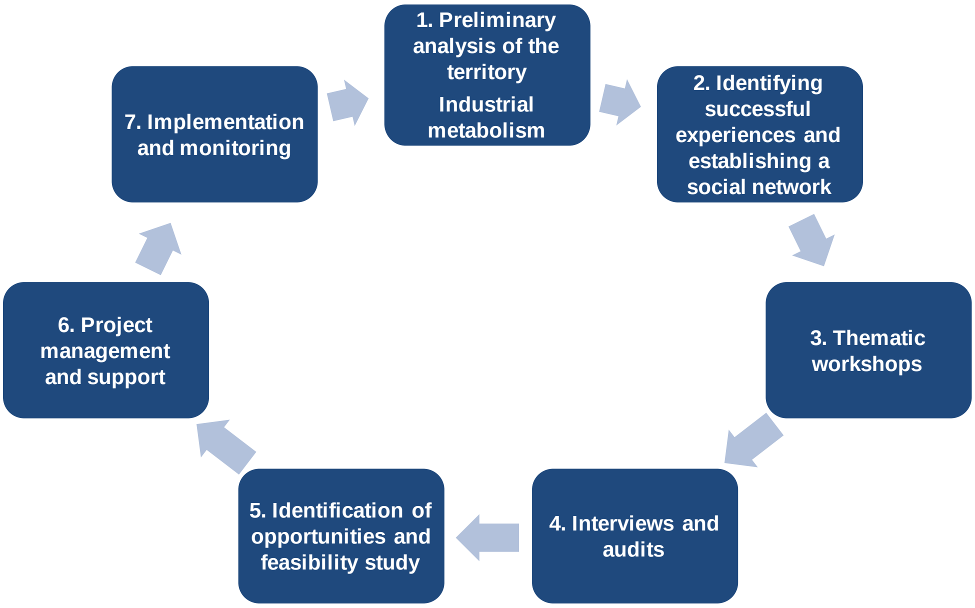
The statistical analysis of eco-criteria highlights the importance of and a clear trend in assessing material and energy flows in existing parks in order to develop industrial symbiosis and/or to set up resource efficient strategies. Centralizing knowledge on material and energy flows appears today as an efficient tool to foster a transition from a linear industrial system to a closed-loop system mimicking biological ecosystems.

Developing social networking and trust among economic player to implement inter-firm collaboration and thus foster eco-innovation implementation implies the existence of a project management body (success factor 1). As detailed in section 1.7.3, a service provider, a public institution or an external consultant can act as a facilitator to foster the emergence of inter-firm collaboration (Fig. 12). Different countries have been developing such procedures simultaneously (Adoue 2004; Chertow 2007; Costa et al. 2010a; Erkman 2001; Grant et al. 2010; Lowe 1997; Massard 2011; Van Beers et al. 2005). Successfully implementing eco-innovation solutions can vary in the implementation time from immediate measures for "simple" resource exchanges up to 5–10 years for the development of shared infrastructures.

To assist facilitators and experts, several tools have been developed to store and analyze data on material and energy flows. Most tools focus on supporting the identification of potential industrial symbiosis, with few of them including functionalities for project management and technical assessment or integrating geographical information systems (Grant et al. 2010).

In addition, tools like life cycle analysis for environmental issues and social life cycle analysis for social issues should be used more systematically to guide the development of adapted business models.

Fig. 12 > Methodology for the development of interfirm collaboration



after Massard 2011

1.8.3 Recommendations, synthesis and concluding remarks

Eco-innovation parks intend to host commercial enterprises with piloting installations and processes that incorporate environmental technologies and services, and sometimes also institutions dedicated to research and development. Twelve dimensions of eco-innovation at the park scale and factors linked to successful experiences have been identified.

The following recommendations summarize best practices for the successful development of an eco-innovation park or the transformation of an industrial area into an effective eco-innovation park:

Organizational set-ups

> Spreading information on successful eco-innovation parks to gain public and private sector support
> Setting up an efficient and legitimate coordination body to act as facilitator and foster the implementation of identified opportunities through eco-innovation.
> Collaborating with science and technology institutions to speed up adaptation and implementation or facilitates the design of eco-innovative solutions
> Providing economically viable solutions for companies through innovative policy framework or funding models (e.g. public-private partnerships)
> Selecting the park location and principal industrial sectors directly influences resource efficiency in later stages of development. Planning new industrial areas entails to consider issues like material and energy flow management or mobility and transportation from the beginning of the regional development strategy through extended Strategic Environmental Impact Assessment procedures.

Technical set-ups

- Developing shared infrastructures for energy production and distribution adapted to on-site demand: shared production and production of heat and steam for industrial processes (e.g. through efficient cogeneration plants fueled by waste and biomass) and shared infrastructures for electricity production using renewable energies Developing shared infrastructures for wastewater collection and (pre-)treatment to mutualize water management.
- Building a shared network to supply non-drinkable water to economic players in order to favor water efficiency and save drinkable water as well as attracting waste recycling companies using cutting edge technologies for specific waste stream from on-site companies
- Identifying locally available recycling activities to assess the opportunity of developing either shared contracts for waste collection or an integrated waste management platform for the entire park and its surroundings.
- Creating business incubators to attract innovative production companies and to develop shared services for all parks' tenants (e.g. shared meeting rooms, cafeteria, childcare, health care, entertainment). The facility can also host a service center providing other services like training programs, security checks or car sharing.

The above recommendations are complementary to measures implemented at the company scale such as eco-design of products or other resource efficient (e.g. sustainable building, energy efficiency, water efficiency and recovery) and cleaner production actions.

Towards an international standard for eco-innovation parks

Due to a lack of standardized methods to measure eco-innovative accomplishments in terms of quantity and/or quality, the specific and long-term success of eco-innovation parks remains however difficult to evaluate and compare. As economic and institutional structures vary, setting standards for industrial areas is a complex process. The Chinese legislation seems to be the only one offering a national set of indicators to recognize a park as an eco-industrial park. The main indicators focus on resource efficiency measures like energy and water consumption, wastewater and solid waste generation per unit of added value, solid waste or water reuse ratio, the existence of a centralized facility for waste treatment or the existence of an environmental management system at the park scale (Geng et al. 2008; Van Berkel 2010). Similar initiatives may develop in the near future, providing a solid basis for the creation of an international monitoring standard for eco-innovation parks.

2 > Survey for European countries

2.1 Austria

Austria is one of the leading economies in Europe with strong assets in tourism (country's most important industry), machinery, metallurgy, and textiles. The industrial development seems to be managed by the Federal Ministry of Economy, Family and Youth (BMWFJ 2013) and the Federal Ministry of Environment (Lebensministerium 2013).

The screening identified two parks and one large sustainable urban development project. No large-scale industrial park was clearly identified as an eco-innovation park. Apart from local and specific projects, no political context or national programs seem to foster eco-innovation park initiatives at the national scale.

Besides, Austria hosts an interesting case of energy network described in chapter A1 Bioenergie Mureck.

Park no. 1: Aspern Vienna's Urban Lakeside

Austria

Geography	Austria, Vienna	
Type of park	Urban	
Size of park	24 ha	20 000 jobs
	N/A companies	20 000 inhabitants
Eco-criteria	Renewable energy Energy efficiency ~~Waste management~~ ~~Water management~~ Biodiversity ~~Material flow~~	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ Air pollution prevention Noise prevention ~~Environmental Mgmt System~~
Status	Under construction	
Project leaders	Private	
References	Internet links www.aspern-seestadt.at/en/	

Origin

This ambitious urban development project aims to ensure harmony between city and nature, taking into account different aspects of sustainability and developing innovative architecture and urban design. It will include an economic hub, a business and high-tech centre, a research and education quarter, as well as a recreational zone.

Objectives

Regarding eco-innovation, the project covers (at least conceptually) various fields of action, including flora and fauna, mobility, efficient use of resources, microclimate, noise and dust prevention during construction, construction material and logistics, etc. Environmental Impact Assessments (EIA) are conducted in order to assess potential harmful consequences of the project and develop the necessary preventive measures. A specific project, NACHASPERN, is addressing the responsible management of resources in an urban development context. It comprises an overall energy concept (including demand analysis, energy efficiency and promotion of renewable energies) and a specific set of criteria to monitor an integrated development, including mobility and urban design.

Success factors

The developers closely *collaborate with research institutes* to set up demonstration projects and provide feedback for research through their implementation. Many local and international public and private actors support the project (*coordinators*), which is part of the "Energy of the Future" national program and benefits from both *policy* and *financial incentives*. Besides, the project's site is well connected to the Vienna's urban center and its transport network (*location*).

Perspectives

Aspern Vienna's Urban Lakeside will be constructed in several phases over a period of at least two decades. The first major stage of construction (2008–2017) includes residential and business units over a gross area of 6.5 ha. In addition, there will be offices, retail and service companies as well as R&D centers.

Park no. 2: Eco-World Styria

Austria

Geography	Austria, Styria	
Type of park	Industrial	
Size of park	N/A ha	14 000 jobs
	170 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Public	
References	(Schwarz et al. 1997); (Posch 2010) Internet links www.eco.at/cms/223/English/	

Origin

Eco World Styria is a globally leading business cluster in energy and environmental engineering located in the Green Tech Valley. This cluster was initiated by the Styrian business promotion agency SFG, a public service dedicated to the styrian economy. This group is the major property of the state of Styria.

Objectives

Eco World Styria supports the companies in the areas of energy and environmental engineering (e.g.: biomass, solar energy, mass flow and water/wastewater) with services and projects focusing on innovation, know-how, and new markets. Eco was chosen for: “Employment” – increase to 20 000 the employees of Styrian environmental technology companies by 2015, “Competence” – double the number of Styrian technology leaders, and “On top” – increase the international presence in the media. The Styria industrial recycling network has one of the highest materail recycling rate in Europe (about 80%) with most important by-products exchange involving waste paper, wood residuals, ashes and scrap metal.

Success factors

The Styrian network includes five universities in Austria and numerous companies in the green tech industry in Austria. One main success factor is therefore the *cooperation with science and technology institutions*. Other success factors are *coordinators* and *economic value added* and clear designation as an *Eco-Innovation Park*.

Perspectives

Future developments are unknown.

Park no. 3: Ecopark Hartberg

Austria

Geography	Austria, Steiermarck	
Type of park	Industrial	
Size of park	15 ha	200 jobs
	30 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ Material flow	Cultural, social, health benefits ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	PPP	
References	(Liwarska-Bizukojc et al. 2009) Internet link www.oekopark.at/de/gewerbe.html www.oekopark.at/tl_files/oekopark/startseite/oeko-broschure_web.pdf	

Origin

Hartberg Municipality (Stadtwerk Hartberg) created the Ecopark Hartberg in 1997 in order to redevelop the industrial estate. It combines theory and practice around three key words: business, research and experience. The site is adapted to companies concerned with the production of any goods and environmental services or technologies.

Objectives

The eco-innovation park provides comprehensive facility services: cleaning, garden, snow removal, security, and office services. In addition to an organic supermarket, a private school and a kindergarten are also available on site. The central building hosts major events, lectures and corporate events. It also includes two cinema rooms with 300 seats each. The supply of electricity, heat and cold for the entire eco-park is CO_2-neutral with a central heating and cooling system based on biogas, photovoltaic, biomass and wind turbines. Also ecological waste management, wastewater treatment and rainwater collection are part of the integrated approach. Indeed the manufacturer of cellulose insulation uses, apart from raw materials, waste paper from onsite consumption (Newspaper, restaurant, cinema) thus creating a symbiotic relationship.

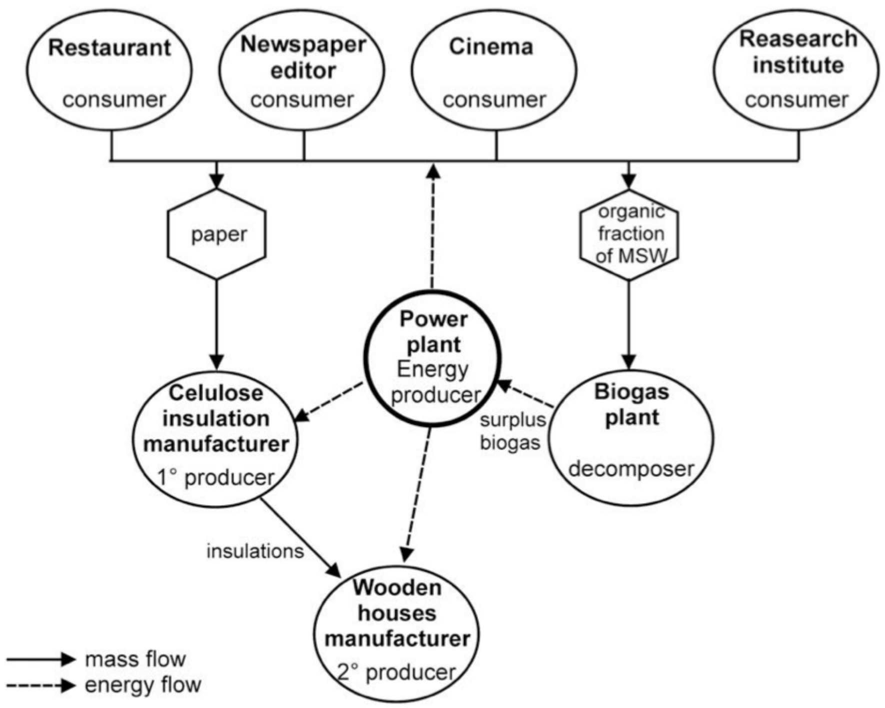
Success factors

The development of the Ecopark Hartberg was supported not only by Hartberg Municipality, but also by the federal government of Austria and the European Union (*incentive* and *policy*). Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

Future developments are unknown.

Fig. 13 > Main material and energy flows in Ecopark Hartberg



after Liwarska-Bizukojc et al. 2009

2.2 Belgium

Since 1988, Belgium is a federal estate constitued by 3 differents regions : Brussels city, Walloon region and Flanders. Despite of remaining a federal estate, several competencies such as industrial and economic policy including business parks equipments, have been transfered to regional governments.

Many eco-innovative strategies exists in the three regions. According to the eco-innovation observatory (Eco-Innovation Observatory 2013), the country’s leading eco-innovation areas are energy efficiency, sustainable construction, sustainable water management and urban greening. Newly emerging eco-innovation areas include biodegradable materials, products based on biosynthesis, and hydrogen energy.

In the Walloon region, under the Marshall Plan 2.Green (Portail De La Wallonie, 2013a), the regional government has dedicated the sixth Competitiveness Cluster to new environmental technologies. One of the main measure was to initiate a call for eco-zoning projects with the Minister’s office for economy (Portail De La Wallonie, 2013b), small and medium-sized firms, developing new technologies and higher education. Recently, the regional government has initiated a regional metabolism study and a awarness campaign for IS and eco-industrial development (Marcourt 2013). Also, the Life SMIGIN project – “Sustainable Management by Interactive Governance and Industrial Networking” – supported 150 SME in France and Belgium between 2006 and 2009 to promote innovative participative approaches on energy, water, raw material and waste management, mobility and land planning in industrial parks (Conseillers Environnement De L’union Wallonne Des Entreprises 2013).

The Flanders region has advanced towards incorporation of the systemic transition concepts and Sustainable Materials Management Program (Vlaanderen in Actie 2013). The Brussels Capital region in 2011 continued its measures aiming to make the city become a role model in sustainable development and promoting initiatives in eco-buildings, energy, water, waste and green public procurement.

At the park scale, equipment operators often manage existing business and industrial parks. Their main tasks are to facilitate corporation settlments and provide adequate infrastrutures. Operators approach is currently dedicated to build sustainable industrial zoning, called eco-zoning (Bory et al. 2011).

No significant data on the following potential eco-innovation parks is detailed in the literature at the time of this review:

- Ardenne Logistics
- Waregem – Transvaal
- Kamp C – Westerlo

Park no. 4: Créalys® Scientific Park

Belgium

Geography	Belgium, Walloon région, Province de Namur	
Type of park	Industrial	
Size of park	110 ha	1738 jobs
	100 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ Mobility, transport Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leader	Public	
References	Internet links www.invest-in-namur.be/FR/Crealys/, www.idealys.be/fr/activites/projet-life/index.html www.lesoir.be/regions/namur_luxembourg/2011-02-15/l-incubateur-regain-a-crealys-822164.php	

Origin

Créalys® firm group (Idéalys) and the Namur Province economical office (BEP) seized the opportunity offered by the LIFE-Environment project (from the European allocation program LIFE-Smigin) led by the Walloon Firms Union in partnership with the Chamber of commerce of “Valenciennes” in 2008. LIFE-Environment is a project dedicated to the business parks collective management of environmental issues. Seventeen firms settled on Créalys® have expressed their interest to a collective management of waste, energy, mobility and landscaping.

Objectives

In 2009, Créalys® became the first walloon parc certified ISO 14001. Main activities in the thematic park include life sciences (agribusiness, bio-industry, health, bio-technology) and information and communication technologies. Large firms such as GlaxoSmithKline Biologicals, Vinçotte, Arseus, SGS (Société Générale de Surveillance) and small businesses or spin-off such as Isomatex, Aseptic Technologies, Coris Bio Concept, NSI, BNG Automation, Straticell are settle in the parc. BEP usually in charge of the management, animation and coordination is also in charge of water management, environmental improvement during firm settlement projects and “Regain” building experience diffusion. BEP 1300 square meters are formed with 3 low energy workshops, around ten offices, a meeting room and shared spaces, all passive energy consumption certified. “Regain” European program which fosters investors to invest in high energy perfomance building or renovating, is the basis concept of this park. BEP and Idéalys also implemented a shuttle transportation system between Namur Station and Créalys®.

Success factors

The BEP office in the park and its role in fostering collaboration between firms is among the key success factors (*coordinators*). The strategic geographical position between two European corridors and the accessibility are also manifest success factors (*location*). Finally, the Créalys® labelling broadens visibility (*Eco-Innovation Park*).

Perspectives

A 55 hectares extension should be equiped in 5 or 6 years. Moreover, several projects are about to be realized like a parking, a pedestrian zone and landscape reshaping study in collaboration with Gembloux municipality during 2012. The firm association Idéalys is also working on its extension within the next park of Ecolys/Rhisnes.

Park no. 5: Ecolys® Park

Belgium

Geography	Belgium, Walloon region, Province de Namur	
Type of park	Industrial	
Size of park	45 ha	1300 jobs
	37 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management Biodiversity ~~Material flow~~	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	Under construction	
Project leader	Public	
References	Internet links www.invest-in-namur.be/FR/Ecolys/ www.blog.pages-energie.com/namur-ecolys-zoning-ecoconstruction.html www.wallonie-developpement.be/fr/article/article-66/Ecolys---un-parc-d-activite-dedie-a-l-eco-construction/	

Origin

After Créalys®, the intermunicipal BEP office initiated the Ecolys® park. The park dedicated to the eco-construction and sustainable building has the ambition to become a model in the Walloon region. A narrow collaboration was set with 3 actors: Cap 2020 (government body), ASBL Bois and Habitat (private companies). Ecolys® us supported within the frame of the 2010 Eco-zoning call for projects of the Walloon Ministery of Economy.

Objectives

Officially opened in 2011, Ecolys® is an extension of Namur-Nord-Rhisnes park. The whole park owns one big agribusiness firm, Kraft Food, several small manufacturing firms and others actors working in the field of consulting and distribution, and it represents. Three distinct parts constitute Ecolys®: a consulting zone which is the eco-construction showcase, an industrial zone for firms in compliance with the sustainable development rules and a mixed zone for craft industry and small businesses. The park focuses on sustainable development issues through a high standard urbanisation: development plan including renewable energy use and landscape shaping to stimulate biodiverstiy on the whole area, and an architecture based on the energy efficiency concept. Bike infrastructure, public bus transport, and car sharing are under development. The Ecolys® park is certified as ISO 14001.

Success factors

The Ecolys® labelling (*Eco-Innovation Park*), the BEP management (*coordinators*) and the geographical situation in the crossroad of Europe are among the main success factors (*location*).

Perspectives

Ecolys® park plans a bio-methanisation plant in order to centralize organic waste from local food processing industries in the Rhine area, a green heat network construction, an industrial wastewater treatement optimization and a collective solid waste management.

Park no. 6: Evolis Business Park

Belgium

Geography	Belgium, Flanders Region, Courtrai	
Type of park	Combined	
Size of park	45 ha	N/A jobs
	4 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ ~~Waste management~~ ~~Water management~~ Biodiversity ~~Material flow~~	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leader	Public	
References	(Bory et al. 2010) Internet links www.evolisbusinesspark.be/fr	

Origin

The intermunicipality of Leiedal developed a high standard project under the Evolis labelling. Since 2007, the project was designated 'top-project' by the regional authorities which brings financial allocation from the Flanders Region. Henceforth, this 'top-project' label includes a new criteria which is the energy neutrality.

Objectives

Leiedal is working on several zone features such as: a high standard planning with landscape planners, green spaces collective management, an ecological corridor; four wind turbines installation (already operating); the construction of a biomass power plant (operating partially with local organic wastes) to feed a hot water network connected as heating system with local firms and different infrastructures (municipal swimming pool, University, exhibition hall, and other firms settled outside the park area); pedestrian and cycling routes with a cycling shuttle between the bus stop and the different firms.
Officially opened in 2009, the park seems not to have any settled firms but the intermunicipality of Leiedal wants a selective occupation including innovative firms with high added value and strongly oriented on the international market.

Success factors

The collective management is the main success factor because this is a non-lucrative association, which plan to include all settled firms (*coordinators*).

Perspectives

The settlement of companies is the current challenge. Next to the park, an area is dedicated to urban and business services development. Planned activities are: minimarket, nursery, post office, bank, restoration, hotel and conference room.

Park no. 7: Galaxia Industrial Park

Belgium

Geography	Belgium, Walloon Region, Province du Luxembourg	
Type of park	Industrial	
Size of park	23 ha	N/A jobs
	6 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ ~~Waste management~~ Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	Internet links www.idelux-aive.be www.galaxia-park.eu www.smartworkcenters.be/centers/galaxia www.wsl.be/fr/p/transinne-wsllux	

Origin

Idelux, the intermunicipal body for the economical development has the main task of generating innovation in the Belgium province of Luxembourg. Idelux is in charge of Galaxia park management dedicated to spatial applications.

Objectives

Besides the constructible area reserved to firms in the spatial sector and the educative center “Euro Space Center” that offer seminar rooms, the park has also a business center. This center has to gather confirmed companies and spin-offs thanks to the WSLlux incubator, providing workspaces and services to companies active in the sector of spatial technologies. The business center is a model of infrastructure because of its energy autonomy thanks to 4700 square meter of solar panels and its air/air heat pumps, and its rainwater harvesting system. Moreover, the center added best available IT technology to ensure safety for people and data.

Success factors

Idelux support to companies (*coordinators*) and the localisation on the European axis Brussels-Luxembourg-Strasbourg are the success factors (*location*).

Perspectives

The main preoccupation for the park development is to support companies’ research and development activities.

Park no. 8: Kaiserbaracke Industrial Park

Belgium

Geography	Belgium, Walloon Region, Province de Liège, Amel	
Type of park	Industrial	
Size of park	34 ha	>70 jobs
	4 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(Arene 2009); (Bory et al. 2010) Internet links www.bspace.be/en/spi/parc/kaiserbaracke-amel/823	

Origin

Initially, the park was not connected to gaz or electricity network and had only generators. Between 2004 and 2005 when the fuel oil price increased significantly, four firms specialised in the wood and cogeneration sector decided to substitute the previous energy supply with alternative solutions. Since the end of 2006, a collective cogeneration plant burning wood wastes supplies the companies with heat and electricity. Since 2009, a second wood boiler and an emergency diesel boiler using vegetables oil are securing the energy supply. Although this project initially arose from the private initiative, it is now promoted by the intermunicipal agency for the economical development SPI+.

Objectives

There is a specific material flow network in Kaiserbaracke. Holz Niessen sorts the wood. Half is sold to the Belwood sawmill. The sawmill processes 50% of the wood for the fabrication of finished and semi-finished products. The other half part is composed of bark and sawdust. The sawdust is then partially transformed as pellet thanks to Delhez Bois Company. Uncontaminated wood by-products feed the wood boiler operated by Renogen. The heat produced dries Belwood boards and Delhez sawdust. As direct sell of electricity to local consumers is forbidden, the electricity produced by the cogeneration plant is sold through the public electricity network. Finally, the ashes are reused at the regional scale in the cement industry sector as substitution material.

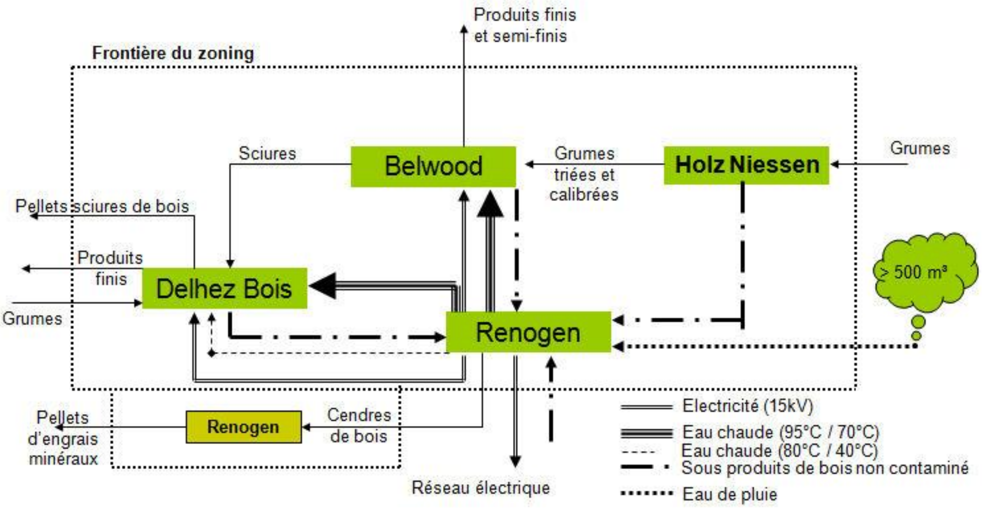
Success factors

The openness and the stakeholder commitment are considered as the key success factors. The simplicity of the legal frame that specifies the market mechanisms is also highlighted (*policy*).

Perspectives

No data on future development plans was found.

Fig. 14 > Industrial symbioses in Kaiserbaracke



after Bory et al. 2010

Park no. 9: Monceau-Fontaines Park

Belgium

Geography	Belgium, Walloon Region, Charleroi	
Type of park	Industrial	
Size of park	2.5 ha	>150 jobs
	16 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(Bory et al. 2010) Internet links www.monceau-fontaines.be	

Origin

This park is located on a disused industrial area housing one of the biggest French Coal Board of the Charleroi coal basin, named Monceau-Fontaines. In 1993, a “training on the job” company named “Quelque Chose A Faire (QCAF) interested by the area decided to initiate a collective project for a social economy area development. Then this private initiative benefited by the intermunicipal agency for economic development, Igretec, and the Walloon region using the European regional development found (FEDER).

Objectives

Monceau-Fontaines is currently a community area dedicated to social economy. It is managed, presented and promoted by a public-private company called ASBL Monceau-Fontaines. The area gathers 16 partners, associations and firms with a social goal. They offer goods and services in various fields: entrepreneurship consulting, heating services, conference rooms, services to inhabitants (ironing, sewing). The main requested action is to sign and adhere to an ethical charter for social economy.

Success factors

The partner collective management under the ASBL status is the key success factor (*coordinators*). Besides, the historical label of the area brings more visibility to the project (*Eco-Innovation Park*).

Perspectives

No data on future development plans was found.

Park no. 10: Tenneville Industrial Park

Belgium

Geography	Belgium, Walloon Region, Province du Luxembourg, Commune de Tenneville	
Type of park	Industrial	
Size of park	10 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ ~~Waste management~~ Water management ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	Under construction	
Project leader	Public	
References	(Collin 2010) Internet links www.idelux-aive.be www.valideo.org	

Origin

In 2007, the intermunicipal agency for economic development, Idelux, in partnership with Tenneville and La Roche Municipality started the area conception and equipment. At the end of 2010 and several months before the end of the works, the area got the Validéo label, which certificates the business park sustainable development planning.

Objectives

The approach aims at providing a pleasant and respectful working situation. The certification includes 4 themes: quality, comfort, social impact and environmental aspect. The strengths of the park is the introduction of an urban charter, high standard public lighting, a separated wastewaters evacuation network, a pleasant living environment and an appropriate landscaping, the limitation of the local traffic and a firm association.

Success factors

The specific approach of the intermunicipal Idelux is the key success factor (*coordinators*). The certification also represents an added value to the park development (*Eco-Innovation Park*).

Perspectives

Idelux forecasts to integrate sustainable development in several projects in the next years.

2.3 Bulgaria

Bulgaria has been one of the fastest growing Eastern European economies during the last decade. It is characterized by a stable macroeconomic environment, the most favourable tax treatment in the European Union, highly skilled labour force and one of Europe's lowest operational costs. The geographical position of the country provides a strategic connection between Europe and Asia. In addition, the Government, the Municipal Authorities and the various domestic and foreign Chambers of Industry and Commerce in Bulgaria support investment projects.

According to the European eco-innovation observatory, eco-innovative activities seem to exist in energy efficiency improvement in housing, renewable energy sector and in waste recycling. One can expect development of eco-innovation initiatives at the park scale in the coming years (Eco-Innovation Observatory 2013).

Bulgaria listed all its industrial zones to them to foreign investors. The pool is available online and in detailed presentations (Danish Energy Agency 2013; Industrial Zones Bulgaria 2013) 14 fully operational zones grouping local and foreign investors currently exist in the country. 21 zones have either fully or nearly operational infrastructures and about 27 are under development. Most of the industrial zones are launched and managed by municipalities with economic development ambition. A smaller number of industrial zones are managed by private firms/industry or as public private partnerships. In numerous parks foreign investors are key players.

Infrastructures and environmental policy at the park scale seem mostly conventional and the identification of innovative strategies, technologies or infrastructure appears difficult. As a result, none of these zones were identified as true eco-innovation parks. Only the Business Park Sofia offers a general management system similar to what is available in other European countries like Germany. The park is detailed below.

No significant data on the following potential eco-innovation parks is detailed in the literature at the time of this review:

> Elin Pelin Industrial Park.

Park no. 11: Business Park Sofia

Bulgaria

Geography	Bulgaria, Sofia	
Type of park	Industrial	
Size of park	30 ha	10 000 jobs
	N/A companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ ~~Waste management~~ ~~Water management~~ Biodiversity ~~Material flow~~	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Private	
References	Internet links www.businesspark-sofia.com/en/page/61/Green_environment	

Origin & Objectives

Business Park Sofia is considered as one of largest office park in Southeastern Europe. Its activities focus on service industry and the synergies are related to the service sector and general park management.
The owner of Business Park Sofia is Arco Capital Corporation Ltd. Arco Real Estate Management Ltd (subsidiary of the owner) is responsible for the park operation. The facility management team is responsible for the quality of the working environment so companies can focus on their core business. Shared services include: 24-hour security; landscaping; free transportation system inside the park boundaries; CCTV system (Closed Circuit Television); controlled access to each building, cleaning and maintenance of the external and internal common areas; window cleaning and facade maintenance; snow removal; electrical, plumbing and HVAC (Heating Ventilation Air Conditioning) maintenance. A green area surrounds the buildings of the Business Park Sofia. There is also a large lake in the middle of the Park making it an attractive working environment.

Success factors

The main success factors are the coordination by the private entity providing join services (*coordinators*) and their economic value added for companies (*value added*).

Perspectives

No data on future development plans was found.

2.4 Denmark

Denmark is known for its progressiveness in waste policy. For example, it was among the first countries to ban organic and combustible wastes from landfill (Costa et al. 2010b).

Denmark has taken the lead in the green growth initiative. Denmark's official objective is that by 2050 the country will become independent from uncertain and scarce supplies of fossil fuels to heat, move and "keep the wheels of industry turning". In many areas, Denmark is pioneering the development of climate-friendly and energy-efficiency solutions: Kalundborg Municipality accounts for 9% of Denmark's CO_2 emissions, but now aims to be a green industry town; Dong Energy has set itself the target of producing 85% of its energy from renewables by 2040 (Ministry of Foreign Affairs of Denmark 2013)

The Danish regulatory framework has encouraged the evolution of IS. The Danish regulatory system is consultative, open, and flexible. Instead of being put on the defensive, as is characteristic of command-and-control framework, firms are required to be proactive by submitting plans detailing their efforts to continually reduce their environmental impact to the overseeing county government.

A dialogue then ensues in which the regulators and the firm establish goals. A more flexible, cooperative relationship is fostered between government and the regulated industries, and as a result, firms tend to focus their energies on finding creative ways to become more environmentally benign. A key aspect of the flexibility is that regulatory requirements are mainly in the form of performance standards (Adamides et al. 2009).

At a larger scale than industrial parks, Denmark also developed an "Eco-cities" nomination system to acknowledge Danish cities with best environmental performances and programs (focusing mainly on energy and greenhouse gas emissions). 6 cities have been nominated in 2008 and 2009 and have set ambitious goals. For instance, Copenhagen has the objective to become "the environment metropolis of the world" by 2015, and Aarhus, the second largest city of the country, to be carbon-neutral by 2030 (Danish Energy Agency 2013). The latter is described below in a detailed case study.

No significant data on the following potential eco-innovation park is detailed in the literature at the time of this review:

> Aalborg East Industrial Area

Besides, Denmark hosts an interesting case of energy network described in chapter A1: the Avedøreværket CHP Plant.

Park no. 12: Aarhus Eco-city

Denmark

Geography	Denmark, Midtjylland	
Type of park	Urban	
Size of park	9100 ha	151 951 jobs
	N/A companies	315 000 inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management ~~Water management~~ Biodiversity ~~Material flow~~	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Public	
References	Internet links www.aarhus.dk/~/media/Subsites/CO2030/Dokumenter/PDF/klimafolder-engelsk-version.pdf www.sciencedaily.com/releases/2009/11/091130103634.htm, www.ens.dk/sites/ens.dk/files/info/news-danish-energy-agency/fact-sheet/Energibyer%20Engelsk.pdf	

Origin

Aarhus is one of six towns nominated by the Danish government as “Eco-cities”. During the last decades, the city has been particularly active to improve its environmental performance, especially through waste management and waste-to-energy systems. Now Aarhus intends to become CO_2-neutral by 2030 and to reduce its energy consumption by more than 20% before 2020. Moreover, an agreement signed in 2009 with the Danish Society for Nature Conservation commits the city to decrease the annual electricity consumption of municipal buildings by at least 2% per year.

Objectives

To reach its ambitious goals, the City of Aarhus initiated various projects, including the renovation of buildings that are not energy-efficient, the implementation of a citywide energy management system, or the expansion of forest and wetland cover in the region through sustainable management. The city produces biogas with organic waste and has developed an extended municipal district heating system based on waste incineration that replaced individual (often oil-based) heating installations. In 2010, 95% of households were already connected to this system. Furthermore, like several other Danish cities, Aarhus has an extended cycle path system and many public transport possibilities that offer attractive alternatives to an urban mobility based on individual cars. It also plans to develop a network of charge spots for electric vehicles. Besides, the city seeks to establish “climate partnerships” with private companies in order to foster eco-innovative projects.

Success factors

The main success factor is the strong commitment of the municipality to foster innovative systems and projects to reach its environmental objectives and monitor the progress through a set of eco-indicators *(coordinators).* This also includes the development of subsidy schemes to promote energy efficient houses as well as private afforestation projects *(incentives).* Moreover, the City of Aarhus participates in the creation of an innovation centre for energy *(cooperation with S&T).* Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

Even if some results are already tangible (especially in terms of energy efficiency and mobility), most of the programs led by the municipality are still under development and deserve be followed in the years to come.

Park no. 13: Herning-Ikast Industrial Park

Denmark

Geography	Denmark, Midtjylland, Herning and Ikast	
Type of park	Combined	
Size of park	75 ha	N/A jobs
	N/A companies	80 000 inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Stopped	
Project leaders	Public	
References	Internet links www.eaue.de/winuwd/118.htm	

Origin

In the early 1990's, Herning and Ikast municipalities and their Chambers of Commerce have joined their efforts to plan and develop a business area that is based upon ecologically and industrially viable principles. New approaches to planning were adopted, replacing the mainstream zoning principles by principles of integration and IS. The motivation was to respond to the multiple problems of urban disintegration, environmental degradation, competition between municipalities and economic development needs in an environmentally and industrially viable way.

Objectives

The objectives of the project were to improve environmental efficiency and inter-firm cooperation, increase use of clean technology and ecological building materials, reduce resource consumption and waste recycling. The protagonists wanted the future businesses of the park to anticipate the Danish environmental standards. The main economic sectors represented were environmentally advanced businesses and agricultural associations representing the farmers owning land in and bordering the area of the future industrial park.

Success factors

The main success factor results from the implementation of an integrated planning approach through local policy action for implementation of new environmental policies and regulations (*incentive* and *policy)*.

Perspectives

The initiative seems to be stopped at the moment because no activities beyond the planning stage were identified.

Park no. 14: Kalundborg – Sustainable city

Denmark

Geography	Denmark, Sjælland, Kalundborg	
Type of park	Combined	
Size of park	N/A ha	3831 jobs
	9 companies	50 000 inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Tibbs 1993); (Lowe et al. 1995); (Erkman 1997); (Ehrenfeld et al. 1997); (Côté et al. 1998) (Jacobsen et al. 2004); (Jacobsen 2006) Internet links www.symbiosis.dk www.sustainablecities.dk/en/city-projects/cases/kalundborg-industrial-symbiosis-waste-makes-resource	

Origin & Objectives

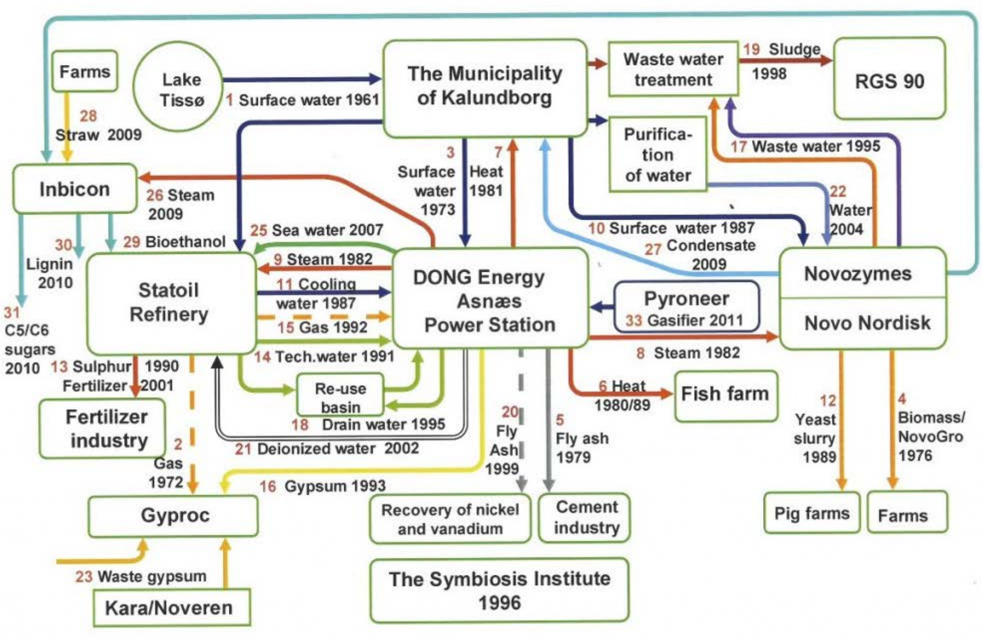
Kalundborg industrial area and municipality is the world's most well-known and documented example of IS and EIP. The whole project began in 1961 with an "external" factor – the scarcity of water – that helped in building close relations among economic players. The first collaboration project aimed at substituting surface water from nearby lake for a new oil refinery, in order to save the limited supplies of groundwater. Then the exchanges started to be motivated by a mutual effort to reduce costs by seeking income-producing uses for "waste" products. Gradually, those involved realized that exchanges of energy and materials could enable both mutual economic benefit and a significant reduction of the environmental impact due to their large industrial operations. The Kalundborg Symbiosis Institute was created in 1996 to encourage, facilitate and manage this kind of business relationships.
Today, Kalundborg symbioses network includes nine public and private enterprises in the Kalundborg area, among which are the world's largest producer of insulin (Novo Nordisk), the world's largest enzyme producer (Novozymes), the largest sewage treatment plant in Northern Europe (Kalundborg Forsyning A/S), the largest power plant in Denmark (Dong Energy) and the largest oil refinery in the Baltic Region (Statoil). The following economic sectors are also represented in the EIP: production of gypsum board (Gyproc), recycling and recovery of waste and contaminated soil (RGS 90), waste treatment company (Kara/Novoren).

Success factors

The basis of the IS cooperation in Kalundborg is open communication and mutual trust between the partners. The synergies are implemented on a voluntary basis. The *diversity of businesses*, the relative geographical isolation of the companies and the awareness of the *economic value added* of the synergies facilitate the emergence of the network. The objective of the symbiosis institute is to implement local more collaboration where public and private enterprises buy and sell residual products, resulting in mutual economic and environmental benefits *(coordinators).* The clear designation as an *Eco-Innovation Park* since the mid-1990' is also consider as a success factor.

Fig. 15 > Industrial symbioses in Kalundborg

The residual products traded include steam, dust, gases, heat, slurry, water, gypsum and sludge.



after Kalundborg Symbiosis, 2013

Perspectives

Kalundborg is now setting its focus on renewable energy and resources. Asnaes Power Station has recently pledged a 50% switch to renewables by 2020, with "block 5" (generation from coal) due to close, and biomass replacing its current quota of raw material.

2.5 Finland

Finland is a cold northern country with a prominent heavy industry sector and a high energy demand. Forestry and pulp and paper industries are major economic players and manage the large Finnish forests area that covers more than 60% of the country including peat land (Pakarinen et al. 2010; Saikku 2006). Thanks to a long history in the development of eco-efficiency and IS, this sector became very resource efficient. Many resource efficient solutions appeared spontaneously and are economically driven as other are response to the evolution of the legislative or policy context (Korhonen, 2001b; Pakarinen et al. 2010; Saikku 2006). Several case studies are detailed in this section.

In addition, CHP production is very common, it started in the 1950's and this type of facility produces a large part of Finland's energy needs. District heating (and cooling, to a lesser extent) systems have also been largely developed and contribute to the country's energy efficiency. These systems led several Finnish industries to constitute "self-evolved eco-industrial parks", like the Uimaharju Industrial Area described below in the case studies, and "energy-recycling networks" like the Jyväskylä Regional Energy Supply System mentioned in section A1 (Saikku 2006).

Besides, different organisations and institutions contributed to the development of eco-innovation and Industrial Ecology in Finland. For instance, the ProMidNord's eco-competitiveness project (realized in the framework of the Baltic Sea Region INTERREG III B Neighbourhood Programme, 2000–2006) (The Baltic Sea Region Interreg Iii B 2013) included the implementation of EIP, such as Rantasalmi. Moreover, there is a Finnish Society for Industrial Ecology (Suomen Teollisen Ekologian Seura Ry 2013) and the Finnish Environment Institute (SYKE) is very active in the promotion and development of eco-innovation, with inter alia its IS System Boundaries (ISSB, 2007–2010) project and a current research programme on management systems for environmental efficiency (2010- 2015) (Finnish Environment Institute Syke 2013).

No significant data on the following potential eco-innovation parks is detailed in the literature at the time of this review:

- Econia business park
- Oulu Ecopark

Also, Finland hosts interesting cases of energy network described in chapter A1: Jyväskylä energy supply system and Katri Vala heat pump (Helsinki).

Park no. 15: Harjavalta Industrial Eco-Park

Finland

Geography	Finland, Satakunta, Harjavalta	
Type of park	Industrial	
Size of park	300 ha	>1000 jobs
	5 (main) companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Private	
References	(Saikku 2006); (Jyrki 2009) Internet links www.sustainbusper.com/book/export/html/456 www.dalkianordic.com/en/news-media/newsroom/2012-01-12,33441.htm www.renewa.fi/en/news/renewa-supplies-20-mw-steam-boiler-plant-to-harjavalta.html	

Origin & Objectives

This industrial park has been developing eco-efficiency activities for more than 60 years. It is located in Harjavalta, a town with a population of 7500 (2012) and a prominent mining sector. After World War II, when Finland experienced energy shortages, a copper company (Outokumpu, now a stainless steel producer) invented the ‘autogenous smelting’ (or ‘flash’ smelting) technology: it used heat produced by oxidising metal to maintain smelting processes. In its wake, various synergies have been implemented within industries and between them.
The main tenants are copper and nickel flash smelters (Boliden), a nickel chemical producer (Norilsk Nickel), an energy producer (Porin Lämpövoima), a hydrogen plant (AGA), a sulphuric acid plant (YARA) and the town of Harjavalta. In addition to these major actors that established symbiotic exchanges (energy cascading and material flows) the site also incorporates the services of more than 100 subcontractors. Many waste and by-products outputs are used as resources: heavy metals, sulphur, sulphuric acid, slag, wastewater, etc.

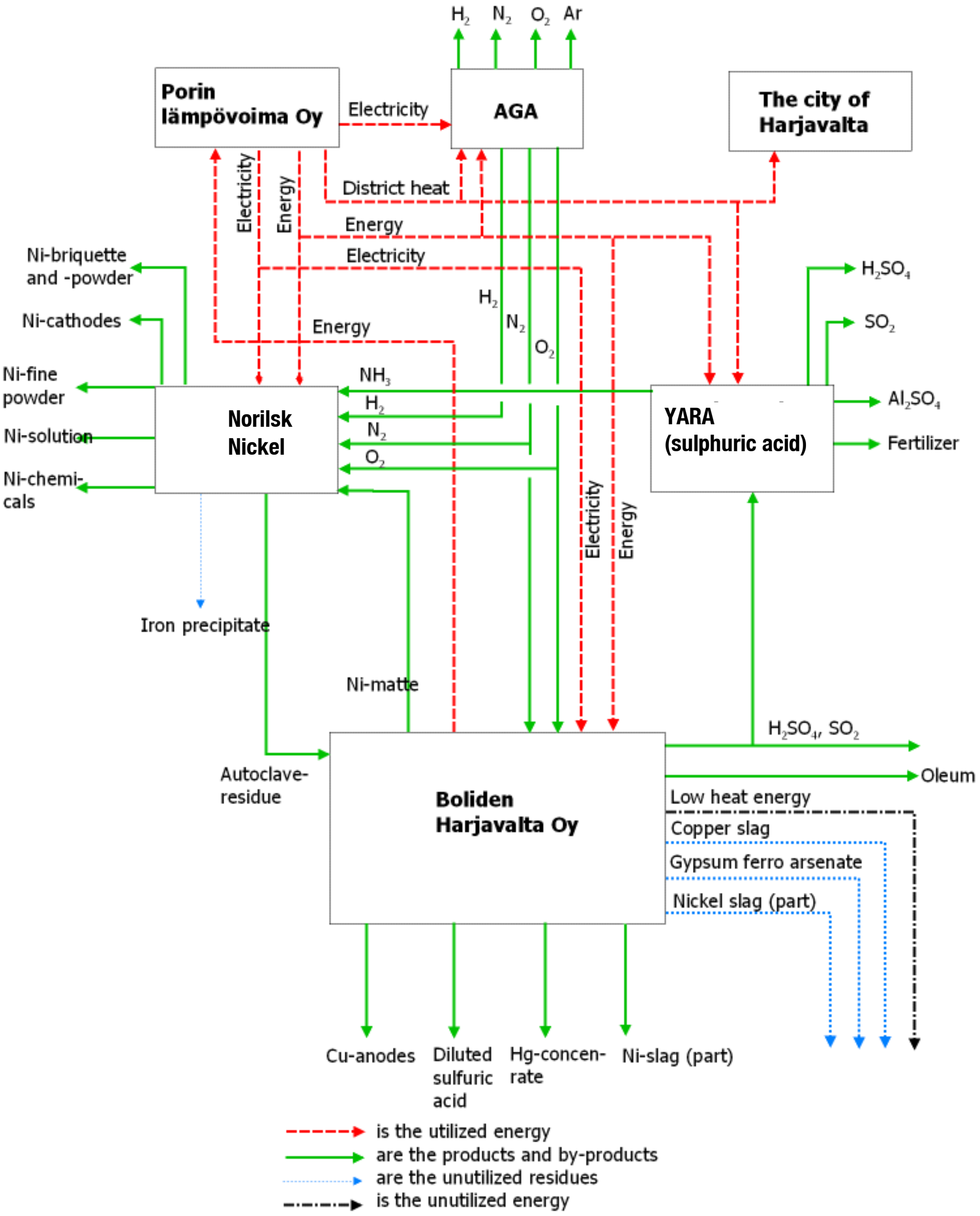
Success factors

Companies cooperate without any umbrella organisation (*policy*), but the “political context held a prominent role in leading them towards eco-innovation activities” according to Saikku (2006). In addition to the metal industry cluster, various other sectors (industries and services) are located on the site and that *diversity* is an asset for the development of IS. Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

The Harjavalta industrial park has a dynamic configuration and the potential for new synergies is very high: e.g. recovering low temperature waste energy for greenhouses, improving utilisation of copper and nickel slag or using wood as a local source of energy. In 2012, the park is enhancing its energy capacity to ensure future needs and will probably increase the use of biomass for energy production.

Fig. 16 > Material and energy exchange in the Harjavalta Industrial Area



after Jyrki, 2009

Park no. 16: Kymi Eco-Industrial Park

Finland

Geography	Finland, Kymenlaakso, Kuusankoski	
Type of park	Industrial	
Size of park	123 ha	599 jobs
	11 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(Melanen et al. 2008); (Sokka et al. 2009); (Pakarinen et al. 2010) Internet links www.ec.europa.eu/environment/emas/pdf/es_library/21_fi_upm_kymi_08.pdf www.ymparisto.fi/download.asp?contentid=107900&lan=en	

Origin & Objectives

Since 1890, IS has been established around a large pulp and paper mill. A detailed description of the system and its continuous evolution through the years is presented in Fig. 17.

The use of by-products in the park started during World War II when sulphite spirits from waste liquor production were used as a fuel for cars. In recent years, by-products (like black liquor and bark) covered about 60% of the park’s energy needs. In addition, multiple symbiotic linkages have been created between the Kymi pulp and paper mill and actors from various sectors: chemical industry, agriculture, wastewater treatment facilities, power plants, etc.

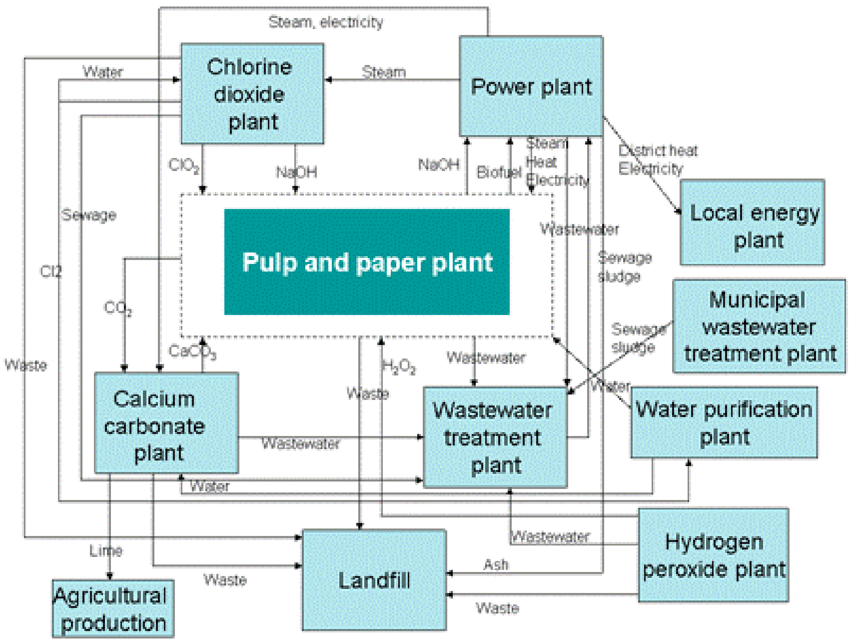
Success factors

According to Pakarinen et al. (2010), it was mainly “*tightening environmental legislation and other policy*” that led the park to reduce its emissions (since the 1970’s) through the use of by-products, replacing fossil fuels (*policy*). Cooperation between companies was also driven by technical and economic factors (*value added*). Besides, the park benefited from the complementarity of the different sectors located on the site (*diversity*), as well as collaboration with universities and research institutes (*cooperation*). Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

Future development of the park activities regarding eco-innovation is unknown.

Fig. 17 > Kymi EIP material and energy exchanges



after Melanen et al. 2008

Park no. 17: MABU (Material Business) Project

Finland

Geography	Finland, Päijät-Häme	
Type of park	Industrial	
Size of park	N/A ha	N/A jobs
	N/A companies	199 700 inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leaders	Private	
References	Internet links www.ymparisto.lahtisbp.fi/easydata/customers/ymparisto/ files/mabu_5124/mabu-esite-english.pdf www.greenovate-europe.eu/about/members/lahti www.cleantechcluster.fi/en/areas_of_competence/lahti/?id=154 www.ladec.fi/	

Origin

The MABU project studies biomass and waste-to-energy flows in the region of Päijät-Häme and seeks out opportunities for local companies to increase the use of those flows as resources for their production processes. This project is conducted by the Lahti Science and Business Park, the most prominent cleantech cluster in Finland and a pioneer in the development of waste recovery technologies. In the area of Päijät-Häme, 96% of urban waste is already utilized.

Objectives

This project aims to increase and improve the availability and processing of local biomass and waste flows. It focuses on various technologies, including the production of biogas and compost, bioethanol and biodiesel, as well as waste-to-energy processes. The use of PVC in construction waste and the development of new operating models for ash processing are also part of the project. To main goal is to support competitive waste management companies, material handling organizations and technology suppliers at the regional scale.

Success factors

One of the driving forces of the MABU project is its ambitious regional climate targets (*policies*). Also, the project benefits from strong *coordinators* and an extended network of research centers and universities (*cooperation S&T*).

Perspectives

Current status and future development of the project are unknown.

Park no. 18: Rantasalmi Eco-industrial Park

Finland

Geography	Finland, Southern Savonia, Rantasalmi	
Type of park	Industrial	
Size of park	10 ha	N/A jobs
	7 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Saikku 2006); (Saikku et al. 2007) Internet links www.ubcwheel.eu/index.php/gpdp:/article/514 www.promidnord.net/	

Origin

The first planned EIP in Finland, located in Rantasalmi, was a project funded by the Baltic Sea Region INTERREG III B Neighbourhood Programme (2000–2006).

Objectives

The Rantasalmi Eco-Industrial Park consists of a cluster of mechanical wood processing industries. Among them, the loghouse manufacturer Rantasalmi Oy is the largest company in the region, with about 100 employees. Waste wood is recovered and provides heating and electricity both for the park industries and the residents of the area. In addition, the park covenants encourage by-products exchanges and cooperation among the tenants for a better environmental management (i.e. reducing waste and emissions, increasing material and energy efficiency).

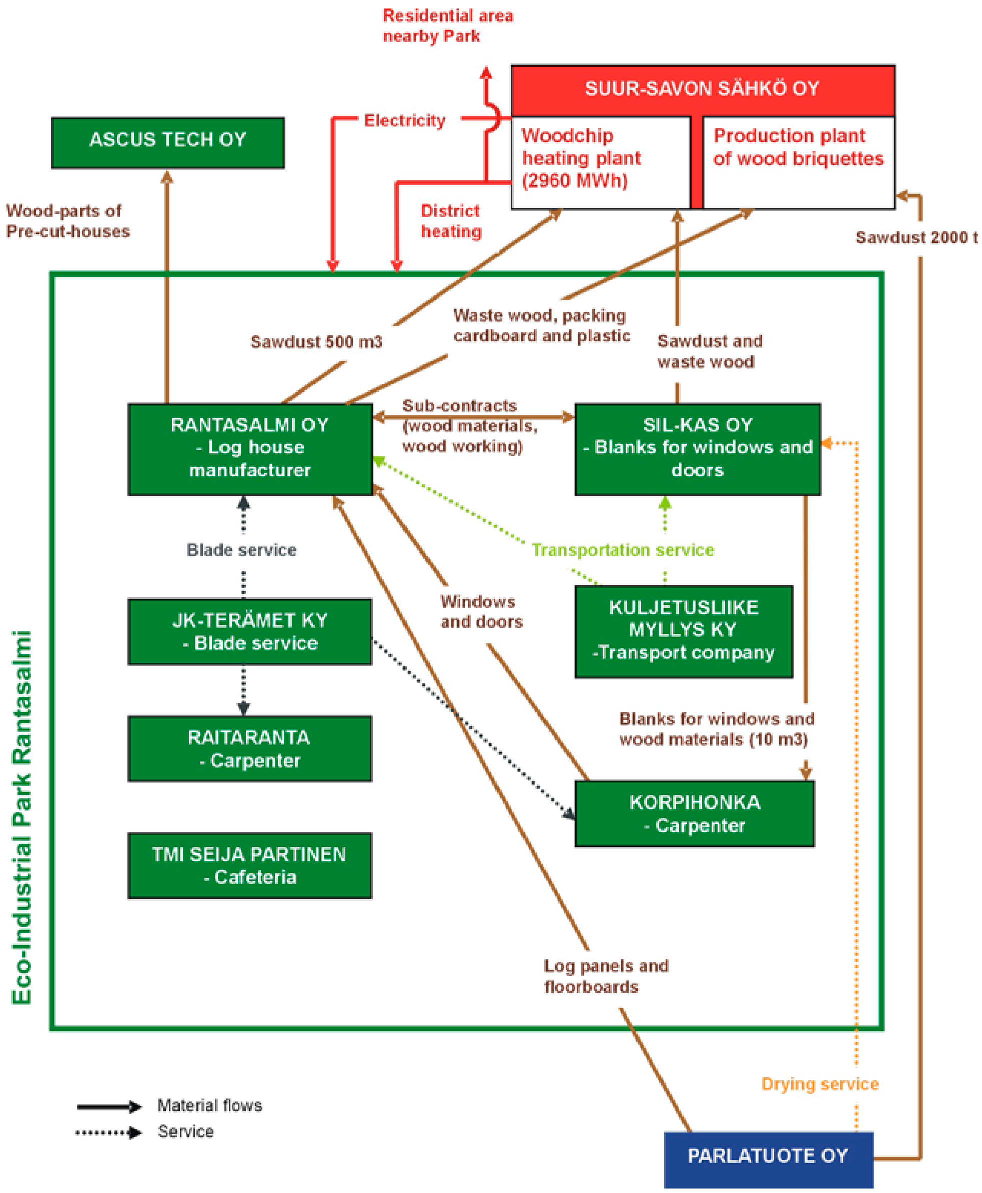
Success factors

The park objectives are also to strengthen the competitiveness and attractiveness of its tenants by improving their image and reducing their production cost through eco-efficiency. Tenants have to commit to the park covenants and sign its environmental policy. Key success factors are therefore *value added*, *policy*, and *ECO-INNOVATION PARK*.

Perspectives

According to Saikku (2006), the park could expand to include several potential cooperation partners located outside its area. Nevertheless, the current status of the park and future development plans are unknown.

Fig. 18 > Rantasalmi Eco-Industrial Park system



after Saikku, 2006

Park no. 19: Uimaharju Industrial Area

Finland

Geography	Finland, North Karelia, Joensuu	
Type of park	Industrial	
Size of park	195 ha	>500 jobs
	6 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Private	
References	(Korhonen et al. 2005); (Saikku 2006) Internet links www.storaenso.com/responsibility/environment/Pages/environment.aspx	

Origin

The Uimaharju industrial area consists mainly of forestry and wood processing industries. The main operator is Stora Enso, one of the largest forest product companies in the World.

Objectives

In addition to a sawmill and a pulp mill, the area also includes a waste ash treatment plant, a CHP power plant, an industrial gas plant and a wastewater treatment plant. Researchers have described the evolution of the park symbiotic activities. The development started in 1955 and progressively became according to Saikku (2006) a “very advanced industrial eco-system as a wood processing cluster, with multiple linkages leading to a high level of energy efficiency and waste recovery. The Fig. 19 shows the last evolution stage observed by academics in 2003.

Success factors

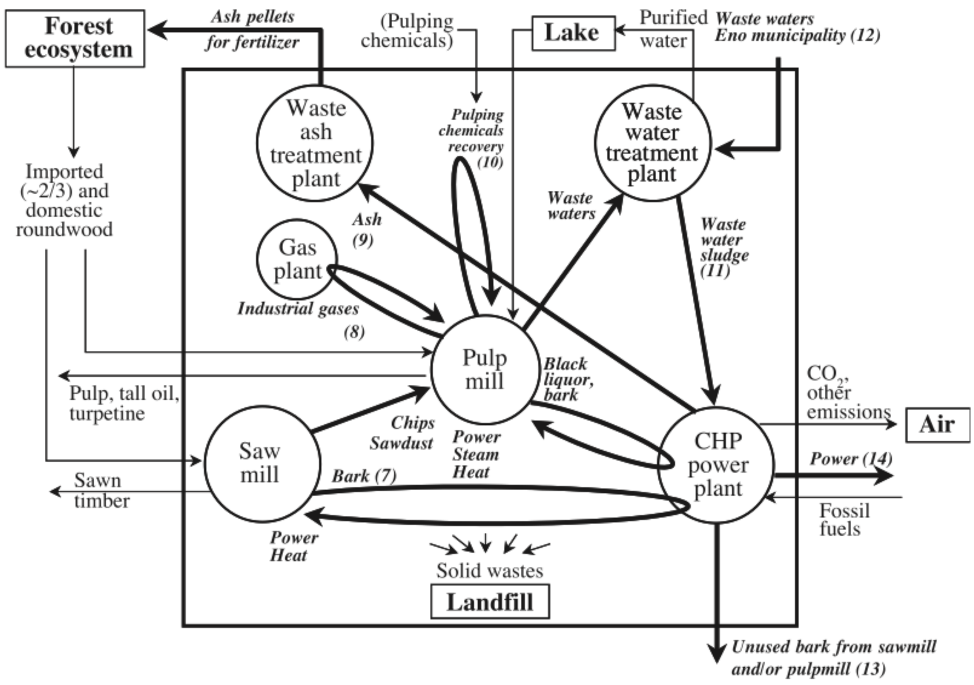
Synergies in the area have been spontaneously established and no administration body is in charge of promoting eco-innovation. According to Saikku (2006), driving forces for eco-innovation have been economic factors (*value added*) and some political measures (*policy*).

Perspectives

The Uimaharju industrial area seems very dynamic and in constant development, but no data is available regarding current status and future evolution schemes.

Fig. 19 > Last stage of industrial ecosystem development in Uimaharju

C Type III Ecosystem 1992–2003.



after Korhonen et al. 2005)

2.6 France

The first platform dedicated to Industrial Ecology and the management of industrial estate stakeholders was created in 2004 under the name French Industrial Ecology Pole (PFEI). Initiated by an association called Auxilia and the Cité des Matières, supported by Prof. Suren Erkman, the PFEI aims at promoting the Industrial Ecology development in France. Its main missions are to federate the voluntary stakeholders (such as territorial communities, associations, corporations, consular organisms, federations, NGOs, universities, institutes, administrations), to generate new reflections, to foster experience feedbacks, to disseminate and promote the approach, and to link actions conducted in France and abroad.

At that time, the French industrial policy tried to build networks including corporations and territorial actors. The DATAR (Délégation inter-ministérielle à l'Aménagement du Territoire et à L'Attractivité Réfionale) prospective report on the French industrial sector in 2004 suggests elaborating specific strategies oriented towards inter-corporations synergies and local partnerships to go with current industrial mutations in industrial parks.

In practice, one of the first experimentation realized in France took place in Dunkerque. Then it became part of COMETHE (Comethe 2013) project (one of the French National Research Agency PRECODD 2007 prize winner) that started in 2008 for 3 years. Coordinated by another association called Orée (Association Orée 2013), it gathered a multidisciplinary consortium around the final goal of creating an Industrial Ecology methodology and implementation tools. Those works were based on 5 different pilot territories, including Dunkerque and the Aubois Region. The City of Troyes, thanks to the Technologic University of Troyes (UTT), happened to be the place where the first Chair in Industrial Ecology has been established in 2005 (Bourg et al. 2003; Duret 2007). The UTT supported the first PhD thesis in Industrial Ecology realized by Cyril Adoue, founder of Systèmes Durables and author of the book "Mettre en oeuvre l'écologie industrielle" in 2007 (Adoue 2007).

From 2010 and 2011, the Directorate-General for Competitiveness, Industry and Services (DGCIS), under the authority of the Ministry for the Economy, Industry and Employment, started a mission untitled "Corporations Sustainable Competitiveness", which encompass innovation, eco-design and Industrial Ecology (DGCIS 2013). End of 2011, the ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie) took over from the DGCIS starting with a new expression of interest entitled "Ecodesign goods and services and Industrial Ecology" to support implementation projects by economic players.

No significant or relevant data on the following potential eco-innovation parks is detailed in the literature at the time of this review:

> Plaine Commune
> Roanne Territoire
> Plaine du Var
> Fos-sur-Mer Industrial-Harbour Park
> Pouzin Fluvial and Industrial Park

Park no. 20: Chemical Valley Industrial Area

France

Geography	France, Rhône-Alpes	
Type of park	Industrial	
Size of park	800 ha	11 000 jobs
	12 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Harpet et al. 2008); (Méhu et al. 2008) Internet links www.lyon-entreprises.com/News/La-redaction/Infos-regionales/Zones-d-activite/Vallee-de-la-Chimie-69,i4807.html, www.cnrs.fr/inee/recherche/fichiers/ANGDChimieCargese/ BrullotCar-gese10_09.pdf, www.apesa.fr/iso_album/cyril_harpet_07_janvier_2009.pdf www.everymanproduction.com/ME2D/Liens/rapportdestage/rapportAbitbol.pdf	

Origin

Situated in the South of Lyon, on Feysin, Pierre-Bénite, St Fons and Solaize municipalities, the Chemical Valley forms a 15 kilometers long corridor along the Rhone River. Until the end the 1990's, Rhône-Poulenc owned the whole industrial activity on a large territory and fostered internal synergies. Despite the resale of business activities with Economic Interest Groups (GIE) as a mediator, existing synergies remained and some of them have been strengthened. In October 2006, a project of Industrial Ecology and territorial intelligence started with the objective of developing a tool for material and energy flow analysis in order to enhance synergies in the area. Rhône-Alpes Region and the Direction Régionale de l'Industrie, de la Recherche et de l'Environnement (DRIRE, replaced later by the DREAL, Direction régionale de l'environnement, de l'aménagement et du logement) financed the study.

Objectives

Large corporations such as Rhodia, Total, Arkema, Air Liquide, Prayon and Lafarge cement are present in the Chemical Valley. Heat, utilities, by-products and energetic resources networks were already part of a local platform. From September 2007 to March 2008, the project gave rise to a material and energy flows study including eleven partners in the chemical sector. Collective actions in nine different fields were proposed. Advanced cases from three fields have been elaborated: freight transfer from road to water and railway; acids and bases treatment with neutralization operations; and recovery of clinker, residues of toxic waste incinerated and construction backfills. Besides, a research center – Institut Français du Pétrole et des Energies Nouvelles – and a cluster of environmental and chemical activities – Axelera- are also settled in the Chemical Valley.

Success factors

The existence of several GIE is considered as a success factor because it enhances mutual trust between members (*coordinators*). The cooperation with science and technology institution, the Institut Français du Pétrole et des Energies Nouvelles, was also a benefit (*cooperation S&T*). The geographical situation along the Rhone River and near the A7 highway is also a strong asset (*location*), as well as the diversity of industrial sectors (*diversity*).

Perspectives

Since 2009, the project remained in stand-by due to lack of funding and stakeholders coordination.

Park no. 21: Croix-Fort Artisanal Park

France

Geography	France, Poitou-Charentes, Communauté de communes de la Plaine d'Aunis	
Type of park	Industrial	
Size of park	40 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency ~~Waste management~~ Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	Under construction	
Project leader	Public	
References	Internet links www.siteaconseil.fr/docs/Environnement_ZA_Croix_Fort_CC_Plaine_d_Aunis.pdf www.poitou-charentes.ademe.fr/sites/default/files/files/Domaines%-20d'intervention/Territoire%20et%20villes%20durables/Exemples%20%C3%A0%20suivre/croix_fort.pdf	

Origin

The Community of Communes of the Plaine d'Aunis launched this initiative in order to incorporate new developments of the area in an environment-friendly approach. The goal is to focus on energy and environmental issues in the planning operations.

Objectives

Croix-Fort industrial area consists of several parts: one is already developed and hosts firms; two parts are in development and another one for future expansion. In 2006, the Community of Communes selected a first part to be planned according to ecological principles. The planning includes carpooling promotion, rainwater harvesting (in a tank used as fire reserve tank), vegetal filters to clean up runoff before they reach public sewer, onsite direct reuse of materials during the building phase, as well as a plan for energy efficiency and renewable energies development (including the construction for three "urban" wind turbines). In 2006, the Community of Communes has been certified ISO 14001 for the design, execution and marketing of the industrial area.

Success factors

ADEME and Poitou-Charentes Region gave their technical and financial support to the Community of Communes (*incentives*). Half of the planning studies and environmental system implementation were covered thanks to this financial support.

Perspectives

Future development of the park activities regarding eco-innovation is unknown.

Park no. 22: Deux Synthe Industrial Park

France

Geography	France, Nord Pas de Calais, Dunkerque	
Type of park	Industrial	
Size of park	170 ha	6000 jobs
	160 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(Orée 2008) Internet links www.ecopal.org www.comethe.org/images/pdf/ECOPAL.pdf www.comethe.org/images/interv-ecopal.pdf www.communaute-urbaine-dunkerque.fr/fr/institution/partenaires/ecopal/index.html	

Origin

In 1999, the City of Grande-Synthe initiated a pre-study of Industrial Ecology in the framework of its Agenda 21 program. In 2001, the Ecopal (Economie et écologie partenaires dans l'action) association was created to promote Industrial Ecology in the territory. It gathers now more than two hundred memberships. The board of directors consists of public (Urban community of Dunkerque, Chamber of Commerce and Industry of Côte d'Opale) as well as private (EDF, Lyonnaise des Eaux, Arcelor Mittal) partners and is chaired by a private firm (Ajinmoto) director.

Objectives

A wide range of activities is represented in the secondary sector (steel industry, metallurgy, food processing, pharmaceutical) and in the tertiary sector (service providers in plastic, transport and textile industries). After several years of experimentation in collectivizing and sharing services, 35 firms contributes to pool dispersed toxic waste collection (cardboard and rags, solvents, oils, aerosols), 60 firms use a mutualized collection system for their paper and cardboard wastes, and pallets are collected for free by Emmaüs and repaired. To perform a better identification of potential synergies between firms, Ecopal realized a material flows inventory in 2007.

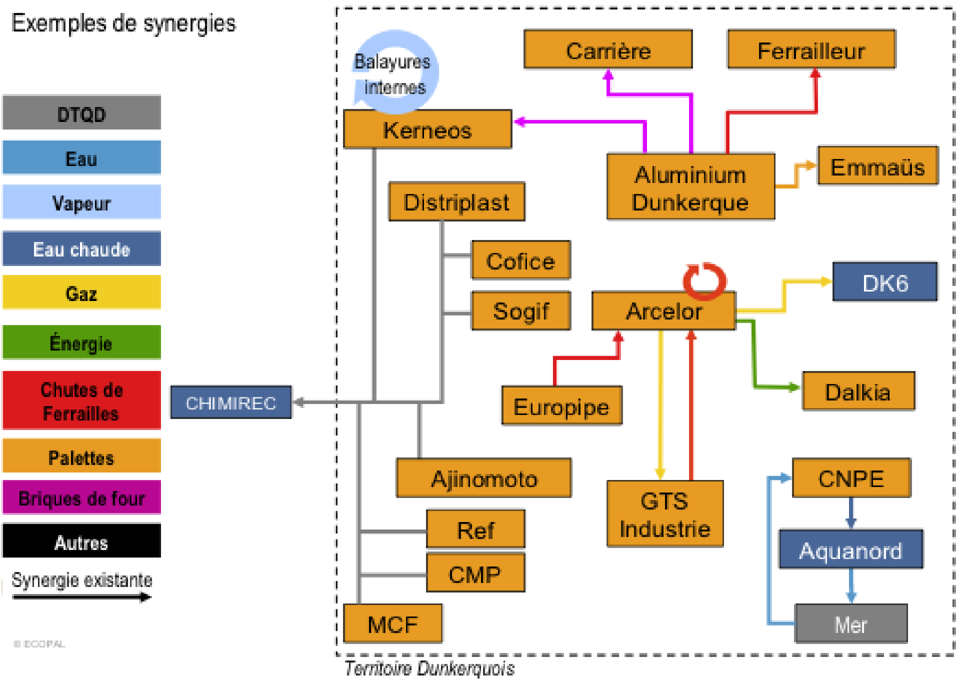
Success factors

The main success factor is the presence of the Ecopal association as a mediator (*coordinators*). Moreover, the association receives a technical and financial support from its partners (*incentives*). Ecopal involvement as pilot area in the COMETHE research project is also a success factor (*cooperation S&T*).

Perspectives

Ecopal next objectives are to help firms implementing industrial synergies, to set up a mission on water purpose in partnership with the Water Agency, the participation of the European project " Answer to Carbon Economy " and a project to share experience between economic actors. Others tasks are in progress such as the creation of an Industrial Ecology regional network and the direction of a future center of excellence. Finally, a project of heat network on business parks has been supervised jointly with the CUD and Ecopal.

Fig. 20 > Industrial symbioses in Dunkerque



after Ecopal 2013

Park no. 23: Grand Troyes Park

France

Geography	France, Champagne-Ardenne, Communauté de l'Agglomération Troyenne	
Type of park	Industrial	
Size of park	160 ha	1200 jobs
	50 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management ~~Water management~~ Biodiversity Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	Internet links www.comethe.org/index.php?option=com_content&view=article&id=50&Itemid=63 www.comethe.org/images/pdf/GRAND%20TROYES.pdf www.comethe.org/images/rapport-final-aube.pdf	

Origin

Executed by Grand Troyes municipality, Grand Troyes Park is part of Aube's departmental project, which includes three pilot areas. It was the first Industrial Ecology pilot area in Aube. The project is largely due to the Center of Research and Interdisciplinary Studies on the Sustainable Development (CREIDD), established in the University of Troyes since 2001. The COMETHE project also had positive impacts on the diffusion of the industrial ecology approach in the region, including the restructuration of the Aube IE Club (Club d'Ecologie Industrielle de l'Aube).

Objectives

Grand Troyes Park is labeled "Business park of reference" in the Champagne-Ardenne region because it favors qualitative development in terms of architecture, green space development, services for firms, and environmental management. It is divided in two different parts. The first part is already available to industrial (bio-energy, agri-resources, food processing, packaging, metallurgy, technical textiles) and service activities such as waste management. The second part is still in development. The COMETHE project contributed to enhance the area attractiveness seeking to implement IS among the park's tenants.

Success factors

Among the key success factors are the Aube IE Club (Club d'Ecologie Industrielle de l'Aube) influence (*coordinators*), the COMETHE research project involvement and the presence of the CREIDD (*cooperation S&T*).

Perspectives

The development orientation of Grand Troyes Park is further to incorporate the Industrial Ecology approach in the development area.
In Aube, others projects are in progress such as: creating a business village to foster small firms development; water flow optimisation and energy recovery from industrial wastewater in paper industry, in collaboration with Lucart (paper industry), the Paper Technical Center and the Aube IE Club; a reflection in Anett group on the energetic optimisation of on-site processes and the PIVERT project on third generation biorefinery (using an approach of Industrial Ecology) led by the IEED (Institut d'Excellence sur les Energies Décarbonées) in collaboration with several partners such as Sofiprotéol, IAR pole, Université de Technologie de Campiègne and the UTT.

Park no. 24: Havre Industrial-Harbour Park

France

Geography	France, Haute-Normandie, Communauté d'agglomération du Havre	
Type of park	Industrial	
Size of park	10 000 ha	1 000 jobs
	N/A companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	Internet links www.havre-port.fr/ www.ecologieindustrielleestuaire.fr/	

Origin

Haute-Normandie regional economy is strongly dependent of the port activity and the enhancement of territory quality. This is why the Port of Havre (GPMH – Grand Port Maritime du Havre) was in charge of an Industrial Ecology study between 2008 and 2009. This study mobilized a small sample of firms and quantified their material flows in order to identify potential synergies. The study did not continue, but in 2011 the Industrial Ecology assessment of the Seine estuary (area that includes the Port of Havre) revived the initiative. The Ecologie Industrielle Estuaire (EIE) association, whose members include GPMH, is in charge of this second assessment. The EIE association created in 2010 after the Grenelle de l'Estuaire aims to engage the Seine Estuary region in an Industrial Ecology process.

Objectives

The Industrial Ecology approach implementation on the Havre Industrial-Harbour Park, involved economic players from the following sectors: petrochemistry (Total refinery, EDF thermal power plant, Air Liquide, Omnova), cement (Lafarge), automotive (Renault), plastic, metal processing and logistic. Several IS already exist involving major economic players like a collective industrial water network and a process steam network based on chemical waste incineration (Sedibex). Other solutions like collective packaging waste collection, used acids/bases valorization in water treatment processes and collaboration opportunities for steam and heat are still under study.

Success factors

The economic benefit from the existing synergies is a major factor of success (*added value*). Coordination bodies such as GMPH or/and EIE (*coordinators*), the proximity of the Estuary (*location*) and the *diversity* of activities are all key success factors.

Perspectives

Several projects are currently in progress: continuation of the Industrial Ecology approach with already settled firms supported by the EIE, development of unoccupied areas, and use of renewable energies (especially wind pump and biomass).

Park no. 25: Lagny-sur-Marne and La Courtilière Industrial Parks

France

Geography	France, Ile de France, Communauté d'Agglomération de Marne et Gondoire	
Type of park	Industrial	
Size of park	97 ha	3200 jobs
	230 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	Internet links: www.comethe.org/images/pdf/MARNE%20ET%20GONDOIRE.pdf www.comethe.org/images/pdf/yprema.pdf	

Origin

Concerned with the implementation of an innovative territorial policy addressing sustainable development issues, the urban community of Marne and Gondoire launched an action program to redevelop an old industrial area and transform it in an eco-industrial park.

Objectives

The main objective for both parks is to build-up a redevelopment project based on Industrial Ecology assessments and the elaboration of an environmental quality Charter. About twenty voluntary firms operating in various sectors (automotive equipment industry, concrete and metal goods, etc.) are involved in the program and studies are being conducted to identify potential synergies between them.

Success factors

Main assets of these EIP are the strong variety of these two business areas (*diversity*), the geographical localisation along the inland waterway (Marne) (*location*) and the COMETHE project cooperation (*cooperation S&T*).

Perspectives

The detection of synergy opportunities constitutes a first step to highlight territorial potential. Next steps are implementation and replication.

Park no. 26: Les Sohettes Bio-refinery

France

Geography	Pomacle-Bazancourt, Champagne-Ardenne, France	
Type of park	Industrial	
Size of park	100 ha	825 jobs
	3 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(Chauvet 2012) Internet links www.test.a-r-d.fr/en/w_docs/zone-anglais.pdf	

Origin

A common vision shared by local agricultural players is at the origin of the initiative. The first firm to settle was Cristal Union, a sugar refinery developed by a farmers' cooperative. This cooperative used a whole year production to finance the project. Chamtor, a cereal group, produces cereal starch and glucose based products from wheat. The industrial ecosystem is then completed with the settlement of an ethanol production plant from beets and wheat. The ARD research and development center (Agro-industrie Recherches et Développements) settlement near the sugar refinery increased the actors' motivation. The ARD brings in prestigious universities (Centrale Paris) and new eco-innovative firms such as Amyris in the cosmetic sector.

Objectives

The site is an emblem for the new bio-economy that refers to biomass production and conversion into a wide range of products dedicated to the food, cosmetic, energy and health sectors. Bazancourt-Pomacle intends to be a leading company of integrated bio-refinery that valorizes the whole vegetal plant. Several synergies are already in progress such as condensates recovery in order to limit the abstractions in groundwater and energy recovery, reciprocal steam emergence, wastewater treatment pooling, bioethanol production from wheat and beet by-products, and a mutual project of energy production with a biomass cogeneration plant. Information on flow synergies also exists. Research program are in fact designed in cooperation with agribusiness and ARD's shareholders.

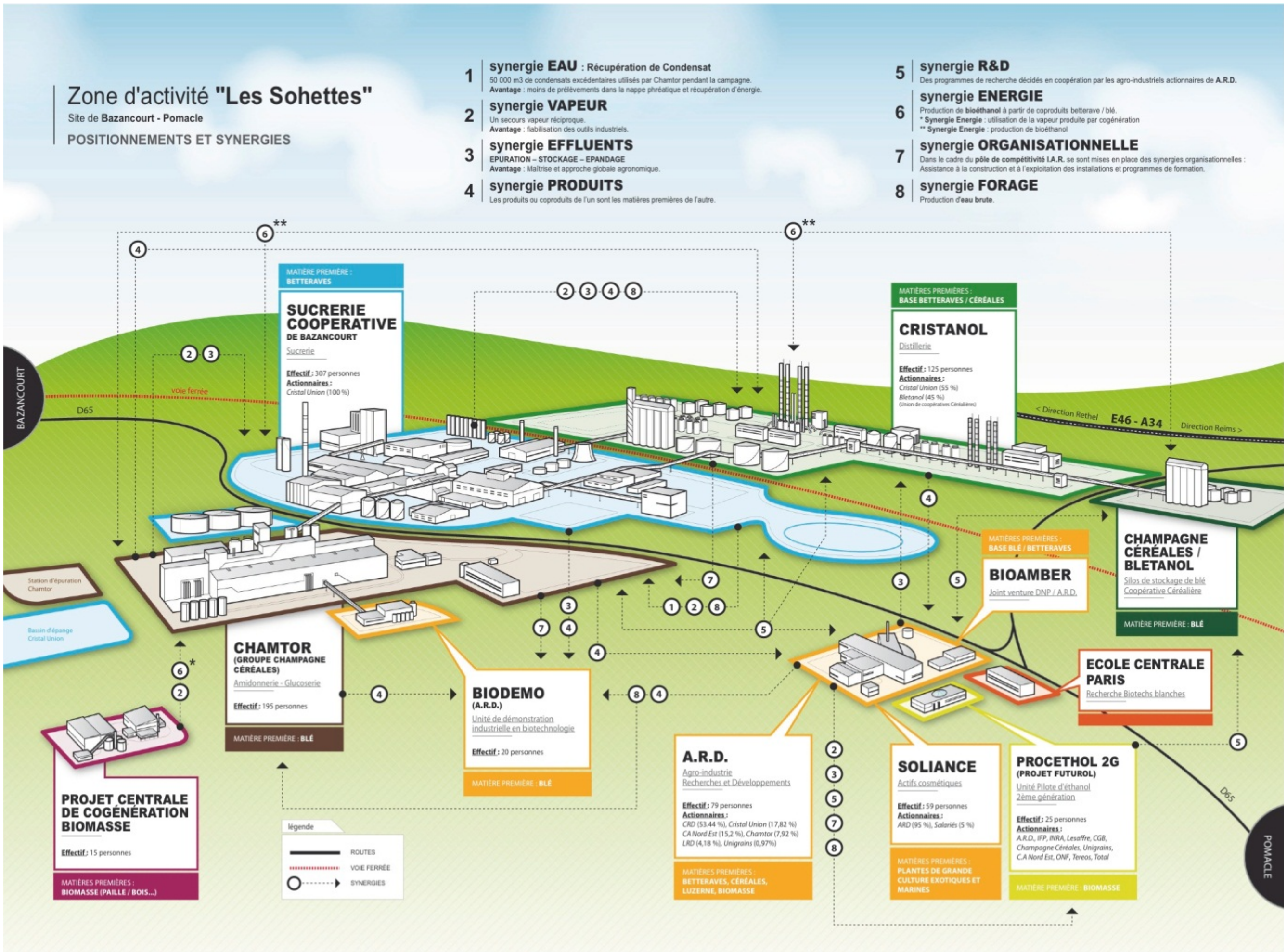
Success factors

In addition to the economic *added value* to the partners, several key success factors are identified. First, existing synergies bring in new firms; in particular those linked with various research activities. In 2005, the creation of competitive clusters in France induced the creation of the IAR (Industries and Agro-resources) cluster. The fruitful collaboration between cereals and sugar cooperatives enabled to finalize this shared research effort initiated 25 years ago. Moreover, the collaboration with research centers participated to the cluster development (*coordinators*, *cooperation with S&T*). Finally, the "biorefinery" labeling also brings more visibility *(Eco-Innovation Park)*.

Perspectives

Sohettes agro-industrial complex plans to expand on 200 more hectares. The CCI of Reims carries out this development project. The objective is to create new activities – as spin-off supported by the ARD or external independent start-ups – that will allow the reuse of by-products. A center of excellence on white biotechnologies is in progress with the partnership of AgroParisTech School and Central Paris.

Fig. 21 > Illustration des synergies existantes sur le complexe agro-industriel des Sohettes



after Les Sohettes 2013

Park no. 27: Lille City

France

Geography	Nord-Pas-de-Calais, France	
Type of park	Urban	
Size of park	3 500 ha	150 000 jobs
	N/A companies	225 000 inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	Internet links www.lemonde.fr/le-monde-2/article/2008/04/04/ecologie-industrielle-la-nature-pour-patron_1029889_1004868.html www.mairie-lille.fr/cms/accueil/lille-durable	

Origin

Lille City membership to Aalborg Charter on sustainable cities shows a clear intention to promote sustainable development. After energy and water savings development, the opening of a sorting center in the inland port, the City objective is to develop closing-loop systems. Lille City in partnership with Gaz de France and Auxilia association launched in 2005 a territorial metabolism assessment in the conurbation including Lille, Lomme and Hellemmes municipalities. Then, the partnership was extended to Nord-Pas-de-Calais Region, ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie), Artois-Picardie water agency and a LMCU (Lille Métropole Communauté Urbaine).

Objectives

The main objective is to identify territorial consumptions and to deliver a decision-support system. The study showed a lack of statistics for a majority of studied flows that local energies are insufficiently used and that important textile flows are incinerated in the absence of alternative resources. Thanks to the "Grand Projet Urbain 2006–2012", the material flow assessment enabled to quantify material reuse objective from 32 000 tons of demolition waste. Energy recommendations contributed to eco-district local assessment in 2007. Insulation material for construction sector is an identified opportunity to recover textile wastes.

Success factors

Two main success factors identified for this case study are the politic support (*policy*, *incentives*) and the coordination at all territorial scale (*coordinators*).

Perspectives

Future development of the city level regarding eco-innovation is unknown.

Park no. 28: Nogent Industrial Basin

France

Geography	France, Champagne-Ardenne, Communauté de l'Agglomération Troyenne	
Type of park	Industrial	
Size of park	150 ha	3500 jobs
	240 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Planned	
Project leader	Public	
References	Internet links www.comethe.org/images/pdf/NOGENT.pdf www.comethe.org/images/rapport-final-aube.pdf	

Origin

The Nogent Association of Districts Councils, Aube General Council and Aube Chamber of Commerce and Industry are running Nogent industrial basin. It is the third Industrial Ecology pilot area in Aube. This is largely due to the Center of Research and Interdisciplinary Studies on the Sustainable Development (CREIDD), established in the University of Troyes since 2001. The COMETHE project also had positive impacts on the diffusion of the Industrial Ecology approach in the region, including the restructuration of the Aube IE Club (Club d'Ecologie Industrielle de l'Aube).

Objectives

Nogent industrial basin consists of several industrial areas generally small sized (one to twelve firms) distributed among Nogent-sur-Seine territory. Firms are therefore spread out over the territory and do not know each other. The objective is to mobilize industries on a common project, to communicate good practices, to develop the attractiveness of the territory, to show the economical and environmental efficiency of Industrial Ecology. Main sectors are agricultural industry, food processing and wholesale. Besides, there are several advanced developments in cogeneration process, bioethanol and diester production.

Success factors

In addition to the Club d'Ecologie Industrielle de l'Aube (*coordinators*) and the COMETHE project (*cooperation S&T*), the main key success factor is the existing tri-modal logistic platform (road, rail, river) with an inland waterway preferred between Nogent-sur-Seine and le Havre that offers the connection to the large North European ports (*location*).

Perspectives

Future development of the park activities regarding eco-innovation is unknown.

Park no. 29: Plaine de l'Ain Industrial Park

France

Geography	Communauté de communes de la Plaine de l'Ain, Rhône-Alpes, France	
Type of park	Industrial	
Size of park	900 ha	4500 jobs
	125 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management Biodiversity ~~Material flow~~	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leader	Public	
References	(Skubich 2008); (Beaupuy 2010) Internet links www.plainedelain.fr/	

Origin

After its creation in 1976, the SMPA (Syndicat Mixte de la Plaine de l'Ain) became the management body of the park, which aims to be a large industrial area to face rural exodus by creating local employment. The park's planning policy has 3 main strategic lines: control over development, diversity of activities and environmental protection.

Objectives

The park is the first one in Europe to be certified ISO 14001 and EMAS. Companies in the park don't have to obtain the certification individually, but the SMPA fosters sound environmental management practices among them. The SMPA promotes a landscape architecture and incorporated large green spaces with trees (about 200 ha) and recreation areas. In 2005, it established a partnership with the French bird protection association (LPO) to minimize the impact of industrial urbanization on the park's wildlife. Besides, the park manager developed shared services and infrastructures for wastewater treatment, ordinary and hazardous industrial waste management and fire protection. Regarding transport and mobility, a railway connects the park with the nearest train station and 25% of the employees use carpooling (national average is 3%).

Success factors

A key success factor is an efficient management body, the SMPA (*coordinators*). It controls the siting of new activities to respect the sustainability objectives of the park and adopts a participatory approach toward the neighboring communities, which are systematically consulted regarding new developments in the area (services or infrastructures). The SMPA also promotes *diversity* as an asset for the park resilience and local employment. Furthermore, the park benefits from a strategic *location* with the proximity of urban areas (Lyon and Geneva) and the availability of important water sources (the Rhone and aquifers).

Perspectives

Currently, the park still has 300 ha of land available. A Norwegian company plans to build a combined cycle gas power plant. This project (planned for 2014) could be developed in partnership with the park's tenants and lead to new synergies. New services are also planned on the site like childcare and sports facilities.

Park no. 30: Port-Jérôme Industrial Park

France

Geography	France, Haute-Normandie, Communauté de communes Caux Vallée de Seine	
Type of park	Industrial	
Size of park	2500 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency ~~Waste management~~ Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	Internet links www.ecologieindustrielleestuaire.fr/	

Origin

The industrial area of Port-Jerome serves as a demonstration zone in the framework of a regional strategy: the implementation of Industrial Ecology principles across the Seine Estuary. The Ecologie Industrielle Estuaire association (EIE, founded in 2010) runs the project and the Community of communes Caux Vallée de Seine is one of its fifteen members.

Objectives

Port-Jerome is a prominent economic development zone in the Seine Estuary region. Companies in the area operate in petrochemical, chemistry, logistics and biofuels sectors. The park is equipped with a mutualized industrial water distribution system and steam exchanges exist between some of the petrochemical players. The park management body is the Community of communes Caux Vallée de Seine, which also hosts a business association (AEPJR) that discusses security and environmental issues since the 1960's. Through this association, about 15 audits have been conducted among companies to collect data on energy and material flows and detect potential IS. Existing synergies were also highlighted such as a process water network, aluminiferous water reuse for onsite wastewater treatment, carbon dust (from carbon black production) reuse and intensification of steam exchanges.

Success factors

Economic benefits (*value added*), the EIE management and the AEPJR as a facilitator between political and economic actors (*coordinators*), along with a significant *diversity* among companies' activities are key success factors.

Perspectives

There are several (planned or under construction) expansion projects in the Port-Jérôme area. The collaboration between the EIE association and the main economic players will go on to develop prior-ranking symbioses.

Park no. 31: Roche en Brénil Wood Ecopole

France

Geography	Communauté de communes de Saulieu, Bourgogne, France	
Type of park	Industrial	
Size of park	35 ha	40 jobs
	5 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	Internet links www.comcomdesaulieu.jimdo.com/d%C3%A9veloppement-%C3%A9conomique/ecop%C3%B4le-bois/ www.poles-excellence-rurale.datar.gouv.fr/lecopole-du-bois-de-la-roche-en-brenil-cote-dor-un-exemple-de-filiere-bois	

Origin

The Ecopole was built between 1999 and 2006, following the closure of a quarry owned by Lafarge. It is certified as "Rural Excellence Pole" (PER) and financially supported by the government. The Belgian Fruytier, one of the European leaders in processed wood industry, settled in the park in 2008, followed by other companies in 2009.

Objectives

The Wood Ecopole focuses on local wood resources development and management. The objective is to process more resources in situ so that local economy can benefit from the value added created by these activities. The Ecopole consists of forestry, wood processing and biofuel (pellets, bioethanol) industries as well as a biomass-fuelled CHP plant. Wood wastes are recovered in various ways among industries on the site mainly for energy production.

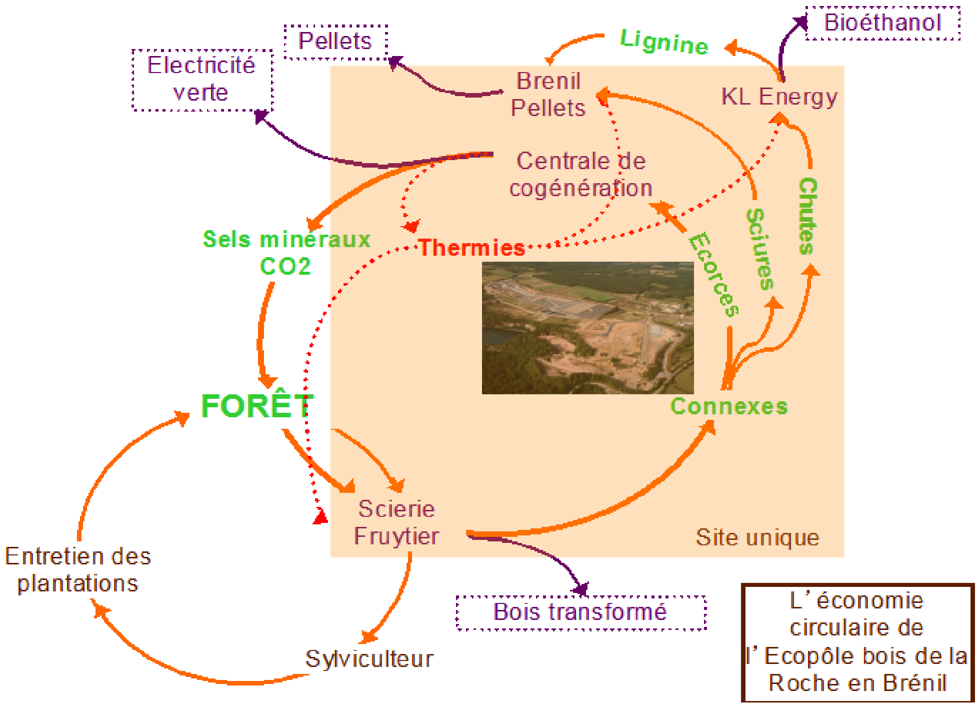
Success factors

The PER certification and the "Ecopole" denomination are key success factors that enhance the project visibility and greatly contribute to attract targeted businesses *(Eco-Innovation Park)*.

Perspectives

Currently, companies of the site provide 40 jobs. The objective is to reach 150 jobs by attracting new activities.

Fig. 22 > Industrial symbioses in the Wood Ecopole



Park no. 32: Technopôle Savoie Technolac

France

Geography	Métropole Savoie, Rhône-Alpes, France	
Type of park	Industrial	
Size of park	80 ha	3000 jobs
	180 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leader	PPP	
References	Internet links www.comethe.org/index.php?option=com_content&view=article&id=79&Itemid=69 www.comethe.org/images/interv-st.pdf www.comethe.org/images/pdf/SAVOIE%20TECHNOLAC.pdf	

Origin

Led by Savoie Technolac®, the COMETHE Industrial Ecology project gathered private and public stakeholders, including the Métropole Savoie governement. The Technopole is part of this project and was founded thanks to the determination of local political and economic actors to continuously improve environmental and energy management. Another actor in the region is the ECOLAC club: members are companies and research centers that actively contribute to the Technopole development by stimulating the implementation of service and infrastructure pooling and sharing.

Objectives

The Technopole cluster consists mainly of companies from the service sector and is also a center of research and higher education in the field of science and technology. Fields of excellence on the site are: electronics and ICT, design and manufacturing of industrial equipment, new materials, clean technologies and solar energy. The Technopole environmental policy is proactive. Since 2001, the park is certified ISO 14001 and also delivers the Ecolac label for companies that respect the site's environmental charter. The park manager is the SYPARTEC (Syndicat mixte pour l'Aménagement du Parc Technologique). The Technopole benefits from studies conducted in the framework of the COMETHE project. Through a material flow analysis, potential IS have been identified (reuse of big bags, joint purchasing of raw material, waste oil recovery, etc.). These symbioses will require more detailed studies to be implemented

Success factors

The Technopole cooperates with research and technology institutions, like the Institut National de l'énergie solaire (*cooperation S&T*). Moreover, the involvement of various local public and private partners in the COMETHE project is a key success factor (*coordinators*).

Perspectives

Following the COMETHE experiment, the next steps for the Technopole are the implementation of symbioses identified during the analysis phase and the development of prospective and communication strategies regarding its actions in the field of Industrial Ecology. Also, the Technopole recently established a convention with Alpesspace, Savoie Hexapôle and GIE Chamnord to collaborate in the development of a common strategy for waste management and Industrial Ecology implementation in several economic areas.

Park no. 33: Torvilliers Industrial Park

France

Geography	France, Champagne-Ardenne, Communauté de l'Agglomération Troyenne	
Type of park	Industrial	
Size of park	30 ha	300 jobs
	16 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Planned	
Project leader	Public	
References	Internet links www.comethe.org/images/pdf/TORVILLIERS.pdf www.comethe.org/images/rapport-final-aube.pdf	

Origin

The city of Torvilliers and the General Council of Aube manage the industrial area of Torvilliers. It is the second Industrial Ecology pilot area in Aube. This is largely due to the Center of Research and Interdisciplinary Studies on the Sustainable Development (CREIDD), established in the University of Troyes since 2001. The COMETHE project also had positive impacts on the diffusion of the Industrial Ecology approach in the region, including the restructuration of the Aube IE Club (Club d'Ecologie Industrielle de l'Aube).

Objectives

The park developers plan to incorporate a material flow approach and a waste management scheme in the whole area development, which is divided in two parts. 10 ha consist of companies operating in the sectors of clothing manufacturing, mechanics, woodworking, etc. In order to identify potential synergies, these companies benefited from material flow analysis in the framework of the COMETHE project. The other part of the park mainly targets the agri-food industry and is still in its early development stage with only two companies onsite. Public and private stakeholders gathered to elaborate an ambitious development of this area in terms of infrastructure pooling and flow exchanges.

Success factors

The involvement of the local Industrial Ecology club (*coordinators*), benefits from the COMETHE project and the presence of an academic research center (CREIDD) are key success factors (*cooperation S&T*).

Perspectives

In Aube, others projects are in progress such as: creating a business village to foster small firms development; water flow optimization and energy recovery from industrial wastewater in paper industry, in collaboration with Lucart (paper industry), the Paper Technical Center and the Aube IE Club; a reflection in Anett group on the energetic optimization of on-site processes and the PIVERT project on third generation biorefinery (using an approach of Industrial Ecology) led by the IEED (Institut d'Excellence sur les Energies Décarbonées) in collaboration with several partners such as Sofiprotéol, IAR pole, Université de Technologie de Campiègne and the UTT.

2.7 Germany

Germany's chemical and related process industry is ranking as number one in Europe. The country is the world's largest chemical exporter with over 55 chemical sites. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) develop a very incentive public policy for resource efficiency, sustainability and to promote innovation for environmental technologies (BMU 2010).

The survey identified 26 examples of eco-innovation parks with a wide range of experiences. Examples are spread out all over Germany with the greatest concentration in the highly industrialized western part: Nordrhein-Westfaleln. Most initiatives received support from the BMU and/or regional programs and most parks are lead by independent industry park manager like the operating company InfraServ GmbH & Co. In many experiences, a "plug&play" concept is applied to offer cost-effective shared services to the investors such as environmental services (e.g.: energy supply, waste management) thus fostering optimization and synergies. Initiatives also exist to network different projects and materials through pipelines at the regional scale like the Nordrhein-Westfalen sustainable business parks network.

Not all eco-innovation park examples offered clear combination of several measures, symbiosis or integrated developments as a top priority leading to economic and environmental gains. However, with initiative like "Zero Emission Parks" (The Baltic Sea Region Interreg Iii B 2013) or the Zero-emission network (Institut Für Angewandtes Stoffstrommanagement Ifas 2013) the forecast can be made that synergies and symbiosis will become a standard for the development of industrial and chemical parks in Germany while the development of renewable energy follow its own parallel path (BMU 2010).

No significant or relevant data on the following potential eco-innovation parks is detailed in the literature at the time of this review:

> InnovationCity Ruhr, Bottrop
> Zero Emission Park Eberswalde
> Dortmund Technologiepark
> Werk Gendorf Industrial Park
> Infrahod Rhodia Industriepark Freiburg
> Industrie Center Obernburg
> Industriepark Münchsmünster
> Chemical Site Schwarzheide
> Industriepark Griesheim
> Industriepark Wolfgang
> Standort Behringwerke Marburg
> Industriepark Köln-Merkenich
> Industriepark Solvay Rheinberg
> TroPark Troisdorf-IndustrieStadtpark
> Chemiepark Rudolstadt/Schwarza

Park no. 34: BASF Verbund site Ludwigshafen

Germany

Geography	Germany, Rheinland-Pfalz, Ludwigshafen	
Type of park	Industrial	
Size of park	~1000 ha	~38 000 jobs
	25 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	Cultural, social, health benefits ~~Mobility, transport~~ ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Scheuermann 2012) Internet links www.basf.com/group/corporate/site-ludwigshafen/en/function/conversions:/publishdownload/content/about-basf/worldwide/europe/Ludwigshafen/Uploads/BASF_in_LU_2011.pdf www.chemicalparks.com/PressReleases/Documents/GermanysChemicalandRelatedProcessIndustry2011.pdf	

Origin

The Ludwigshafen chemical site is a chemical cluster providing services in industrial research and production. It is the largest production site of BASF and hosts the company's headquarters, significant research and production activities, corporate units and competence centers. With more than ten square kilometers, over 160 production plants and 2000 buildings, it is the world's largest integrated chemical facility for manufacturing complex and highly refined productions (inorganic basic chemicals, petrochemicals and derivates polymers, fine and specialty chemicals, detergents, body care products, paper and fertilizers).

Objectives

On the site available are a large variety of raw materials (basic products and intermediates), services and utilities, as well as R&D support. The "Verbund structure" is among the essential infrastructures to mention. It is composed of two steam crackers, a synthesis gas plant and acrylic factories, which are linked to an extensive network of pipelines (2750 km), roads (106 km) and railway tracks (230 km). Raw materials, products and energy are then efficiently and intelligently delivered inside the industrial area. The system aims at saving resources and minimizing emissions thanks to chemical processes implemented with low energy inputs and high yields. The network also allows for using output by-products from a factory as input material in another. Heat losses in production processes are directly recovered on-site to produce steam that feeds other production plants through the energy network. Production operations can supply for up to 50% of the global steam demand. The infrastructures also include two combined heat and power plants, a wastewater treatment plant, and an incinerator for chemical residues.

Success factors

The main success factors are the geographical *location* and the accessibility (direct access to Rhine river with transshipment facilities, direct rail with intermodal transport terminal, logistic center and motorway access), but also private investments for developing infrastructures, services/utilities and supply of raw materials that contribute to the creation of *added, value* for the site's tenants. Moreover, the Verbund system is clearly mentioned by BASF as a key feature for the site's environmental performance *(Eco-Innovation Park)*. Besides, a public-private partnership gave rise to the creation of a chemistry-focused technology centre (chem²biz), which provides complete services in the field of chemistry, nanotechnology, and new materials (*cooperation with S&T*).

Perspectives

Significant expenditures (10 billion euros) are currently carried out in order to develop by 2015 various new plants, infrastructures and services, including a work-life management centre, the extension of social counseling to include care counseling, and the modernization of institutions such as the "Feierabendhaus" and day care facilities.

Park no. 35: Bayer Industrial Park Brunsbüttel

Germany

Geography	Germany, Schleswig-Holstein, Brunsbüttel	
Type of park	Industrial	
Size of park	420 ha	1000 jobs
	10 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Scheuermann 2012) Internet links www.brunsbuettel.bayer.de/internet/bms-bru.nsf/id/de_home	

Origin & Objectives

The Bayer Industrial Park in Brunsbüttel is a high-tech site for the chemicals industry. Located on the banks of the North Sea, Kiel Canal and the Lower Elbe River, it forms part of the economic landscape of the Metropolitan Region of Hamburg. The industrial park is also incorporated in the ChemCoast network a public private partnership that aims to strengthen and consolidate the chemical industry in the north of Germany by facilitating market access to chemical companies. The park is coordinated through Bayer MaterialScience AG and offers connection to seaports and thus directs access to world markets.
The economic players in the network work closely together to purchase material and use resources and services, collaboration includes reliable supply of raw materials; optimum supply and disposal facilities; networking opportunities: pipelines to refinery and oil field, link-up to ethylene pipeline. A wastewater treatment plant and a flue gas treatment are available onsite.

Success factors

The main success factors are *coordinators* and *location*.

Perspectives

Future developments are unknown.

Park no. 36: CAMP CO_2-Zero

Germany

Geography	Germany, Nordrhein-Westfalen, Eschweiler	
Type of park	Industrial	
Size of park	9 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leaders	Public	
References	Internet links www.eschweiler.de/city_info/webaccessibility/index.cfm?waid=462&item_id=858544&region_id=437&design_id=0&modul_id=33&record_id=49359&fsize=1&contrast=0&search=camp www.nrw.de/presse/auszeichnung-nachhaltige-entwicklung-von-gewerbeflaechen-9102/ www.nachhaltige-gewerbegebiete.de/index.php?option=com_content&view=article&id=6&Itemid=19	

Origin

RWTH Aachen (Rheinisch-Westfaelische Technische Hochschule Aachen), Eschweiler city and AGIT (Regional development agency for the Technology Region Aachen) have initiated together with other project partners, a development concept for a former military camp. The concept is part of the public initiative “Indeland”: the application of sustainable development throughout the region.

Objectives

The project aims at the conversion of an old military base and the promotion of natural surroundings, mostly forests. The buildings will be demolished and replaced by “Camp CO_2-Zero”: a business park powered by renewable energy and fostering environmental protection. The first step is to rehabilitate the area for the public.

Success factors

This EIP received the “Eco Industrial Park” label from regional environment council and is part of the regional sustainable business parks network: “Nachhaltige Gewerbeflächenentwicklung in Nordrhein-Westfalen”. Besides, advice is brought by the Research Institute for Regional and Urban Development (ILS) (*cooperation with science and technology institutions*), and the concept is developed in collaboration with RWTH Aachen technical school

Perspectives

The current status of the project is unknown.

Park no. 37: Chemical Industrial Park Knapsack

Germany

Geography	Germany, Nordrhein-Westfalen, Knapsack/Hürth	
Type of park	Industrial	
Size of park	180 ha	2200 jobs
	27 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Scheuermann 2012) Internet links www.chemiepark-knapsack.de www.infraserv-knapsack.de	

Origin & Objectives

The Chemical Industrial Park Knapsack is situated 10 km south west of Cologne. The park is divided into two sections: Knapsack and Hürth, connected via an internal road, railway tracks and a pipeline. The private operator on the park is InfraServ GmbH & Co. Knapsack KG. The guideline of the park's operator mentions the improvement of processes and procedures for environmental conservation. Processes and technology concerning environmental protection have been continually developed since the founding of the site, especially in the wastewater and exhaust gas treatment sectors, since the construction of a central department for water and air in 1961. Targets include careful handling and efficient use of raw materials and energy sources as well as other assets.
The chemical companies benefit from join facilities and from a customized range of services (e.g. waste management) offered by the chemical park's operator.

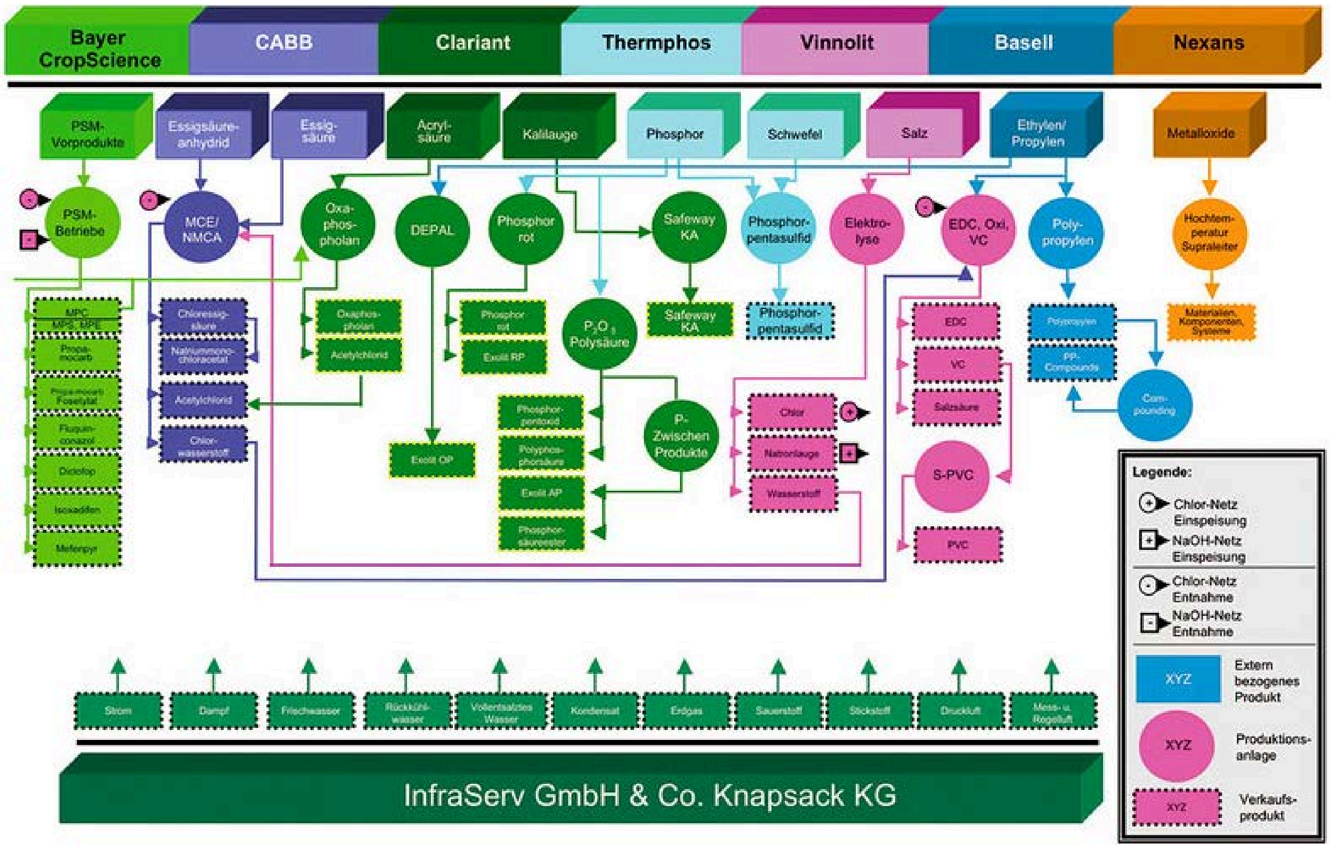
Success factors

The park is located in the heart of Europe, well connected to infrastructure, and receives support of politics and authorities at all levels (*policies, coordinators, incentive*). Moreover, it enjoys intensive cooperation with universities of applied science, universities and research institutions, cooperation with regional initiatives (chemcologne) (*cooperation*). The *economic value added* from mutualized services and networks should also be considered as a success factor.

Perspectives

Numerous associative opportunities with renowned national and international companies located on-site exit to further develop Chemical Industrial Park Knapsack. 30 ha are available for further development. Besides, the Norwegian energy company Statkraft is planning to build at the Chemical Industrial Park Knapsack the world's most advanced combined-cycle power plants with a generating capacity of 430 MW.

Fig. 23 > Chemical Industrial Park Knapsack substance network



after Infraserv Gmbh et al. 2007

Park no. 38: Chemie- und Industriepark Zeitz

Germany

Chemie- und Industriepark Zeitz		
Geography	Germany, Sachsen-Anhalt, Zeitz	
Type of park	Industrial	
Size of park	~ 229 ha	~1100 jobs
	48 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Scheuermann 2012) Internet links www.industriepark-zeitz.com/downloads/standortbroschuere_englisch.pdf www.industriepark-zeitz.com/lage_in_europa_und_deutschland,3,3,de.html www.chemicalparks.com/parks/20/Seiten/default.aspx www.gn-energy.com/en/projects/34/	

Origin

In 1996, mineral oil processing shut down and the dismantling of the hydrogenating plant induced a large renovation of the area under the direction of the company “ZSG Zeitzer Standortgesellschaft GmbH” (founded the same year). Significant investments – more than 87 million euros until now – led to the development of the area into a modern Chemical and Industrial Park with supraregional economic importance.

Objectives

Currently, more than half of the area is about to be occupied and modern infrastructures meet industrial high requirements for supply and disposal. A state-of-the-art energy management for electricity, natural gas and heat economy is performed. The area is equipped for the disposal of industrial and domestic waste, as well as rainwater. Engineering, technical and commercial services are also available. The site manager & service partner “Infra-Zeitz Servicegesellschaft GmbH” manages the area and supports projects (such as new settlements, investments, approval procedure, etc.). It also guarantees the provision of supply services. In 2006, a “Competence Centre for Industrial Recycling of Biomass” has been established to implement onsite the regional cluster strategy that promotes the industrial use of renewable resources.

Success factors

The main success factors are an attractive international *location* with a good connection to the railway and motorway networks, as well as the services and utilities provided to foster the settlement of both SME’s and large-scale industrial plants *(value added).*

Perspectives

The purpose of the “Competence Centre for Industrial Recycling of Biomass” is to enable innovation and competitiveness by supporting R&D results for a local industrial implementation. In this framework, the following related projects are planned: a material/energetic use of biomass/indigenous raw lignite by gasification methods and an industrial production of organic chemical polymers from renewable raw materials.

Park no. 39: Chemiepark Bitterfeld Wolfen

Germany

Geography	Germany, Sachsen-Anhalt, Bitterfeld Wolfen	
Type of park	Industrial	
Size of park	1200 ha	11 000 jobs
	360 companies (60 in production, 300 services, construction, retail, etc.)	n.a. inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ ~~Waste management~~ Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Scheuermann 2012) Internet links www.chemiepark.de/ www.bitterfeld-wolfen.de/de/upload/P-D%20ChemiePark001.pdf	

Origin & Objectives

Preiss-Daimler ChemiePark Bitterfeld Wolfen GmbH coordinates the industrial park. The site's characteristics are the common use of infrastructure such as: use of pipeline bridge system for raw material and products, supply of drinking water and industrial water, wastewater treatment and the use of rail systems and the use of a fire department.
About 20 of the Chemical Park resident companies are producers of fine and special chemicals including Bayer, Degussa, Heraeus Tenevo, Linde, Akzo Nobel, Supresta, Solvay, Guardian Flachglas, CBWChemie GmbH, FEW Chemicals GmbH, ORGANICA Feinchemie GmbH Wolfen and Sensient Imaging Technologies GmbH. The park also focuses on renewable energy technology (Q-cells).

Success factors

Preiss-Daimler provides raw materials such as chlorine, caustic soda, hydrogen, nitrogen, oxygen and hydrogen chloride for processing. Some of these raw products come from other chemical facilities locations, like Bernburg and Leuna (*coordinators*). An extensive pipe network bridges the suppliers' chemical precursors of the various areas to the users. Another important objective of the park is to make the strong contaminated site usable again. The ground water decontamination takes place within an ecological large-scale project that is financed by the Federal Government (*incentives*). In addition to the coordination by Preiss-Daimler, a large number of scientific institutions collaborate with the park: Halle, Leipzig, Magdeburg, Dessau, Köthen (*cooperation*). The protagonists of the ChemiePark seek recognition as an innovative regional growing initiative.

Perspectives

Future developments are unknown.

Park no. 40: Chempark Dormagen

Germany

Geography	Germany, Nordrhein-Westfalen, Dormagen	
Type of park	Industrial	
Size of park	360 ha	9800 jobs
	60 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	Cultural, social, health benefits ~~Mobility, transport~~ Land use optimization Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Scheuermann 2012) Internet links www.chempunkt.de/dormagen.html	

Origin & Objectives

The private company Currenta is the manager and operator of Dormagen, Leverkusen, and Krefeld-Uerdingen parks, which account for around one-third of the total chemical production in Nordrhein-Westfalia.
More than 70 companies specialized in production, research and services help support the implementation of synergies focusing on production and related environmental aspects: wastewater, waste, pollution control, soil conservation, process information and safety. The service provider also develops waste management and safety concepts through support on approval procedures and other customized services. The Dormagen Chemical Park targets companies in the chemicals industry (production of pesticides, plastics, rubber, polymers and organic intermediates). Companies have access to around 2000 different substances and products, including: insecticides, herbicides, fungicides, plastics, polyurethane and coating raw materials, rubber, fibers, dental products, petrochemicals, synthesis gas products.

Environment plays an important role in all processes where production emissions could be reduced by about four-fifths (e.g. with combined heat and power plant). Many companies committed to the "climate protection program efficiency class A + +".

Success factors

The park fosters research, development and forms a strong network together with a whole range of business sectors, companies, research institutes and associations (*coordinators*, *cooperation*). The park is at the center of Europe's chemical market (*location*). The *economic value added* of mutualized services and networks should also be considered as a success factor.

Perspectives

Future developments are unknown.

Park no. 41: Chempark Krefeld Uerdingen

Germany

Geography	Germany, Nordrhein-Westfalen, Krefeld-Uerdingen	
Type of park	Industrial	
Size of park	260 ha	7000 jobs
	40 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ Land use optimization Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Scheuermann 2012) Internet links www.chempunkt.de/krefeld-uerdingen.html	

Origin & Objectives

The private company Currenta is the manager and operator of Krefeld Uerdingen, Leverkusen, and Dormagen parks, which account for around one-third of the total chemical production in North Rhine-Westphalia.
More than 70 companies specialized in production, research and services help support the implementation of synergies focusing on production and related environmental aspects: wastewater, waste, pollution control, soil conservation, process information and safety. Processes are optimized in order to ensure maximum safety, conserve natural resources and generate as few environmental impacts as possible. Many technologies are used to control air pollution (new filter system) and energy efficiency (insulation material and use of special metal alloys). Companies have access to a wide range of substances and products through mutualized production systems including: polyurethane and coating materials, plastics (pc, durethan), rubber chemicals, basic and fine chemicals, intermediate products for fragrances and crop protection active ingredients, inorganic pigments (iron oxide, titanium oxide).

Success factors

The park fosters research, development and forms a strong network together with a whole range of business sectors, companies, research institutes and associations (*coordinators*, *cooperation*). The park is at the center of Europe's chemical market (*location*). The *economic value added* of mutualized networks should also be considered as a success factor.

Perspectives

Future developments are unknown.

Park no. 42: Chempark Leverkusen

Germany

Geography	Germany, Nordrhein-Westfalen, Leverkusen	
Type of park	Industrial	
Size of park	450 ha	30 000 jobs
	300 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Scheuermann 2012) Internet links www.chempunkt.de/leverkusen.html	

Origin & Objectives

The private company Currenta is the manager and operator of Leverkusen, Dormagen and Krefeld-Uerdingen parks, which account for around one-third of the total chemical production in North Rhine-Westphalia. More than 70 companies specialized in production, research and services help support the implementation of synergies focusing on production and related environmental aspects: wastewater, waste, soil conservation, process information and safety.

Leverkusen park hosts a wide range of sectors: from chemical and pharmaceutical industries to the high-tech sector. More than 5000 chemicals are manufactured at Chempark Leverkusen, mainly nitration and chlorination products, aromatics, fine chemicals and silicon chemicals. Companies on site have access to around 5000 different raw materials and products. These include: chlorine and nitro compounds of benzene and toluene, pharmaceuticals. Recycling or re-use of residual substances have been given priority over their disposal for both environmental and economic terms. A Japanese garden (15’000 m^2) has been developed next to the industrial zone for recreation.

Success factors

The park fosters research, development and forms a strong network together with a whole range of business sectors, companies, research institutes and associations (*coordinators*, *cooperation*). The park is at the center of Europe’s chemical market and is located close to the major Rhineland cities of Cologne and Dusseldorf (*location*). The *economic value added* from mutualized services and networks should also be considered as a success factor.

Perspectives

Future developments are unknown.

Park no. 43: Dow Valuepark

Germany

Geography	Germany, Sachsen, Schkopau	
Type of park	Industrial	
Size of park	150 ha	1200 jobs
	21 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ Material flow	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Liwarska-Bizukojc et al. 2009) (Scheuermann 2012) Internet links www.dow.com/valuepark/ehs/index.htm	

Origin & Objectives

Dow ValuePark® is the industrial park concept of Dow Olefinverbund GmbH, a wholly owned subsidiary of The Dow Chemical Company. The objective of the ValuePark® is to develop a concept for safety and mutualized material production. Dow embraces the concept of “Vision Zero”: zero accidents and zero damages to the environment. The company joined the Responsible Care® initiative in 1989, which aims at favoring continuous improvement in health, safety and environmental (HSE) performance, together with open and transparent communication with stakeholders in the chemical industry.

The ValuePark® focuses on the needs of chemical manufacturers and plastics processors. The integration of Dow’s strategic partners and customers on-site is its main goal as service provider: implementation of long-term synergies by integrating material flows, logistics, shared infrastructure and services to reduce fixed assets. It offers various services such as counseling for planning and obtaining permits, a wastewater treatment plant, waste incineration, intercompany transport and logistics, emergency services, chemical analyses services, rail dispatching, and different utilities (i.e. water, cooling water, nitrogen, other industrial gases, natural gas).

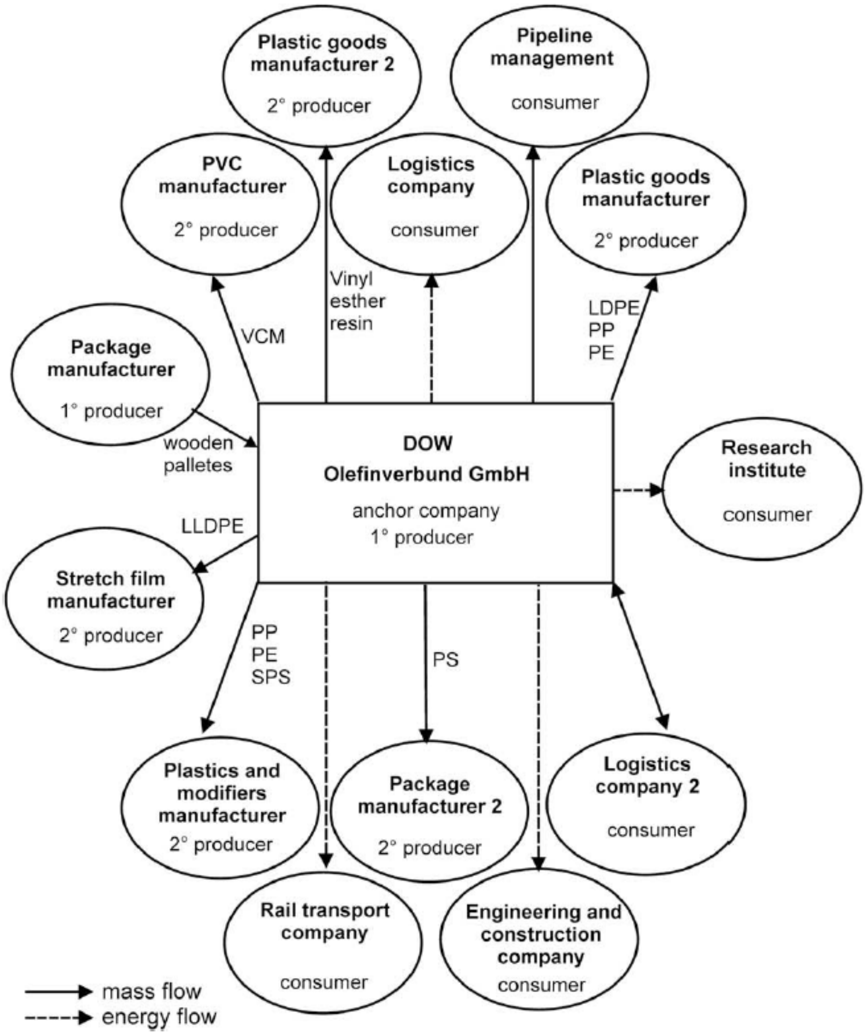
Success factors

The prerequisite to integrate the ValuePark® is to comply with Dow’s high environment, health, and safety standards. The main success factor is therefore the *coordinators* and the *economic value-added*.

Perspectives

Future developments are unknown.

Fig. 24 > Aerial view of the material flow scheme of the main symbiotic relationships between the fourteen companies at the Dow Value Park



after Liwarska-Bizukojc et al. 2009

Park no. 44: Felsenpark

Germany

Geography	Germany, Nordrhein-Westfalen, Hemer	
Type of park	Industrial	
Size of park	11 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Stopped	
Project leaders	Public	
References	Internet links www.nrw.de/presse/auszeichnung-nachhaltige-entwicklung-von-gewerbeflaechen-9102/ www.nachhaltige-gewerbegebiete.de/index.php?option=com_content&view=article&id=8&Itemid=25	

Origin

In 2008 the consulting office GSW GmbH, member of the force & defense network, was in charge of the recovery of an area, turning it into the security and disaster protection center (ZSK).

Objectives

The project aims at the transformation of old military barracks: “Am Felsenpark”. This area is situated in direct vicinity of protected natural areas and public gardens and plans to use this environmental quality as an asset to attract workers. The redevelopment process concerns energy production through installation of solar panels and heating system based on a wood pellets burner.

Success factors

Aside from the natural area surroundings, the local renewable energy production gives a certain added value to the park so it received the Eco Industrial Park label from regional environment council *(Eco-Innovation Park)*. The park is also part of the regional sustainable business parks network: “Nachhaltige Gewerbeflächenentwicklung in Nordrhein-Westfalen” and advise is brought by the Research Institute for Regional and Urban Development (ILS)(*cooperation with science and technology institutions*).

Perspectives

The project status is defined as “stopped” as a new orientation for the project & area is under decision.

Park no. 45: Gertshofen Industriepark

Germany

Geography	Germany, Bavaria, Gertshofen	
Type of park	Industrial	
Size of park	35 ha	1500 jobs
	10 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leaders	Private	
References	(Scheuermann 2012) Internet links www.industriepark-gersthofen.de/de/	

Origin & Objectives

Gersthofen Industriepark is a fully developed industrial site in the center of Bavaria. The park operator is the Industriepark Gersthofen Servicegesellschaft (IGS). The company offers a large panel of services. Infrastructures and services include: biological clarification plant and wastewater systems; data networks; storage for raw materials, technical material, finished products and hazardous material; fire-fighting water retaining systems; pipeline bridges and systems for power and materials supply; social facilities, railroad lines; workshops (metal, plastics, electric, measurement and control technology); and a plant security system. IGS is certified as ISO 140001 and EMAS compliant.
The site concentrates chemical industries and has evolved over the last century into an ultra-modern research, production and service site. Companies located at Gersthofen industrial park collectively use comprehensive infrastructures and benefit from the synergies that enhance efficiency.

Success factors

The park benefits from strong collaboration with institutions and governmental agencies. The *cooperation with science and technology* institutions and their role as *coordinators* can therefore be considered as major success factors. The *economic value added* from mutualized services and networks and the *diversity of activities* should be considered as the success factors.

Perspectives

Future developments are unknown.

Park no. 46: Gewerbenetzwerk Pfaffengrund

Germany

Geography	Germany, Baden-Württemberg, Heidelberg	
Type of park	Industrial	
Size of park	93 ha	N/A jobs
	18 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	PPP	
References	(Sterr et al. 2004) Internet links www.iuwa.de/projekte/index.html	

Origin & Objectives

Pfaffengrund is the oldest industrial and commercial region of the city of Heidelberg. The industrial network implemented in this park is lead by the working group Industry and Commercial Area Pfaffengrund, which is a combined initiative of the Heidelberg Economic Development Association (HWE) and the companies located in the Pfaffengrund region.

Various industrial sectors including chemistry, car manufacturing, pharmaceutical industry, and services are producing in Pfaffengroud, the biggest being BASF, Daimler Chrysler, Roche, John Deere, Heidelberger Druckmaschinen and ABB, complemented by a dynamic service sector. Existing by-product synergies include: corrugated board manufacturer taking used paper as input material; polyethylene waste used in plastic manufacturing; shared collection and joint transport of used pallets to refurbishing company; utility synergies; burning of waste untreated wood for space heating.

Success factors

The Heidelberg Institute for Environmental Economy Analysis runs a recycling project that brought significant savings of disposal costs for the producers, thus returning the financial subsidies of the single companies within less than a two-year time period. The *cooperation with science and technology* institutions and their role as *coordinators* can therefore be considered as major success factors. The *economic value added* from mutualized services and networks and the *diversity of activities* should be considered as the success factors.

Perspectives

Currently, the main goals are to turn the industrial region of Rhein-Neckar into the 7th largest agglomeration area of Germany and to create a recycling cluster.

Park no. 47: Honeywell Seelze

Germany

Geography	Germany, Niedersachsen, Seelze	
Type of park	Industrial	
Size of park	500 ha	1100 jobs
	5 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	Cultural, social, health benefits ~~Mobility, transport~~ ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	Internet links www51.honeywell.com/sm/seelze/en/industry-park.html	

Origin & Objectives

Honeywell's Seelze Industrial Park offers a broad range of services. This company owns the site and is the operator of the industrial park. The largest of the companies located at the Park belongs to the international US group Honeywell Inc. The Seelze Industrial Park is committed to the Responsible Care® programme. Responsible Care® requires companies to constantly improve their products and processes in respect of the effects on health, safety and the environment. The program applies to all the chemicals companies on the industrial park.

Honeywell's Seelze coordinates power supply, (modern CHP plant), water supply (drinking and Demineralised water); supply of compressed air; nitrogen distribution in two qualities, cooling facilities; environmental protection measures. A central sewage treatment plant with physical-chemical and two-stage biological treatment for all accruing sewage is present onsite. All waste is collected for central sorting and processing and subsequently forwarded to approved recycling or disposal facilities. Safety and environmental staff (safety specialists, specially appointed officers for waste, air pollution control, water pollution control, hazardous substances, radiation protection and malfunctions/incidents) are also available onsite.

Success factors

The main success factor is the *coordination between economic players*.

Perspectives

Future developments are unknown.

Park no. 48: Industriepark Höchst

Germany

Geography	Germany, Hessen, Frankfurt/Höchst	
Type of park	Industrial	
Size of park	460 ha	22 000 jobs
	90 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ Air pollution prevention Noise prevention ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Scheuermann 2012) Internet links www.industriepark-hoechst.com/index/services/umwelt/umweltschutz.htm www.infraserv.com/index/leistungen/umwelt-schutz-sicherheit/umwelt-schutz-sicherheit_usg.htm	

Origin

The Industriepark Höchst was built on the foundations of the Hoechst AG parent plant. Infraserv GmbH & Co. Höchst KG operates Industriepark Höchst.

Objectives

As a leading site operator, the company provides to the park's tenants a wide range of utility and services: from fitting laboratories, extensive logistics services to waste disposal. Tenants enjoy the park's characteristics as highly evolved infrastructures, a high-capacity media-distribution system, and perfect links to major traffic routes. The park represents an adapted environment for companies in the chemical, pharmaceutical and process industries, for their research, distribution and sophisticated plant operations.

Success factors

The park fosters environmental protection and safety: from avoiding unnecessary trucking and minimizing noise and odors to reducing water consumption and cutting down on packaging material. With its extensive portfolio of services, Infraserv Höchst assists the companies achieving their environmental goals. Services include permit procedures, audits and management systems, remediation management, water protection, emission control (*coordinators*). The *economic value added* of mutualized services and networks should also be considered as a success factor.

Perspectives

Future developments are unknown.

Park no. 49: Industriepark Kalle Albert

Geography

Geography	Germany, Hessen, Wiesbaden	
Type of park	Industrial	
Size of park	100 ha	5600 jobs
	70 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency ~~Waste management~~ Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Scheuermann 2012) Internet links www.infraserv-wi.de/44.asp	

Origin

The Industriepark Kalle-Albert has over 150 years of industrial history. It is now a modern industrial base with innovative site management operated by InfraServ GmbH & Co. KG, Wiesbaden.

Objectives

The park is adapted to international companies specialized in chemicals, films, sausage casings, pressure plates, synthetic resins, biotechnology/pharmaceuticals and nano-technology. InfraServ supplies water and operate the drainage network (separate sewer and storm water for cooling and process water) and a biological wastewater cleaning system. The sewage sludge is stabilized together with municipal sewage sludge, dewatered and used as fuel. The energy supply is taken over by its own power plant, which in conjunction with a comprehensive energy management system for the provision of electricity, steam, compressed air on to provide for nitrogen production.

Success factors

The *economic value added* from mutualized services and networks and the *diversity of activities* should be considered as the main success factors.

Perspectives

Future developments are unknown.

Park no. 50: InfraLeuna

Germany

Geography	Germany, Sachsen, Leuna	
Type of park	Industrial	
Size of park	1300 ha	9000 jobs
	20 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leaders	Private	
References	Internet links www.infraleuna.de	

Origin & Objectives

InfraLeuna is a chemical site whose production structure ranges from specialty to bulk chemicals. The park shows a mature and complex cooperation in material and energy flows between companies on site and with other chemical sites in the region.
Power stations from InfraLeuna Energiegesellschaft GmbH and enviaM supply electric and stream networks operated by InfraLeuna. The operator is also responsible for the supply and disposal of water. A waste incineration plant generates heat and energy for the companies present in the park. A 25 km road network, a 75 km track network and a 600 km pipelines network guarantee fast movements within the chemical area. The infrastructure and service concept, which is specific for Leuna, provides chemical companies with numerous advantages and services, which is highly efficient and cost effective. Since 1990, renowned companies like Total, Momentive, Linde, Domo and Taminco as well as numerous medium-sized companies have settled on the chemical site.

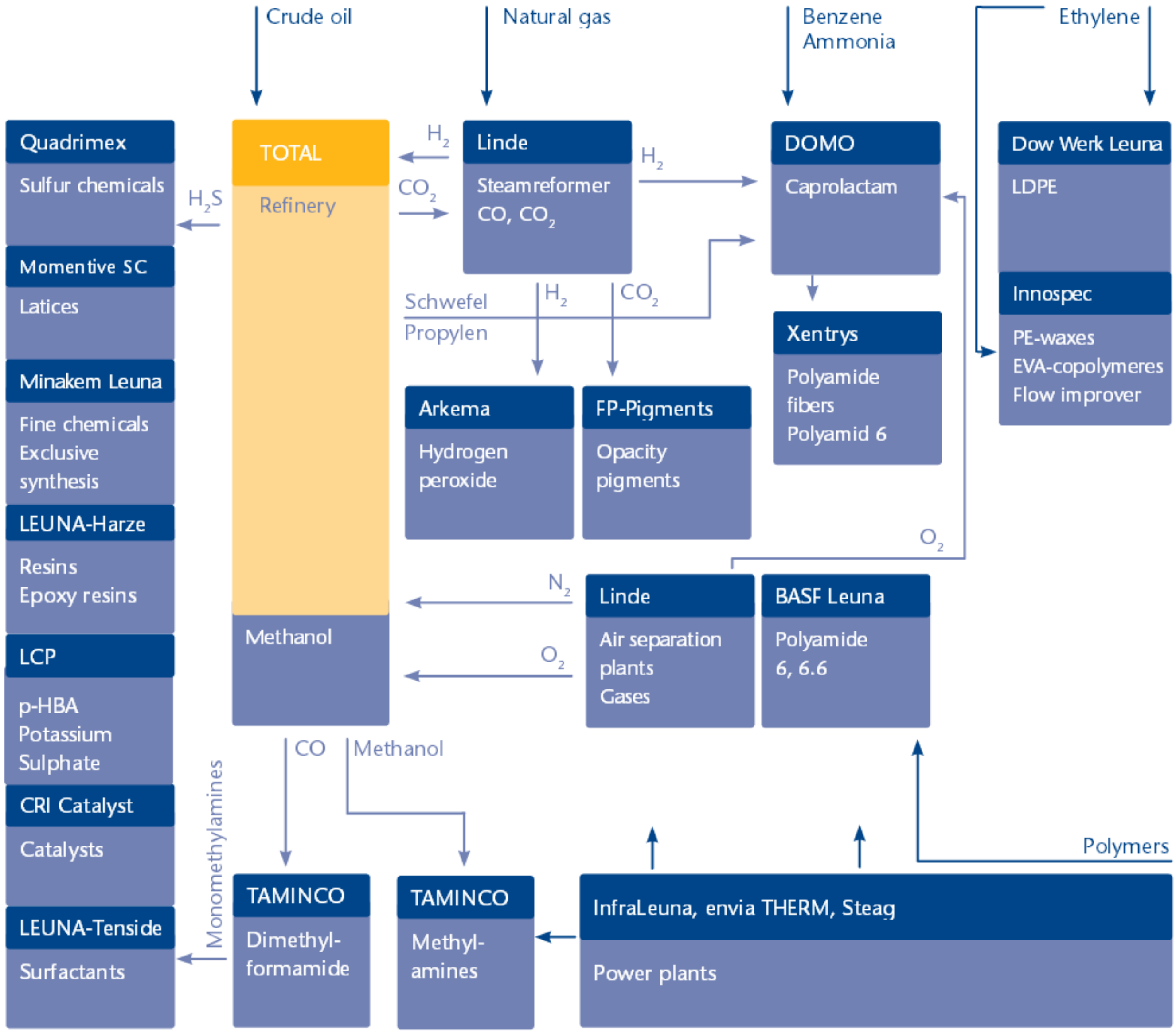
Success factors

Molded by its chemical tradition, the region continues to train and provide internationally competitive graduates and specialists from colleges and universities in Leipzig, Halle and Merseburg (*cooperation*). Public incentives have considerably improved the prospects of settlement from potential investors (*incentive*). InfraLeuna has rolled out an integrated management system certified for quality, safety and environmental protection as per international directives (*policy*). It complies with the stringent standards pursuant to DIN EN ISO 9001 and 14001. InfraLeuna has also been a member of the environmental alliance of the State of Saxony-Anhalt since October of 2004. The *economic value added* of mutualized networks should also be considered as a success factor.

Perspectives

Future developments are unknown.

Fig. 25 **> Site chemical network**



after Infraleuna 2013

Park no. 51: Marl Chemical Park

Germany

Geography	Germany, Nordrhein-Westfalen, Marl	
Type of park	Industrial	
Size of park	650 ha	N/A jobs
	30 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Siam 2004); (Scheuermann 2012) Internet links www.chemicalparks.com/parks/24/Seiten/default.aspx www.chemsite.de/chemsite-en/chemieparks-industriestandorte/chemiepark-marl/index.php	

Origin & Objectives

The Marl Chemical Park is the third largest integrated industrial site in Germany and also Evonik's largest production site (a monomers producer). The park is coordinated through ChemSite and with Infracor as site operator and service provider.
The chemical park consists of a fully developed infrastructure, a unique materials flow system, and a comprehensive range of services tailored (wastewater treatment, incineration of hazardous waste, cogeneration system supply for steam, emissions measurements, 120 km of railway track system including a freight station and container terminal, and port facilities with connections to the North Sea) to the needs of the producers. All existing supply and disposal systems, logistics, maintenance, security and environmental protection services are made available. It has set a fully integrated material flow system at and between the sites. Marl is directly connected to an extensive pipeline grid (e.g. ethylene, propylene, C4 section, hydrogen). Large international companies like Air Liquide, Air Products, Evonik, EOS Styrenics, ISP, Lanxess Buna, Rohm and Haas, Sasol, and Vestolit are currently producing at this site.

Success factors

The park receives funding from Nordrhein-Westfalen and Europe (*incentive*). Due to the central position in Europe and direct access to the European highway, railroad, waterway, and pipeline networks, the site enjoys good access to the European market (*location*). Scientific competence is gained through a tightly meshed network of universities, universities of applied sciences and research institutions available in the region (*cooperation)*. In addition, the site operator and service provider may also be considered a success factor (*coordinators*).

Perspectives

Future developments are unknown.

Park no. 52: Neue Bahnstadt, Opladen

Germany

Geography	Germany, Nordrhein-Westfalen, Leverkusen	
Type of park	Combined	
Size of park	72 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leaders	PPP	
References	Internet links www.neue-bahnstadt-opladen.de/ www.nrw.de/presse/auszeichnung-nachhaltige-entwicklung-von-gewerbeflaechen-9102/ www.nachhaltige-gewerbegebiete.de/index.php?option=com_content&view=article&id=11&Itemid=32	

Origin

The City of Leverkusen and the Deutsche Bahn (national railway company) have initiated together this project.

Objectives

The project aims at the renovation of old industrial buildings for an innovative use. A 100-year-old factory hall is being converted into offices and industrial spaces thus creating a combined park. Besides, a University campus and student housing are also being included on the area and may foster cooperation between economic players and science and technology institutions.

Success factors

This EIP received the “Eco Industrial Park” label from regional environment council and is part of the regional sustainable business parks network: “Nachhaltige Gewerbeflächenentwicklung in Nordrhein-Westfalen). Therefore, the main success factors are *cooperation* and the clear designation as an *Eco-Innovation Park*.

Perspectives

The current status of the project is unknown.

Park no. 53: Oberbruch Industry Park

Germany

Geography	Germany, Nordrhein-Westfalen, Oberbruch	
Type of park	Industrial	
Size of park	110 ha	1500 jobs
	20 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leaders	Private	
References	(Scheuermann 2012) Internet links www.industriepark-oberbruch.de/ http://de.wikipedia.org/wiki/Industriepark_Oberbruch www.nuon.com/company/core-business/industry-park-management/	

Origin

Oberbruch Industry Park is situated on the former site of Glanzstoff where it had been leading over a century of business activity as a pioneer of modern chemical fibres. In order to maintain its activities, the park management decided to call upon the skills Nuon Energy to create an eco-innovation park.

Objectives

Nuon manages four industry parks in the Netherlands and in Germany providing the land, the infrastructure, the utilities and the waste water purification, energy and process support products, such as steam, compressed air, cooling systems, various water qualities and a selection of gas types, to suit their requirements. Nuon also offer a complete package of general, technical and support services. Oberbruch Industry Park is specialized in processing chemicals, plastics and new materials; the park operates on the same principle as a public utility company. Customized solutions are offered as well as total industrial park management from A to Z. Nuon Energy und Service GmbH supplies on-site companies with all types of energy, and is responsible for wastewater treatment & disposal and rubbish removal and offers additional services such as security, logistics and quality analysis. All services are certified and comply with the DIN EN ISO 9001:2001 and 14001 standards.

Success factors

Customers benefit from the company’s 100 years experience in the chemical industry and its broad expertise in the field of energy procurement and distribution (*coordinators*). A further advantage is the very low rate of community tax in Heinsberg in comparison with the surrounding area and other parts of Germany (*incentive*). The central role of Nuon guarantees coordinated material supply and waste management. The companies benefit from exemplary cooperation and from excellent contacts with R&D facilities in the surrounding area (*cooperation*). Oberbruch views itself as an extended workbench of the neighbouring Rheinisch-Westfaelische Technische Hochschule (RWTH) Aachen. The location is the cradle of Germany’s synthetic fibers industry and the gateway to the West European markets (*location*). Therefore additive success factors to consider are *economic value added*, provided by infrastructure and service mutualisation, and clear designation as an *Eco-Innovation Park*.

Perspectives

Future developments are unknown.

Park no. 54: Pharma und Chemiepark Wuppertal

Germany

Geography	Germany, Nordrhein-Westfalen, Wuppertal	
Type of park	Industrial	
Size of park	~18 ha	1250 jobs
	N/A companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leaders	Private	
References	(Scheuermann 2012) Internet links www.wuppertal.bayer.de/scripts/pages/de/pharma-_und_chemiepark/index.php www.wuppertal.de/wirtschaft-stadtentwicklung/medien/dokumente/Chemiepark.pdf www.chemicalparks.com/PressReleases/Documents/GermanysChemicalandRelatedProcessIndustry2011.pdf www.pharmaceutical-technology.com/projects/bayerhealthcarenewce/	

Origin

Established originally in 1866, the industrial park was exclusively dedicated to Bayer's activities. Since 2003, the park is open to external companies, but remains specifically designed for producers of pharmaceutical and active ingredients, with a preference for biological or technical SME's.

Objectives

The Park is adapted to biotechnological development and production of highly specialized pharmaceutical products and offers ISO 14001 certified infrastructures. All companies benefits from a comprehensive range of services: cooling system, energy supply, supply of purified water for pharmaceutical use, specific wastewater treatment, waste processing (centralized off-gas incineration unit). Raw materials such as solvents are available onsite and stored in a centralized tank farm. The "Plug & Play" service is fully operational. The park also includes industrial service providers such as analytics companies and manufacturers of laboratory equipment. Basic services (site security, health and safety), as well as technical (training, documentation, auditing, maintenance and engineering), and commercial (start-up support) services are also provided on site.

Success factors

The park has an efficient management unit (*coordinators*) and concentrates many activities and services in one location: biotechnology utilities, API (Active Pharmaceuticals Ingredients) production and R&D plant for biotech processes (*economic value added*).

Perspectives

Future developments are unknown.

Park no. 55: Schwedt Industrial Park

Germany

Geography	Germany, Brandenburg, Schwedt	
Type of park	Industrial	
Size of park	200 ha	1200 jobs
	70 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ ~~Waste management~~ Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Scheuermann 2012) Internet links www.pck.de www.ipsdt.de/vorteile.html	

Origin & Objectives

The Industrial Park Schwedt, operated by the PCK refinery, is the biggest contiguous industrial area for refinery in northern Brandenburg. Every year, PCK processes 12 million metric tons of crude oil. The primary products are diesel fuel, petrol (gasoline), kerosene, liquefied petroleum gas, heating oils and bitumen. The park proceed to a large scale cleanup of pollutants from former industries, a major ecological project carried out in cooperation with the Brandenburg state government, the Ministry for the Environment, Health and Consumer Protection, the Federal Privatization Agency (BvS) and the Uckermark District authorities.
The onsite operating companies provide a wide range of local services and support. Many special raw materials and media can be obtained directly from on-site suppliers (e.g.: synergies by using co-products of on-site companies). The park also has specific initiatives and infrastructures to target air pollution (e.g.: refurbishment of the tank farm to reduce hydrocarbon emissions and the installation of an emissions monitoring system) or wastewater treatment.

Success factors

The location aims at attracting companies in the renewable energy sector, specially the biofuels, but also logistics, metallurgy industry as well as many other sectors. A strong with the University of Applied Sciences in Eberswald exists (*cooperation*). The park benefits from special support from both regional and state level agencies (*incentives*) as well as business oriented policies at the municipal level (*policies*). Besides, it is situated on the northeast of the economic region of Berlin-Brandenburg on the axis Berlin-Szczecin, directly on the Polish border. It is an ideal point of departure to the markets of Central Europe and the Eastern Europe as well as in Scandinavia and in the Baltic States (*location*).

Perspectives

Future developments are unknown.

Park no. 56: Zero Emission Park Bottrop

Germany

Geography	Germany, Nordrhein-Westfalen, Bottrop	
Type of park	Industrial	
Size of park	1 ha	250 jobs
	180 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	PPP	
References	Internet links www.zeroemissionpark.de www.zeroemissionpark.de/Dokumente/Stoffstrommanagement.pdf	

Origin & Objectives

The Zero Emission Park project is one of the first initiatives in Germany to run an integrated project for the development of sustainable industrial and commercial areas. The zero emission goals imply avoiding the “adverse effects” of economic activities in industrial zones and especially the CO_2 emissions through continuous improvement measures. The main goal is to optimize the use of material and energy flows (close loops). The methodology relies on the current challenges of urban development policies and includes the analysis of material flows, water and waste management, etc. It also provides the basis for applying concepts like energy-efficiency or environmentally friendly mobility. The Federal Institute of Building, Urban Affairs and Spatial Development (BBSR), the Federal Office for Building and Regional Planning (BBR) and the Federal Ministry of Transport, Building and Urban Development (BMVBS) sponsor the Zero Emission Park concept.
Little information on the specific economic activities present in Bottrop is available through the Zero Emission Park website.

Success factors

The Zero Emission Park concept has been created as a joint project. Scientists and experts from different universities worked together with local stakeholders such as businesses, chambers of commerce, government and residents. The *cooperation with science and technology institution* is a major success factor, as well as the supportive *policy* and the clear designation as an *Eco-Innovation Park* (through the designation “Zero-Emission Park”).

Perspectives

Future developments are unknown but the project seems to stop in 2009.

Park no. 57: Zero Emission Park Bremen

Germany

Geography	Germany, Bremen, Bremen	
Type of park	Industrial	
Size of park	300 ha	6200 jobs
	400 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	PPP	
References	Internet links www.zeroemissionpark.de www.zeroemissionpark.de/Dokumente/Stoffstrommanagement.pdf	

Origin & Objectives

The Zero Emission Park project is one of the first initiatives in Germany to run an integrated project for the development of sustainable industrial and commercial areas. The zero emission goals imply avoiding the "adverse effects" of economic activities in industrial zones and especially the CO_2 emissions through continuous improvement measures. The main goal is to optimize the use of material and energy flows (close loops). The methodology relies on the current challenges of urban development policies and includes the analysis of material flows, water and waste management, etc. It also provides the basis for applying concepts like energy-efficiency or environmentally friendly mobility. The Federal Institute of Building, Urban Affairs and Spatial Development (BBSR), the Federal Office for Building and Regional Planning (BBR) and the Federal Ministry of Transport, Building and Urban Development (BMVBS) sponsor the Zero Emission Park concept.
Little information on the specific economic activities present in Bremen is available through the Zero Emission Park website.

Success factors

The Zero Emission Park concept has been created as a joint project. Scientists and experts from different universities worked together with local stakeholders such as businesses, chambers of commerce, government and residents. The *cooperation with science and technology institution* is a major success factor, as well as the supportive *policy* and the clear designation as an *Eco-Innovation Park* (through the designation "Zero-Emission Park").

Perspectives

Future developments are unknown but the project seems to stop in 2009.

Park no. 58: Zero Emission Park Kaiserslautern

Germany

Geography	Germany, Rheinland-Pfalz, Kaiserslautern	
Type of park	Industrial	
Size of park	100 ha	200 jobs
	22 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	PPP	
References	Internet links www.zeroemissionpark.de www.zeroemissionpark.de/Dokumente/Stoffstrommanagement.pdf	

Origin & Objectives

The Zero Emission Park project is one of the first initiatives in Germany to run an integrated project for the development of sustainable industrial and commercial areas. The zero emission goals imply avoiding the “adverse effects” of economic activities in industrial zones and especially the CO_2 emissions through continuous improvement measures. The main goal is to optimize the use of material and energy flows (close loops). The methodology relies on the current challenges of urban development policies and includes the analysis of material flows, water and waste management, etc. It also provides the basis for applying concepts like energy-efficiency or environmentally friendly mobility. The Federal Institute of Building, Urban Affairs and Spatial Development (BBSR), the Federal Office for Building and Regional Planning (BBR) and the Federal Ministry of Transport, Building and Urban Development (BMVBS) sponsor the Zero Emission Park concept.
Little information on the specific economic activities present in Kaiserslautern is available through the Zero Emission Park website.

Success factors

The Zero Emission Park concept has been created as a joint project. Scientists and experts from different universities worked together with local stakeholders such as businesses, chambers of commerce, government and residents. The *cooperation with science and technology institution* is a major success factor, as well as the supportive *policy* and the clear designation as an *Eco-Innovation Park* (through the designation “Zero-Emission Park”).

Perspectives

Future developments are unknown but the project seems to stop in 2009.

2.8 Ireland

The National Development Plan of Ireland for environmental policies (2007–2013) focuses on several fields: transport, waste management, climate change, environmental research, and sustainable energy. In 2007, investment programs for environmental sustainability exceeded EUR 1.3 billion (OECD 2011). According to the Irish Industrial Development Agency (IDA), the country has the ambition to become a major investment hub for clean techs (Ida Ireland 2013) Ireland has committed to a significant increase in sustainable power generation (mainly from wind and wave) (Cer 2013), and many projects are planned or in progress. Also, a controversial project to build at Poolbeg one the largest waste-to-energy incinerator in Europe has been approved in 2008 (Shields et al. 2009), but seems to be delayed (Waste Management World 2013).

Concerning eco-innovation in industrial areas, an IDA initiative aims to incorporate “alternative energy plants” (including a district heating system) in business parks, taking the Letterkenny Business and Technology Park as a pilot area; but no recent information is available regarding the current status of this project. Furthermore, the Irish EPA Science, Technology, Research and Innovation for the Environment Program (STRIVE, 2007–2013) financed an 18 months project to establish an “eco-industrial network” for SMEs in the Mid-West Region. According to the authors of the project report, however, the results have been inconclusive due to uncertain and unstable economic conditions (O’regan et al. 2008).

Ireland is rather considering eco-innovation at the national level (macro scale) than at the park scale. In the framework, the Irish EPA fosters Cleaner Production and Ecodesign through national measures, and recently financed a Spatial Allocation of Material Flows Analysis (SAMFA) of the construction sector to “develop a meta-model for predicting the consequences of consumption patterns at the local scale” (Roy et al. 2010).

No significant or relevant data on the following potential eco-innovation parks is mentioned in the literature at the time of this review:

> Letterkenny Business and Technology Park
> Lough Boora Parklands

2.9 Italy

The legislative “Bassanini Decree” (no.112/98) introduced in 1998 the concept of “Environmentally Equipped Industrial Areas” (EEIA). This national Decree specifies that regions and provinces have the task to identify and regulate EEIA, and defines some common characteristics such as:

- Infrastructures and systems necessary to protect health, safety and environment;
- Centralized management of infrastructures and services;
- Exemption for manufacturing plant located in EEIA of permits concerning the use of services therein.

The national framework is consequently depending on the will of each region to promote EEIA through specific laws and regulations. In 2010, seven Italian regions had edited specific legislation in order to regulate this approach: Abbruzzo, Calabria, Emilia Romagna, Liguria, Marche, Puglia and Toscana. Like the EIP concept, EEIA aims at closing cycles of material, water and energy, at sharing environmental services and at optimizing environmental intensive activities. The main difference is the kind of initiative that originates from legislation for EEIA.

Regional legislation related to EEIA is not the only way to promote environmental management of industrial areas or eco-innovation parks in Italy. In Friuli Venezia, Giula and Sicilia, the regional law on governing consortium of industrial development, which has to deal with environmental issues, also forecasts EIP development. In other regions, regional or urban planning documents promote clustering of economic activities. Some voluntary initiatives also exist. Two regions, Toscana and Emilia Romagna are about the most advanced in terms of eco-industrial development (Eccelsa 2010). Different studies tried to identify most of them, but only the most representative are described in this chapter (Cancila et al. 2010; Cancila et al. 2005; Cartesio 2013; Frenquellucci 2013).

Moreover, the Ecoaudit Ecolabel Committee provided guidance for the implementation of environmental management system (EMAS) in Italian Industrial districts and industrial areas in 2005. Beside the “Bassanini Decree”, this document establishes another framework to implement the cluster approach to “Homogeneous Production Industry (HPI)”. There is narrow links between EEIA induced by national and regional laws and the implementation of EMAS in HPI that implies to identify a representative promoter, to perform an environmental analysis of the area and to set-up an environmental program for the area.

No significant data on the following potential eco-innovation parks is mentioned in the literature at the time of this review:

- 3A-PTA Parco Tecnologico Agroalimentare dell’Umbria
- Area Industriale SPIP Parma
- Bioindustry Park silvano Fumero
- Closed Project Tuscany
- Montagna-energia Valle di Non
- Ponterosso – san Vito al Tagliamento Industrial ParkZona Imprenditoriali Provincia Ancona, ZIPAZona Industriale Udine ZIU
- Zona Industriale Valle del Biferno

Park no. 59: Amaro Industrial Park (Area Industriale di Amaro)

Italy

Geography	Italy, Friuli Venezia Giulia	
Type of park	Industrial	
Size of park	66 ha	>1000 jobs
	28 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leader	PPP	
References	(Cancila et al. 2010) Internet links www.cosint.it/layout_html_standard/italiano/urbanistica/area_di_amaro.html	

Origin

The area development begun in 2000 when the area management entrusted to the Industrial Development Consortium of Tolmezzo CO.S.IN.T. This Consortium created in 1964 became a Public Economical Entity in 1999 as a public private partnership (98% public, 2% private). It supports the Alto Friuli region socio-economical growth through the competitive increase of existing companies and promotes new settlements.

Objectives

Main economical sectors represented are mechanical and metal industry, information and communication technology and services. Existing infrastructures set-up thanks to those projects are; a 1 MW photovoltaic plant, LED public lighting, centralized waste-water treatment plant, inert material storage area, green areas, centralized fire fighting service, multipurpose center and technological innovation center.

Success factors

The geographical situation of the park at the confluence of Carnia's valleys and near the main motorway is an asset for companies (*location*). Nevertheless, bank river operations along the industrial area for about 2 kilometers length were necessary. The Consortium is responsible of these global maintenance interventions (*coordinators*). Since 2007, CO.S.IN.T. is ISO 14001 certified in order to support the environmental characterization of the industrial areas under management. Verification and control of the environmental compliance from companies are carried out. Besides, the Consortium participates to projects to improve energy efficiency and environmental sustainability in the area. The Consortium receives financial *incentives* from the region to intervene inside the area in order to invest in sustainable energy offer development and to lower energy costs, and to offer centralized services to companies.

Perspectives

Future developments are unknown.

Park no. 60: Cairo Montenotte Industrial Park (Area Industriale di Cairo Montenotte)

Italy

Geography	Italy, Liguria, Cairo Montenotte	
Type of park	Industrial	
Size of park	42 ha	200 jobs
	14 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(Cancila et al. 2005) Internet links www.fgriciclaggi.com/ www.ivg.it/2010/04/liquidata-cairo-reindustria-finito-il-suo-scopo/	

Origin & Objectives

In 1994, a Consortium named “Società per la reindustrializzazione di S. Giuseppe di Cairo” was created for the reclamation of the disused industrial area. The perfect situation of this industrial area near Bormida River, served by rail and main roads, and near the residential area of Cairo Montenotte, convinced a group businessmen and the Commune to build up a society with the mission to start the area reclamation and the reindustrialization.

Objectives

The area benefits from an environmental certification and fourteen companies are installed -occupying more than 200 employees. The main economical sectors are logistic, mechanical industry and waste recycling, with waste recycling also developed at the park level. After the area transformation and reclamation, the project’s leader Cairo Reindustria provided economic promotion services and support interactions with local entities. The society was liquidated in April 2010 because it had completed all its tasks.

Success factors

The main success factors are the *location* and coordination from the redevelopment of the industrial area (*coordinators*).

Perspectives

Aside from the environmental certification of the reclamation and reindustrialization, a rail center is available and an intermodal center is planned to develop connections with the road network.

Park no. 61: Envipark (Parco Scientifico Tecnologico per l'Ambiente)

Italy

Geography	Italy, Torino	
Type of park	Industrial (Science & Technology Park)	
Size of park	3 ha	~500 jobs
	~70 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency ~~Waste management~~ Water management Biodiversity ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Seira 2008); (Boulanger 2011) Internet links www.envipark.com www.italiancleantechnology.com/us/company/63/ www.ie.tudelft.nl/index.php/Environment_Park_-_Turin	

Origin & Objectives

The Piemonte Region, the Province and the City of Torino and the European Union created the Environmental Park in 1996 on remediated industrial area. The park baselines are technological innovation and eco-efficiency. The main motivation is to provide a space with shared services and equipment where SMEs, Research Bodies and Startup companies can work together.

Envipark is an applied research center aiming to provide SMEs advanced solutions and innovative technologies in order to use renewable energy, reduce resource consumption and prevent pollution. Energy and environment technology transfers are implemented through partnerships, special projects or training activities. The park is built around 2 "Business Units" dedicated to Property Management and Research and Innovation activities. Infrastructures onsite include a small hydropower plant, rain water recovery system, thermal and heat recovery system and eco-efficient buildings with green roofs.

Success factors

The cooperation between local authorities and business associations played a key role to build up the project (*coordinators* and *incentives*). Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

The future development aims to empower economic players (through hydrogen supply or eco-efficiency in building for example), to increase renewable energy use, to develop market accessibility, to improve technology transfer and to implement new synergies with settled companies.

Park no. 62: Lucento Industrial Area (Area Industriale di Lucento)

Italy

Geography	Italy, Torino, Lucento	
Type of park	Combined	
Size of park	7 ha	N/A jobs
	43 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ Mobility, transport Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leader	PPP	
References	(Cancila et al. 2005) Internet links www.consorzioambientalelucento.org/index.htm	

Origin

Until the end of the 1950's, a metallurgical complex occupied the area. After an urban requalification in the mid 1990's, the area became an industrial park with marketing and craft activities near a river area. In order to avoid the prejudice of the close residents, Castello Lucento environmental Consortium was created. Its mission is to ensure the environmental certification of the area. The consortium became the backbone of the environmental activities installed in the area. All economic players in the area are members.

Objectives

Lucento Consortium main missions are to select the upcoming activities with respect to their environmental compatibility, to control the environmental prescriptions and to train and inform concerned people. The Consortium also serves as an interface between private and public agencies in order to control efficient waste handling and elimination. Others relevant tasks are the urgency management plan, the development of waste management good practices, and to study marketing and transport traffic reduction solutions. Since 2002, the Consortium is ISO 14001 certificated.

Success factors

The main success factors are the role of the consortium as a coordination body (*coordinators*).

Perspectives

Future developments are unknown.

Park no. 63: Navicelli di Pisa Park (Area Navicelli di Pisa)

Italy

Geography	Italy, Toscana, Area Navicelli	
Type of park	Industrial	
Size of park	120 ha	~500 direct jobs (~1000 external workers)
	15 companies (and 47 planned)	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency ~~Waste management~~ ~~Water management~~ Biodiversity ~~Material flow~~	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leader	Public	
References	(Cancila et al. 2010) Internet links www.svilupponavicelli.it	

Origin & Objectives

The Navicelli S.p.A society was created in 1982 to organize, manage and support the development of ports services and navigation in the PISA port and channel. It became a public entity in 2008. Currently, its missions are the administration and management of the collective property, maintenance and dredging of the channel, and coordination and control of navigation. It also has certain typical area management functions.
The main economical activities are related to shipyards. The area is not considered as Environmental Equipped Industrial Area (EEIA) in the Municipal Master Plan. But, in the context of EEIA theme, Navicelli undertook in 2007 initiatives to conduce energy check-up in companies in order to estimate current consumes and evaluate renewable energies potential. As well as promoting EEIA theme, the Navicelli S.p.A society conducts several projects especially on energy efficiency and energy supply (smart grids), on energy accumulation and hydrogen sector development. It also develops green taxi boat and ship life cycle analysis as well as green areas arrangement. With the Pisa University collaboration, Navicelli is also currently involved in an integrative procedure of certification (ISO9001, ISO14001, ISO18001, OHSAS).

Success factors

The main success factors are the coordination role played by Navicelli (*coordinators*) and the *cooperation with science and technology institutions*.

In order to be considered as EEIA, Navicelli participated to the regional call for funding for the global project “APEA 2020 Navicelli” aiming at financing environmental investments such as:

> Micro wind and photovoltaic renewable energy plants
> Noise protection equipped with collective photovoltaic panels
> LED public lighting with sunset sensor
> Green areas arrangement
> Energy efficiency with green-it solutions

Perspectives

Future developments are unknown.

Park no. 64: Padova Industrial Park (Zona Industriale di Padova)

Italy

Geography	Italy, Veneto, Padova	
Type of park	Industrial	
Size of park	1000 ha	70 000 jobs
	1400 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency ~~Waste management~~ Water management ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ Air pollution prevention Noise prevention ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Cancila et al. 2005) Internet links www.zip.padova.it/eng/zip1.htm www.zip.padova.it/eng/proj/Siam_eng.pdf www.zip.padova.it/eng/proj/100303_portfolioZipProductiveAreas_eng.pdf	

Origin & Objectives

The industrial zone has been designed and realized thanks the ZIP Consortium created to develop the area's infrastructures. Consortium main partners are the Municipality, the Province and the Chamber of Commerce. The space covered is one of the largest industrial areas of Europe, including a freight intermodal area. It offers a 7 km long railway junction, 2 motorway tollgates, a 30 km long optic fiber ring, 5 service centers with post offices, hotels, restaurants, banks, offices, services for companies and employees and 18% in surface for gardens.

The area is currently suffering space saturation. Economical sectors represented within the 1400 companies are varied (industry, logistic, trade). The Consortium activities focus on providing services to settled companies and developing industrial policies that enhance both domestic and foreign business. The current Consortium strategy aims at integrating and unifying management of the entire zone. The environmental commitment of the Consortium is centered on green areas development aiming at cutting down noises and air pollution. The project Parco Fenice that results from cooperation with the National Corps of Italian Boy Scouts and Girls Guides fostered the eco-sustainable development through pedestrian and bicycle path as well as environmental training.

Besides, the cooperation with the Fraunhofer Institute aimed "to develop issues concerning renewable energies, energy conservation, water networks for industrial purposes and sustainable development by fostering the use of new technologies" (Consorzio Zip 2013). The Zip Consortium is also involved in the SIAM project. The project – promoted by Enea (Agency for New Technologies, Energy and Environment) and supported by EU, through Life Ambiente (Life Environment) – aims to develop and test a model of sustainable production area, by involving eight industrial areas located in six Italian regions.

Success factors

The main success factors are the role of the consortium as coordination body (*coordinators*), the *diversity* of businesses, and the *cooperation with science and technology institutions*.

Perspectives

Two potential developments are being discussed with the Fraunhofer Institute: the building of a waterworks to prevent the use of drinkable waters in industrial production and to recycle the valuable resource, and the building of a district heating. Furthermore, the Sunrise project forecasts to supply the logistics infrastructures in the area with solar and photovoltaic system.

Park no. 65: Ponte Rizzoli Industrial Park (Area Industriale di Ponte Rizzoli)Italy

Italy

Geography	Italy, Emilia Romagna, Ozzano dell'Emilia	
Type of park	Industrial	
Size of park	23 ha	N/A jobs
	170 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Planned	
Project leader	PPP	
References	(Cancila et al. 2010); (Eccelsa 2010) Internet links www.provincia.bologna.it/imprese/Engine/RAServePG.php/P/279411360504/T/Ponte-Rizzoli	

Origin & Objectives

In 2010, the Region has selected this productive area as a strategic area to be transformed in Environmentally Equipped Industrial Area (EEIA). The Industrial Area of Ponte Rizzoli will receive financial regional incentives in order to build up collective infrastructures for the energetic and environmental sustainability. The area transformation is currently being planned and preliminary studies were carried out to identify local environmental issues, local business incentives and involvement to create a single area manager of mixed public-private nature, and to establish an Area Environmental Program.

Main economical sectors are production activities in the manufacturing and businesses services sectors. All the companies were involved in a survey to set up priorities. The results pointed out: inadequate public transport and waste services, need for services to assist environmental administrative procedures, improved energy supply management and need for join energy transformation and waste storage units. Planned developments will match the companies' wishes and EEIA requirements: building up of permeable areas, pollution protection equipment, environmental mitigation areas, rainwater harvesting and reutilization infrastructures, a cogeneration plant and a district heating network, as well as supporting energy efficiency in buildings. A service center is also planned to host the future area manager. The region may also support a three-generation plan, an extension of the district heating, a photovoltaic energy plant, the reshaping and ecological characterization of the local channel and the building of storage tanks for rainwater recovery.

Success factors

The main success factors are the EEIA *policy* and the *incentives* provided to develop innovative solutions for resource management.

Perspectives

No recent information is available about the stage of implementation of the above-mentioned developments.

Park no. 66: Prato 1st Industrial Macrolotto (1° Macrolotto Industriale di Prato)

Italy

Geography	Italy, Toscana, Prato	
Type of park	Industrial	
Size of park	150 ha	~3000 jobs
	~350 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency ~~Waste management~~ Water management ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leader	Private	
References	(Cancila et al. 2005) Internet links www.conseronline.it/ www.oecd.org/secure/pdfDocument/0,2834,en_21571361_38013663_39288356_1_1_1_1,00.pdf	

Origin & Objectives

The regional district of Prato and non-profit organizations (CONSER -Macro-lotto n°1 Consortium Services of Prato and IDRA – Water recycling Interventions s.c.c.p.a) created the park in 1975. Local authorities played a key role to entrust a private company (Servizi alle Imprese srl) with coordination and secretariat activities. Its role is to promote new scale economies.
Among the 350 companies settled, 52% have industrial activities, 29% are involved in trade, and 19% in craft. 35 companies are characterized by high water consumption (dyeing, finishing, carbonizing, printing, etc.). CONSER promoted the EMAS adhesion of the whole industrial area as well as energy efficiency, broadening of recycling water use and water and air quality monitoring. The NGO also fostered the creation of specific offices to optimize resources and employees transportation systems. IDRA manages the recycling plant and the filtration system of the Bisenzio River to provide water for processes, fire protection, cooling and sanitation. It allows a saving of ground water equivalent to the consumption of over 100 000 inhabitants/year. “Servizi alle Imprese srl” is in charge of awareness raising environmental and social programmes. An onsite nursery was built in order to take care of the kid’s workers. Besides this free service, parents have the possibility to provide a list of errands to be made (laundry, drugstore, shopping) before picking-up back kids, allowing them to increase time with family (social innovation).

Success factors

There are different success factors that facilitate building up this eco-innovation park: the constant process of identification and assessment of companies and the collective management (*coordinators*), the private investment in the Consortium to set-up innovative programs (*incentives*), such as EMAS. Finally, the increase in competitiveness strengthens the companies’ involvement (*value added*).

Perspectives

“Servizi alle Imprese srl” now forecasts a centralized energy production through cogeneration plants.

Park no. 67: San Daniele s.c.a.r.l Agrifood Park (Parco Agro-Alimentare di San Daniele s.c.a.r.l)

Italy

Geography	Italy, Friuli Venezia Giulia, San Daniele del Friuli	
Type of park	Combined	
Size of park	20 ha	~1100 jobs (another 700 in ancillary industries)
	100 companies	27 000 inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leader	PPP	
References	(ASDI 2011) Internet links www.parcoagroalimentare.it/ www.osservatoriodistretti.org/node/50/distretto-parco-agro-alimentare-di-san-daniele www.regione.fvg.it	

Origin & Objectives

The Industrial District Development Agency (Agenzia di Sviluppo del Distretto Industriale – ASDI) was created in 2005 after the Regional Act of Law (RAL) ratification. In 2006, the ASDI of agro-food district became a consortium with limited liability involving public and private equities. The main shareholders are the 6 Municipalities, Province and Chamber of Commerce of Udine, entrepreneurial associations as well as financial and banking organizations. The main ASDI's missions involve economic development and branding, projects development, synergy implementation among local businesses and development of new partnership agreements. The structure also contributes to the territorial governance for infrastructure enhancement and is active in the protection and the improvement of the environmental conditions.
"San Daniele" is a renowned brand for seasoned raw ham. Activities encompass processing and preserving of meat as well as the entire production chain from farming to packaging. The park also groups together other agro-food industries like milk transformation, fishery, sweet and salad bakeries, wines and alcohols production. The promotion strategy is based on the strong relationships between agro-food industry and the natural ecosystems. The ISO 14001 certifications of the 6 Municipalities, the Hills Community and the Ham Consortium aim at improving the environmental quality of the area, increase transparency and credibility of all local players (investors, tourist operators, local community) and at public environmental awareness raising. Others innovative solutions are developed for waste recovery (solid and liquid saline waste) like the processing of animal by-products to produce oil.

Success factors

The main success factors are the ASDI coordination's role (*coordinators*) and the local policy context (*policy*).

Perspectives

Future developments are unknown.

2.10 Luxembourg

According to Luxinnovation, the national innovation and research agency, there are no eco-industrial initiatives in Luxembourg (Luxinnovation 2013b). Nevertheless the *Ministère du Développement durable et des Infrastructures, Département de l'Aménagement du Territoire* mentioned the participation of the Ecopark Windhof in the European territorial development program INTERREG IV B as an interesting pilot. Recognized eco-industrial networks inspired the park development.

The National Agency for Innovation and Research created an Eco Innovation Cluster. The objective of the Luxembourg Eco Innovation Cluster is to reinforce the competitive advantage of the Luxembourg companies active in the field of eco-technologies and sustainable construction, which is, strictly speaking, not an eco-innovation park approach as sought in this screening (Luxinnovation 2013a). However, the Eco Innovation Cluster has recently initiated the project "Organic City – Diddeleng Neischmelz", which plans an urban eco-district on a former industrial park.

Park no. 68: Ecopark Windhof

Luxembourg

Geography	Luxembourg, Koerich, Windhof	
Type of park	Combined	
Size of park	80 ha	2000 jobs
	150 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	Internet links www.ecoparc.lu/le-projet/ www.entreprisesmagazine.com/web/resources/emag38s_1539.pdf www.solarwind.lu	

Origin & Objectives

In 2010 a number of local companies founded Ecoparc Windhof with the purpose of promoting the zone, fostering coordination, developing its accessibility, binding with public transportation and targeting environmental impact reduction. The first objectives set were inspired by the international examples of: Eco-industrial park of Devens (USA), Industrial Ecosystem Development Project, Kalundborg Eco-Industrial Park (Denmark), Burnside Park (Canada), Parc de la Plaine de l'Ain (France). The eco-innovation park is lead by the GIE Ecoparc Windhof Company (group for economic interests). It coordinates the site for its sustainable development based on an Agenda 21 action plan which includes: energy, space, water and waste management but also additional shared services like a nursery, restaurants, pedestrian access, bicycle lanes, a purchasing center service and consistent signage.
Companies established at Ecoparc Windhof work in a range of sectors including information technology and telecommunications, construction, management consulting, warehousing and waste management. There is also a little recent residential development.

Success factors

The main relevant success factor is therefore the *diversity* of activities. Developed outside the main city center, the park also enjoys its own road and public transportation connections (*location*). The nature in the surrounding landscape is one of the main assets of the site as it provides a high quality environment. The local institutions support the creation of the park and the eco-innovation initiatives (*policy*). Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

The Ecoparc Windhof recently joined an ambitious European research programme with national and international partners in order to implement a cradle-to-cradle methodology and is currently developing the solar wind project, an onsite building with solar panels and urban wind turbines.

Park no. 69: Organic City – Diddeleng Neischmelz

Luxembourg

Geography	Luxembourg, Dudelange	
Type of park	urban	
Size of park	34 ha	N/A jobs
	16 companies	1500 inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management Biodiversity Material flow	Cultural, social, health benefits Mobility, transport Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Planned	
Project leader	PPP	
References	Internet links www.ecoinnovationcluster.lu/Services/The-eco-district-project www.revue-technique.lu/wp-content/uploads/2011/01/RT_2010_03_s.pdf www.deweymuller.com/online/www/content/10/1703/2799/2801/containerleft/17971/3596/DEU/Schlussdokumentation_Schmelz%20Diddeleng.pdf	

Origin & Objectives

The Luxembourg EcoInnovation Cluster initiated the project Organic City – Organic Life in Dudelange which aims at transforming an industrial wasteland from former steelworks into an eco-district. The project "Diddeleng Neischmelz – Live2gether – Schmelz2gether" is supported by private companies and research centers belonging to the cluster as well as by national and local authorities.

The project mainly focuses on optimizing energy consumption. Houses with positive energy are planned as well as the use of on-site produced renewable energy: solar energy (garages for electric bicycles or solar lamppost), geothermal energy and biomass energy. The urban project plans to establish a waste management network with selective sorting of waste for recycling and on-site energetic valorization. A cogeneration plant with a variable energy mix of gas and biogas is planned. Another priority is set on an efficient use of water. Rainwater will be collected and used for cleaning and watering of plants. Water from households will be passed through a heat exchanger to recover the containing energy. A train station, pedestrian and bicycles lanes as well as limited circulation for cars within the district favor public transport and eco-mobility. Shopping facilities are planned in walking distance. Green roofs and walls support the biodiversity of the district. The master plan takes into account requirements for a social mix and an eco-center for environmentally responsible behaviour.

Success factors

The project is planned and coordinated by the Luxembourg EcoInnovation Cluster (*coordinators*) in cooperation with private companies and research centers (*cooperation S&T*). Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

The project Organic City – Diddeleng Neischmelz is currently in the planning stage.

2.11 Netherlands

In the Netherlands, public authorities designate industrial parks as legitimate locations for industrial, service and sales activities. Many of these parks originate in the 1960s. As the land was sold to the firms that occupied them, many parks had deteriorated at the end of the 1980s due to changes in ownership and lack of attention to infrastructure. This has made industrial parks a focus for national policymakers over the last two decades. This includes several covenants, which aim primarily at improving cooperation in the redevelopment of industrial parks at the regional level.

From the perspective of eco-innovation parks, one of the most interesting programs has been *Duurzame Bedrijventerrein (Sustainable Industrial Parks)*. It was first introduced in the memorandum *Environment and Economy* in 1997 as one of the concepts meant to inspire sustainable economic development. It finally led to the subsidy program *Duurzame Bedrijventerrein*, which ran from 1999 to 2003 (Boons 2012).

Projects are, in general, initiated for both economic and environmental reasons. The initial eco-innovation development focused on the establishment of pollution prevention projects with a utility sharing character. A reason for the development of such projects is found in the fact that they are perceived as low risk projects with a potentially substantial economic and environmental benefit (Heeres et al. 2004).

The local entrepreneurs' association is often, on behalf of its member companies, the initiator of the project and, in turn, closely coordinates its actions with local and regional government. The important role of those associations in the overall project organization also ensures the active participation of its member industries. In the following Dutch cases, companies and government (and/or other participants) generally share the planning costs. Companies often contribute to 50% of the cost as they provide staff and equipment, and support the investments needed for the realization of infrastructures (except for the part that is covered by other subsidies).

With an area of more than 8000 km² and about 7.1 millions of inhabitants, Randstad is a large polycentric urban region in Netherlands that includes four largest cities (Amsterdam, Rottedam, The Hague and Utrecht). Thanks to complementarity and well-organized cooperation, synergies arose between the urban centres. Those cities have indeed different specialization areas such as commercial services (Amsterdam), manufacturing, petrochemical/chemical industries, and transport sectors (Rotterdam), public administration and agriculture (The Hague), wholesale trade and education (Utrecht). Besides, many cooperation networks fostered the emergence of a network urban structure. Nevertheless, the region will not be considered as an eco-innovation park in this survey because it is a higher level of metabolism that incorporates much smaller examples of eco-innovation parks that are described below.

No significant or relevant data on the following potential eco-innovation parks is detailed in the literature at the time of this review:

> Agropark Noordoostpolder
> Agro Industrial Complex Dinteloord
> De Binckhorst site
> Ecofactorij
> Ladonk
> Kleefse Waard Industrial Park
> VAM Mera industrial park
> Chemelot
> Wavin site EIP

Park no. 70: Biopark Terneuzen

Netherlands

Geography	Netherlands, Zeeland, Terneuzen	
Type of park	Industrial	
Size of park	45 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	Internet links www.bioparkterneuzen.com www.environmenttimes.co.uk/news_detail.aspx?news_id=658	

Origin

At the origin of this initiative is Zeeland Seaports, a public company with four stakeholders: the Province of Zeeland and the municipalities of Borsele, Terneuzen and Vlissingen. Biopark Terneuzen was established in February 2007 and aims to develop solutions for sustainable agro-industrial activities. In this perspective, it fosters the creation of symbiotic linkages within companies in the same geographic area. The park promoters use a new terminology for these industrial synergies: “Smart Links”.

Objectives

These “Smart Links” are based on Industrial Ecology principles and aims to establish energy and material flow exchange networks among the park’s tenants. Main sectors in the Biopark are agro-food industry and linked services, fertilizer and biofuels producers, recycling industry, chemistry industry and a biomass power plant. Several “Smart Links” are already operational (see figure below). For example, piping systems connect producers of biodiesel and bioethanol (Rosendaal Energy and Nedalco), ammonia and fertilizer (Yara), and food starches (Cargill). They exchange waste, purified water and by-products to use them as feedstock, energy or utility supplements. Also, WarmCO2, a co-operation between Zeeland Seaports, Yara and pipe installer Visser & Smit Hanab, provides recovered resources (hot water and CO_2) to a major horticultural greenhouse nursery in the local area.

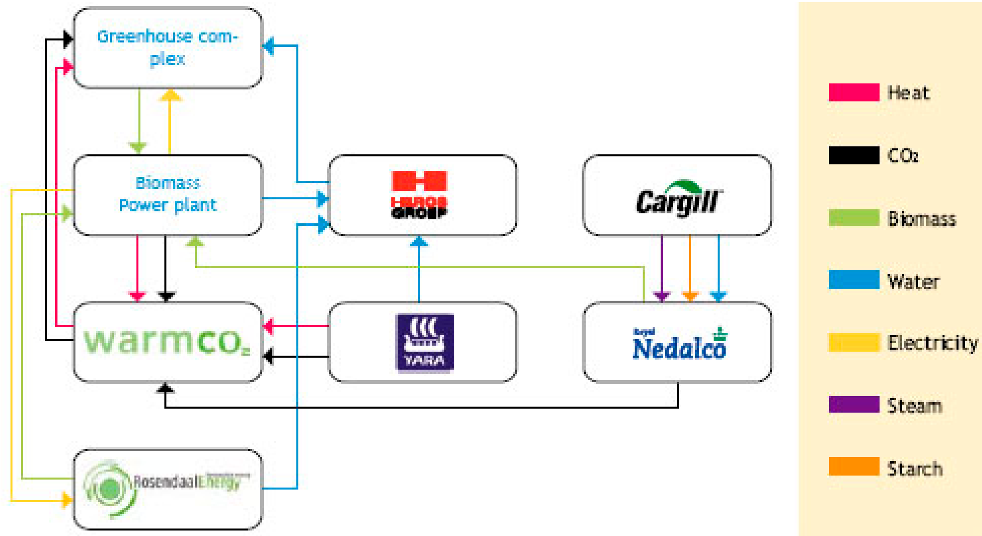
Success factors

Biopark Terneuzen describes itself as an eco-innovation park *(Eco-Innovation Park)* and its developers present many financial arguments to attract future tenants (*value added*): “eliminate storage and disposal costs, lower environmental taxes, optimize production costs, and improve profitability”. In addition, Biopark Terneuzen collaborates with several research and academic institutions, like TU Delft (*cooperation S&T*). According to the park website, these institutions “assist in investigating potential Smart Links between Biopark participants and in mapping-out the technical, commercial, organisational and practical conditions for their implementation”.

Perspectives

The park is still at an early stage of development and is seeking new partners in order to create new symbiotic links.

Fig. 26 > Smart links in Biopark Terneuzen



after Biopark Terneuzen 2013

Park no. 71: Chemiepark Delfzijl

Netherlands

Geography	Netherlands, Groningen, Delfzijl	
Type of park	Industrial	
Size of park	~ 100 ha	~1250 jobs
	11 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Private	
References	(Scheuermann 2012) Internet links www.chemieparkdelfzijl.nl/nl www.chemieparkdelfzijl.nl/site/uploads/files/Duurzaamheidsjaarverslag_2009_v4_def.pdf www.akzonobel.com/ic/sustainability_ic/ www.akzonobel.com/system/images/AkzoNobel_Report_2011_final_tcm9-72359.pdf www.nl.wikipedia.org/wiki/Chemiepark_Delfzijl	

Origin

In 1954, the Dutch Soda Industry was the first factory to settle in the area using local raw materials such as salt, limestone and coke. The process induced the production of a by-product – calcium chloride – that was recovered, purified and sold. In 1959, the Salt Company, which is now part of AkzoNobel, began its activities of brine purification that generates by-products such as calcium and magnesium salts. Between 1961 and 1986, produced sodium sulphate was directly sold. In 1986, a dry salt plant allowed to recover about 2000 ktons of salt. Other companies decomposing brine (NaCl) by electrolysis into chlorine gas and sodium hydroxide solution implemented recovering solutions internally (AkzoNobel) or externally with other local companies. In 1978, a consortium bringing together 3 companies (AkzoNobel, DSM an Dyno) opened a first methanol production plant using natural gas. In 2006, it evolved with the creation of BioMCM whose core activity is the methanol production from glycerin, which is a by-product of the biodiesel production.

Objectives

According to AkzoNobel’s website, their goal is “to reduce their carbon footprint by shifting more and more to sustainable energy sources, as well as introducing greener state-of-the-art technologies”. Strong characteristics are mutual customer-supplier relationships, the widespread availability of natural resources (salt and natural gas) with a more efficient use through cascading systems, and the good logistics connections.

Success factors

The Chemical Park officially communicates on its commitment in sustainability and describes itself as a highly integrated, dynamic and sustainable chain of companies *(Eco-Innovation Park)*. The cascading use of widespread available resources (*location*) creates *added value* and seems to be essentially spontaneous, but the company’s commitment in innovation and the presence of highly skilled professionals also influenced its emergence.

Perspectives

Future innovative developments include: an additional production of salt with electricity in AkzoNobel, more energy efficient and safer facilities, a semi-industrial scale application of fuel cells using hydrogen produced by the chlorine plant to supply electricity to industrial plants and the reuse of natural salt cavities as underground gas storage to better cope with energy consumption peaks.

Park no. 72: Emmtec Industry & Business Park

Netherlands

Geography	Netherlands, Drenthe, Emmen	
Type of park	Industrial	
Size of park	130 ha	N/A jobs
	18 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Private	
References	(Eilering et al. 2004) Internet links www.emmtecservices.com/	

Origin

Acordis, formerly part of Azko Nobel, has played also a major role as pioneer and anchor company in the process of creating the site. Also, Emmtec Services sells sustainability as a product to the companies established. All the knowledge it has accumulated is regarded as a competitive advantage. Consequently, it is very reluctant to provide information, and because of this it is not possible, at this moment, to make a comprehensive survey of the exchanges taking place between the companies.

Objectives

The most important sectors represented are large-scale manufacturing and maintenance companies, chemistry industry, new materials, commercial services and utilities. As the companies at Emmtec Industry & Business Park have complementary demands for energy and water, residual heat is used, cooling and process water is recycled. Besides, residual substances are used as raw material and packaging materials are taken back by the suppliers.

Success factors

Companies onsite trust each other, which can be explained by the history of the industrial park: they were formerly part of the same organization and benefit from an existing organizational structure (*coordinators*). *Diversity* could also be considered as a success factor.

Perspectives

No available data regarding future development of activities in the field of eco-innovation.

Park no. 73: Moerdijk

Netherlands

Geography	Netherlands, North Brabant, Moerdijk	
Type of park	Industrial	
Size of park	2600 ha	14 000 jobs
	400 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leader	Public	
References	(Heeres et al. 2004); (Ard 2008)	

Origin

This brownfield redevelopment project in the port of Moerdijk was initiated at the beginning of 1998 but is still at an early phase of development. A definite project organization structure has yet to be defined.

Objectives

Moerdijk is an example of a park where the focus is on sustainable production processes. The port authority is an actor for the development of material flow exchanges: a waste incinerator supplies steam to the local power plant and to a truck washing activity, a producer of biogas supplies CO_2 for the process of a pigment manufacture. Besides, Moerdijk is certified Ecoports, which is the equivalent of environmental management system for ports. The onsite Shell refinery is at the core of the project, among other economic sectors including Arcelor Mittal, Tetra Pak, Thyssen Krupp or DHL.

Success factors

The success of Moerdijk is related to the active participation of companies that are willing to invest (*value added*) and the active participation of an entrepreneurs' association, which functions as a successful communication platform (*coordinators*).

Perspectives

No available data regarding future development of activities in the field of eco-innovation.

Park no. 74: Rietvelden – De Vutter (RiVu)

Geography	Netherlands, North Braban, Den Bosch	
Type of park	Industrial	
Size of park	290 ha	7500 jobs
	550 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ Mobility, transport Land use optimization ~~Air pollution prevention~~ Noise prevention ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(Ard 2008); (Heeres et al. 2004)	

Origin

Created in the 1950s, the Rietvelden/Veemarktkade area was dedicated to heavy industry. But in 1980, several leakages from oil industries induced soil pollution. A business association, called RiVu, was founded in 1986 (after the departure of polluting industries) in order to redevelop the area. RiVu developed a project for the brownfield redevelopment in 1997. This project was used as an example for the sustainable development of industrial parks in the policy document Environment and Economy published by the Dutch Ministry of Economic Affairs. Following this experience, the Ministry started the subsidy program Duurzame Bedrijventerrein in 1999 that was meant to stimulate the sustainable development of industrial parks.

Objectives

At Rietvelden – De Vutter, several plans existed for the park redevelopment. First, Heineken, with the help of RiVu and the municipality, wanted to convert the existing industrial park into an industrial park for Food Industry & Logistics. When Duurzame Bedrijventerrein started in 1999 the project received several subsidies. Many actions were conducted to improve the general area quality: a study on water reuse in industrial processes, the establishment of a waterway connection with the port of Rotterdam, the development of an old railway, collective purchase schemes for energy and office materials, a common waste management system and a plan to reduce noise.

Success factors

The presence of the RiVu business association, which plays the role of the interlocutor between communities, government and companies, is a key success factor for this project (coordinators). The subsidy program decided by the ministry is another one (incentives).

Perspectives

RiVu wishes to be involved in the elaboration of policy guidelines for economic development and become an area administrator.

Park no. 75: Rotterdam Harbor INES project

Netherlands

Geography	Netherlands, South Holland, Rotterdam	
Type of park	Industrial	
Size of park	10 500 ha	87 900 jobs
	80 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(Heeres et al. 2004); (Saikku 2006); (Baas 2008b); (Baas 2008a); (Scheuermann 2012) Internet links www.rotterdam.nl/eCache/TER/11/17/400.html www.rotterdaminvestmentagency.com/page/Port+and+Industrial+Cluster/1434/en/ www.portofrotterdam.com/en/port/Pages/default.aspx	

Origin

An "Industrial Ecosystem" (INES) project was set up in 1994 in the western part of the Rotterdam Harbor area. An industrial association, Deltalinqs, initiated the project. The aim was to support the development and implementation of environmental management systems within single companies. The first INES project was carried out in 1994–1997 and identified 15 potential IS. The second INES Mainport project 1999–2002 focused on themes like water efficiency, CO_2, energy, utility sharing, waste management, soil and logistics. The project initiated a strategic decision-making platform involving actors from industry, port authority, government, an environmental advocacy association and universities. The latest Rotterdam Harbor Industry Complex Programme (2003–2010) was intended to be a driving force towards a sustainable regional development. It launched a new strategic platform including representatives of the Ministries of Economy and Environment, the province of Zuid-Holland, the Development Board of Rotterdam, the Port Authority and the industry association Deltalinqs, a plant manager, the national Sustainable Mobility Programme manager, representatives of the Universities of Delft and Erasmus in Rotterdam and the representative of an environmental advocacy organization.

Objectives

Approximately 60% of land is used by oil and chemicals sectors generating 14 000 direct jobs and 66 000 indirect jobs. Dependency relations already existed between some corporations. But some improvements have actually taken ten years to materialize. Two illustrative IS projects in the Rotterdam harbor region are: 1) use of air-emitted waste heat (3000 houses in the Hoogvliet residential area were connected to the heat supply system in 2007) and 2) CO_2 recovery for greenhouses (started in 2005).

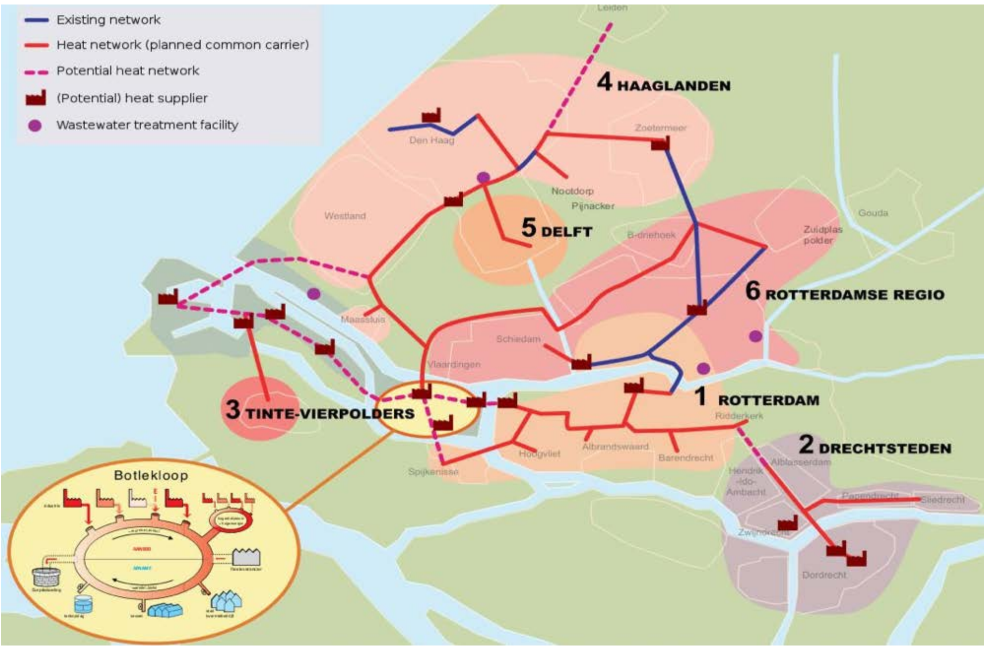
Success factors

A success factor in the INES case is provided through the presence of a communication platform formed by a cluster of industries located in the Europoort/Botlek region (*coordinators*). The companies represented in this network kept each other informed about their progress and issues regarding the implementation of pollution prevention and environmental management systems. Besides, the Europort/Botlek Interests industry association has developed an intermediary role between the government and industries. Collaboration with universities is another success factor because a pre-feasibility study was done on all 15 ideas by researchers from participating universities (*cooperation with S&T*).

Perspectives

Concerning the future planned development, activities are set up to connect 500 000 dwellings and companies to the heat supply system in 2020.

Fig. 27 > Rotterdam Harbour heating network



after Baas, 2008b

Park no. 76: South Groningen Business Park

Netherlands

Geography	Netherlands, Groningen, Ter Apelkanaal	
Type of park	Industrial	
Size of park	49 ha	N/A jobs
	4 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency ~~Waste management~~ Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Private	
References	(Eilering et al. 2004)	

Origin

In South Groningen Business Park, an eco-cluster of four companies has been formed coincidentally after the establishment of existing chain partners in the same industrial park. Consequently, companies started to spontaneously exchange by-products and energy flows.

Objectives

The four companies are Ten Kate, a fat rendering company, the US company Applied Food Biotechnology (AFB), producer of flavoring agents for pet food, the German company DGF Stroess VlaPro (DGF), producer of gelatin, and the Dutch company Avebe, a starch factory. Ten Kate supplies proteins to AFB and DGF, DGF supplies fats to Ten Kate. In association with the energy company Essent, Avebe supplies steam and electricity to the three other companies by means of a CHP plant.

Success factors

In that case, the main success factor is probably economic benefit (*value added*). Indeed the exchanges that take place between Ten Kate, DGF and AFB generate annual cost savings of about two million Euros for the companies. The environmental gain from the measures is a reduction of approximately 5000 transport movements and energy savings of roughly 6 million kWh. In addition, an unspecified amount of water is also saved tanks to these exchanges.

Perspectives

No available data regarding future development of activities in the field of eco-innovation.

2.12 Poland

Industries in Poland show many good practices of eco-innovations in energy saving, water management, waste treatment and solar energy due to public programs and private initiatives in many industrial sectors. Further innovative developments are expected in energy efficiency, clean coal technologies and resource saving, as well as in renewables and waste management (Eco-Innovation Observatory 2013) Eco-innovation is fostered via national policy strategies on environmental protection, energy efficiency in buildings, etc. The *polish information and foreign investment agency* has drawn up a list of over 55 Industrial parks (Danish Energy Agency 2013).

Many parks in the country mentioned the environment, renewable energies or environmentally friendly technologies companies as a priority. However, the screening identified only 5 eco-innovation park cases. One of them was entitled “Eko-Park” but seems to be only a cluster of companies fostering energy efficiency. The “plug & play” management, similar to what is found in Germany is also available in some parks. In addition, a lot of the industrial parks listed are at a preliminary stage of development.

The development of the parks is often supported by EU funding. Many parks provide grants, tax exemptions, few restrictive regulations and offices to attract and help foreign companies to settle.

Some parks clearly may see environment regulation as a threat to business opportunities, as quoted from the Bukowice Industrial Park description: *“They are no ecological and sewage disposal restrictions or limitations. Almost any industry (including heavy chemical) may settle and operate in BIP”* (Danish Energy Agency 2013).

No significant data on the following potential eco-innovation park is mentioned in the literature at the time of this review:

> Sunflower Farm Ecological Technology Centres

Park no. 77: Boruta Zgierz Industrial Park

Poland

Geography	Poland, Zgierz	
Type of park	Industrial	
Size of park	174 ha	500 jobs
	150 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	Internet links www.paiz.gov.pl/investment_support/industrial_and_technology_parks/zgierz	

Origin & Objectives

The Commune City of Zgierz decided to set up the Boruta Zgierz Industrial Park project for economic development purposes: attractiveness and unemployment reduction. The Park is situated on the area of the former Boruta Dye Industry Plant and also aims at the restoration of this brownfield.
The park includes several join infrastructures like a combined heating and power plant, steam production plan, large transformer stations and waste management entities.
The park has many assets: subsidies from the European Union, real estate tax relief, energy, non expensive combined heating and power plant, industrial steam installations and large transformer stations, supply of water, natural gas, and energy. Moreover, the costs related to business activity are reduced thanks to: negotiation of energy prices (heating, natural gas and fuels) on the behalf of companies operating in the park, and negotiation of external services for investors such as: water, sewage, telecommunication services, insurance, and transport services.

Success factors

The park was part of the project “Material, energy and water management in industrial parks: IS” lead by the KU university Leuven (Belgium), the Technical University of Lodz (Poland) and two parks in Romania, namely: Rompetrol Industrial Park, Carfil Industrial Park. Success factors are therefore *value added*, *cooperation with science and technology institutions* and *incentives*.

Perspectives

Future developments are unknown.

Park no. 78: Business Garden Warsaw

Poland

Geography	Poland, Warsaw	
Type of park	Combined	
Size of park	6 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management Biodiversity ~~Material flow~~	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leader	Private	
References	Internet links www.businessgarden.pl/projekt.html www.en.swedecenter.pl/newsroom/laying-of-the-foundation-stone-for-the-business-garden-warsaw-project	

Origin & Objectives

SwedeCenter, a development company of the Inter IKEA Group may be the first to set an ecological business park in Poland – Business Garden. Business Garden Warsaw is planned to be the first of 3 similar “green” business parks located in Poznan (2013) and Wroclaw (2014).
All Business Garden projects focused on a green and healthy working environment in which the tenants provide all services and amenities. They also enjoy good access by private and public transport. The Business Garden will be constructed on a six-hectare site. Only 40% the surface will be developed as the remaining 60% will be conserved as gardens and water features.

Success factors

The project will be the first “green” business park in Poland meeting significant ecological criteria to apply for a LEED certificate. This LEED certification aims to promote a comprehensive approach to ecological sustainability by meeting the requirements regarding sustainable sites, water efficiency, energy and atmosphere, materials, waste management as well as innovation and design with environmentally friendly materials. Success factors are therefore the clear designation as an *Eco-Innovation Park* and the *coordinators*.

Perspectives

The construction of the first phase of the complex (hotel, office buildings) was scheduled to start in April 2010 and to be completed in late 2011. The cornerstone ceremony for Business Garden Warsaw, took place on the 2nd June 2011. Future developments are unknown.

Park no. 79: Police Industrial Park

Poland

Geography	Poland, west Pomeranian, Police	
Type of park	Industrial	
Size of park	150 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Private	
References	Internet links www.paiz.gov.pl/investment_support/industrial_and_technology_parks/police www.policepark.pl/	

Origin & Objectives

INFRAPARK Police S.A. is the park managing company providing investors with comprehensive services and technical infrastructure. The park hosts activities in the chemical industry, metal components production and assembly, and biofuel production. Police Industrial Park propose join services for local supply of raw materials and rough products (for example sulfuric acid, phosphoric acid, ammonia, titanium white, etc.), negotiated electrical supply, negotiated heat supply, presence of specialized local fire brigade and around the clock monitoring system of surrounding environmental status. The site disposes of an industrial waste disposal system for chemicals recovery and a wastewater treatment plant for sanitary and industrial waters.

Success factors

Many advantages are related to the close proximity of a big chemical plant and the closeness of sea and barge ports, a unique geographical location that facilitates transportation. The main success factors are therefore *location*, *value added* and *coordinators*.

Perspectives

Recently, the park acquired funds from the European Union to extend technical infrastructure.

Park no. 80: Pulawy Production Park

Poland

Geography	Poland, Pulawy	
Type of park	Industrial	
Size of park	700 ha	N/A jobs
	12 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ ~~Waste management~~ Water management Biodiversity Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	Internet links www.paiz.gov.pl/investment_support/industrial_and_technology_parks/pulawy www.sse.pulawy.com www.zapulawy.pl	

Origin & Objectives

Puławy is situated in South-East Poland. Puławy Municipality and Zakłady Azotowe Puławy S.A. (ZAP S.A.) set up the Puławy Production Park in April 2003. The park covers 700 ha. Zakłady Azotowe Puławy S.A. is currently a leader of the Polish fertilizer/chemical industry and a significant exporter.
Puławy Production Park provides complex services to attract investors from various industry sectors running from all kind of utilities, raw material supply to technical infrastructures. Services include medium and low voltage power networks, natural gas network, process steam networks, water systems, sewerages, wastewater treatment plants, process air (compressed air), instrument air (dry compressed air), vast variety of feedstock and products for further processing, freight siding, electronic weighbridge for lorries and trains, raw material supply (benzene, sulfur, coal, polyethylene, etc.) and product supply (hydrogen, ammonium, urea, etc.). New buildings must meet the condition that 10% of the area is maintained biologically active (e.g. through green roof)
Entities acting on the Pulawy Subzone are exempted from income tax. Pulawy is also a dynamic scientific center in Poland and Europe with the presence of the following scientific institutes: Instytut Nawozów Sztucznych (Fertilizer Institute) and Instytut Uprawy Nawożenia i Gleboznawstwa PIB (Institute of Soil Science and Plant Cultivation). Puławy's pro-ecology activities and investments were recognized by the title of Lider Polskiej Ekologii (Polish Ecology Leader) (2005) and Mecenas Polskiej Ekologii (Polish Ecology Patron) (2007).

Success factors

Success factors are incentive, cooperation with science and technology institutions, clear designation as an Eco-Innovation Park and coordinators.

Perspectives

Future developments are unknown.

Park no. 81: Wroclaw Industrial Park

Poland

Geography	Poland, Wroclaw	
Type of park	Industrial	
Size of park	163 ha	6000 jobs
	250 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ ~~Waste management~~ Water management ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Private	
References	Internet links www.paiz.gov.pl/investment_support/industrial_and_technology_parks/wroclaw www.wpp.wroc.pl	

Origin & Objectives

Wroclaw Industrial Park was established to revitalize industrial buildings and facilities in the existing park and to increase the park surface. To promote efficient technologies, existing industrial facilities are adapted to fit environmental protection and work safety regulations and to integrate well into the city's spatial development.
250 companies from nearly 60 different industries employing more than six thousand people are in business in Wroclaw Industrial Park. Key sectors are construction, electrical machines, electrical engineering, electronics, IT, welded constructions, metallurgy, metals, machining, and logistics.
A private managing entity offers a "Plug & Play" concept for industrial and non-industrial services, available in close proximity to companies operating in the Park. The service package includes: management of industrial facilities: construction, modernization, adaptation, supply of the necessary process utilities: electricity, heat, water, gas, compressed air as well as providing access to the sewerage system and telecommunication and computer network, industrial services (including maintenance, overhauls and repairs of cranes and hoisting equipment, construction and storage services, occupational health and safety services) and non-industrial services (including day care center, conferences, restaurant and catering as well as hotels).

Success factors

The main success factors are the *coordinators* and the *diversity*.

Perspectives

Future developments are unknown.

2.13 Portugal

According to Costa, Massard and Agarwal (2010b), “Portugal centralizes waste legislation development at the national level only. There are two main documents setting this framework: the National Environmental Act and a Law Decree setting the provisions for all the activities related to waste handling, processing, transport, storage and disposal”.

In terms of policy, one national waste plan and four plans for specific waste flows (e.g. urban, industrial, medical, agricultural) exist, covering targets and instruments. For urban waste, regional plans are also developed. National recycling networks also exist, each dedicated to one of eight types of waste materials. Each system is managed by a non-for-profit entity, formed by representatives of producers and recyclers.

Some policy instruments are already contributing to shape the context for the development of IS in Portugal. These include the mandatory electronic information reporting on waste, landfill and incineration taxes and the principle of free trade of waste. The later implied the creation of a voluntary instrument named Organized Waste Market (OWM), managed and coordinated by a private entity and backed by public institutions. It aims at promoting the offer of and demand for waste materials, facilitate the transactions and promote the use of recycled products in the market.

The use of wastes substitutes for raw materials is considered an option under the Portuguese waste management regulation (e.g. cement producers receive ash from power plants). However, such efforts are scattered, uncoordinated and are somewhat confined to large industries.”

IS is introduced for the first time in the 2011–2020 National Waste Management Plan (Agência Portuguesa Do Ambiente 2013) The Portuguese government might launch an action program for waste recovery promotion in the next few years.

The UNEP Urban resilience program also enables Portuguese academic researchers to study the metabolism of the Lisbon Metropolitan area with the aim of developing innovative and sustainable resource management based on potential IS (Niza 2010).

There are a lot of emerging projects with eco-industrial concerns in Portugal but few of them can at the moment be considered as eco-innovation park under construction or in use. No significant data on the following potential eco-innovation parks is mentioned in the literature at the time of this review:

- SGR – Waste management company SA
- Seixal EIP
- Leiria EIP
- Maia EIP
- Estarreja EIP

Park no. 82: Relvão Eco-Industrial Park

Portugal

Geography	Portugal, Santarém, Chamusca	
Type of park	Industrial	
Size of park	1400 ha	N/A jobs
	26 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(Costa et al. 2010b); (Costa et al. 2010a) Internet links www.3drivers.pt/Menu/Publicacoes/Apresentacoes/ISIE-ines2.aspx	

Origin & Objectives

Created in 2005 by the Chamusca municipality, the development of the Relvão EIP challenges local economic and social issues like agricultural based economy, low level of instruction, low economic perspectives and rural exodus by attracting new companies and with it, population settling and life quality improvement. The project aimed to expand the benefits surrounding the development of Relvão EIP, improve local sustainability by stimulating the integration of life-cycle thinking into urban and industrial planning, stimulate life-cycle thinking into waste management policy strategies between top and bottom agents and create innovative uses for waste materials.
It took only 4 years to attract more than 20 companies in the park. The main economic sector is the waste management and recovering industry. The objectives of the EIP are to develop knowledge of the characteristics and the quantities of waste materials between companies in the region and thus to detect potential IS to implement.

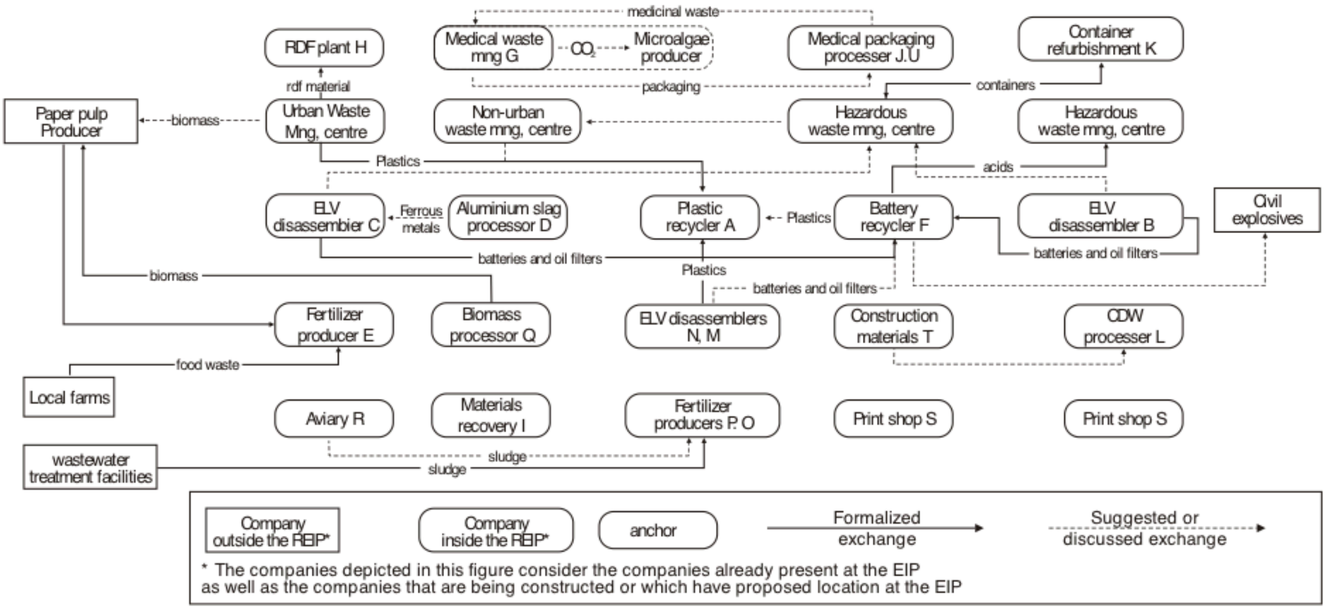
Success factors

This project was part of the European Network of Living Labs and gave rise to great cooperation between local stakeholders and academic researchers. The specific success factors of this initiative are therefore the strategic location in the middle of the country (*location*), an intensive cooperation between the local stakeholders and the academic institutions (*cooperation*) and clear designation as an *Eco-Innovation Park*.

Perspectives

The municipality of Chamusca is studying the extension of the Relvão EIP. An environmental impact assessment was launched in 2010 to analyze the impacts of the subdivision into building lots of a new area of 25 ha. New companies are also setting up in the area (e.g. a pig farm allowing a potential biogas recovery).

Fig. 28 > Industrial symbioses in Relvão EIP



after Costa et al. 2010a

Park no. 83: ResiSt Project

Portugal

Geography	Portugal, Lisbon Metropolitan Area	
Type of park	Combined	
Size of park	2962 ha	N/A jobs
	N/A companies	2 815 852 inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Planned	
Project leader	Public	
References	(Niza 2010) Internet links www.lisboaenova.org/pt/workshops/2010/1299-lanento-do-projecto-resist-workshop-22042010	

Origin & Objectives

In the context of the UNEP Urban Resilience program, the ResiSt project was launched in 2010 by a group of academic researchers to analyze the capacity of the Lisbon Metropolitan Area to resist against critical events like natural disasters (as earthquakes), unfavorable economic situation (as fossil fuel price rising), disrupted food supply, etc. The group is leading a material flow analysis, which would be helpful to simulate the impacts of critical events on the Lisbon urban area and to study its resilience. The final aim of the project is to advice politicians to increase the autonomy of the urban system and to implement a sustainable resources management (energy, water and material). IS is recognized as one of the instruments contributing to developing sustainable urban systems.
The project includes all type of economic activities established within the Lisbon Metropolitan Area from agricultural, industrial and services activities to housing.

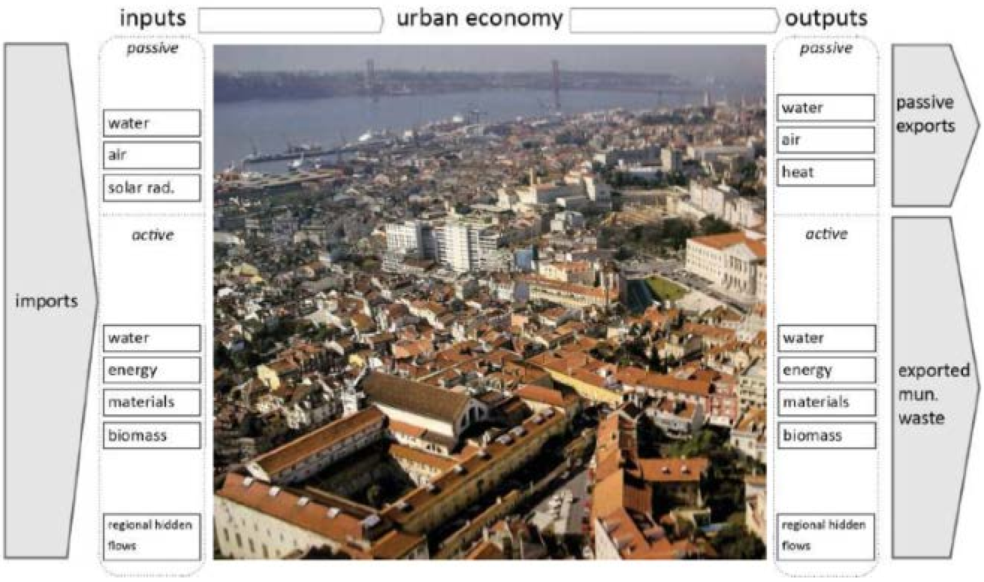
Success factors

The main success factors are the cooperation with science and technology institutions to perform the material flow analysis (*cooperation*) and the *diversity* of economic activities involved.

Perspectives

Future developments are unknown.

Fig. 29 > Lisbon Metropolitan Area MFA diagram



after Niza 2010

2.14 Slovenia

According to the Eco-Innovation Observatory (2013), no specific large-scale eco-innovation policy and strategy exist in Slovenia. Public incentive for eco-innovations only exists through general innovations and R&D support programs. The environmental policy focuses on greenhouse gas emissions reduction, nature protection, improved quality of life and reduction of waste and industrial pollution. Therefore, the screening identified only one case to eco-innovation at the park scale.

Park no. 84: EKO-PARK d.o.o Lendava

Slovenia

Geography	Slovenia, Lendava	
Type of park	Industrial	
Size of park	12 ha	>100 jobs
	20 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leader	PPP	
References	Internet links www.ecomarkproject.eu/en/casestudies/view/42 www.eko-park.si/	

Origin & Objectives

EKO-PARK d.o.o Lendava is the project leader and the forecasted site managing company. The park is partially funded by the European Union, namely the European Regional Development Fund.
The core business of the promoter is the supply of drinking water, maintenance of roads and public spaces. However, the park's mission is to minimize impacts of its industrial activities, especially on water. The environmental management system (no ISO certification) includes: water treatment (treatment plant on site), low energy consumption building, low energy consumption public lighting, and waste management (industrial liquid waste is separated and recycled). Also the project includes the building of photovoltaic and solar-thermal power stations, and a cogeneration plant.

Success factors

For research aspects, the park enjoys cooperation with Ljubljana and Maribor University, especially on better water treatment and monitoring (*cooperation*). Other success factors include the support from the European Union (*incentive*) and the clear designation as an *Eco-Innovation Park.*

Perspectives

The park's development is threatened by the actual economic situation, the low prices of conventional energy and the lack of general regional development.

2.15 Spain

Spain is considered as a leader actor in Europe in environmental sectors such as water management, sustainable construction, biogas industry (Eco-Innovation Observatory 2013) and solar energy. However, most of its efforts in terms of eco-innovation are not following an area-based approach. Nonetheless, most of the eco-innovation parks and initiatives described below are the results of several regional programs aiming at fostering sustainable development.

Between 2004 and 2006, the European project ECOSIND (Generalitat De Catalunya 2013a) financed several subprojects of Industrial Ecology in the Spanish region of Catalonia, and also in Abruzzo, Toscana (Italia) and Peloponnese (Greece). This program also included the MESVAL (Generalitat De Catalunya 2013c) project in Catalonia, where networks have been designed to connect the technological centers from different industrial sectors and stimulate the implementation of IS (exchange and reuse of waste streams). Also, the MECOSIND (Generalitat De Catalunya 2013b) project created an International Master program in Industrial Ecology, led by the Autonomous University of Barcelona. More recently, the ECOMARK initiative (Ecomark 2013) has been launched with a budget of 1 600 000 € for a duration of two years from September 2010 to December 2012. Spain is among the five countries involved in the project. The initiative encourages 1) SMEs to settle in EIP and 2) existing industrial parks to convert to sustainability. Applying the “Green Marketing” principle, the objective is to enhance the image of the industrial sector while reducing its environmental impact and to foster innovation through the implementation of improved and integrated management systems. The main outputs of the initiative will be market-oriented guidelines for “Green Marketing Plans”, schemes for innovative services and demonstration of a reduced negative impact of IAs on their environment (Ecomark 2013) Spain also participates in the MEID (Mediterranean Eco Industrial development) project, a regional initiative that aims to develop a model for sustainable industrial areas (including planning, construction and governance) (MEID 2013).

As for the latest national initiatives, the Spanish government launched its “Comprehensive Industrial Policy Plan 2020” (Gobierno De España 2013) in December 2010, as part of the recent Sustainable Economy Strategy (2009). The main objectives are to foster innovation, reduce costs and strengthen competitiveness. Among the strategic sectors identified in the plan of action for 2011–2015 are environmental protection industry, renewable energies and energy efficiency.

No significant and relevant data on the following potential eco-innovation parks is mentioned in the literature at the time of this review:

> ITER
> Polígono Industrial El Coll de la Manya
> Torrelavega Park

Park no. 85: 22@Barcelona

Spain

Geography	Spain, Catalonia, Barcelona	
Type of park	Combined	
Size of park	198 ha	130 000 jobs
	7064 companies	90 214 inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ Mobility, transport Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Public	
References	(Grobbelaar 2012) Internet links www.ecomarkproject.eu/en/casestudies/view/21 www.22barcelona.com/	

Origin

The Barcelona City Council launched the 22@Barcelona project in 2000 to regenerate an obsolete industrial area inside the city by attracting new environmentally friendly businesses and foster sustainable urban and economic development as well as social cohesion. The total cost of the project to date (UN-Habitat 2012) is USD 235 million (EUR 180 million). It was also part of the ECOMARK initiative.

Objectives

The objective is to build a new compact city, where innovative companies collaborate with research, training and technology transfer centers, and co-exist with housing, facilities and green areas. 22@Barcelona focuses on five knowledge- intensive economic clusters or sectors: ICT, media, biomedical, energy and design. More than 1500 companies were established in the area between 2000 and 2010, representing almost 45 000 workers.

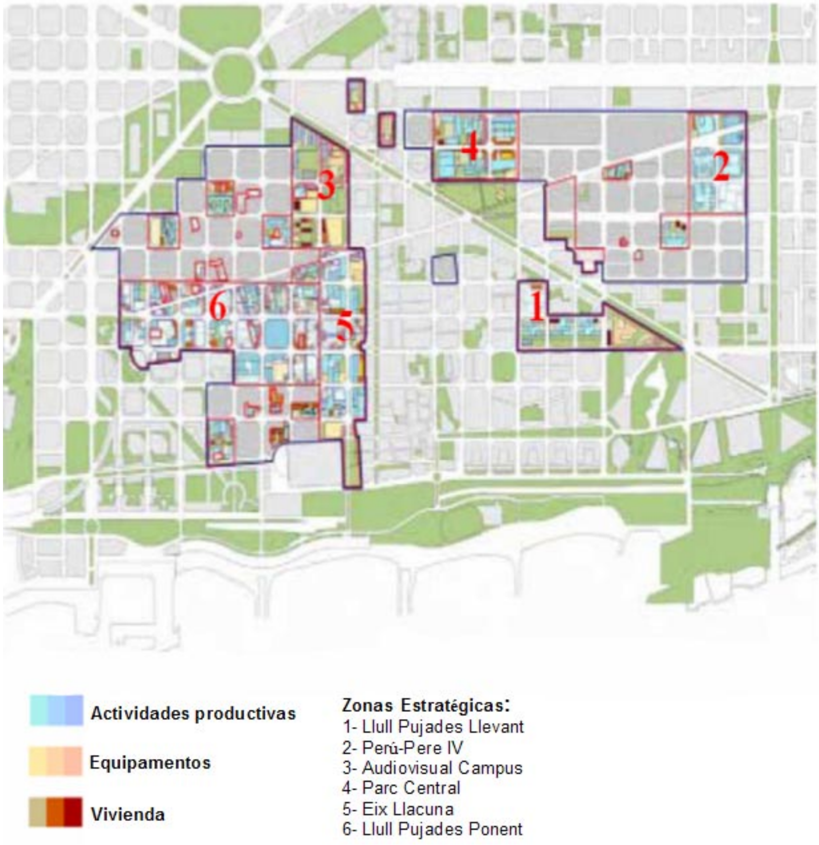
Success factors

The combined area benefits from its urban location and is served by an international airport, public transport (metro, tramway, train) as well as bicycles lanes (*location, diversity*). Altogether, it is planned to reach 70% of people using public transport, bicycle and walking. A centralized climate control system contributes to energy efficiency. The government, city council and ten universities were involved in the process of designing this sustainable urban area. Moreover, various research centers are present in the area and will collaborate with the future technical center (*cooperation with S&T*). The 22@Barcelona management company has been created to design, manage and promote this initiative. It collaborates closely with public institutions and the private sectors (*coordinators*). 22@Barcelona benefits from a strong communication component: there are specific projects to promote the area within schools and universities, and conferences addressed to the businesses are regularly held.

Perspectives

During the last decade, the Poblenou district where the project is located developed very fast: the number of businesses more than doubled and the promoters expect to reach 150 000 workers during the next years. Moreover, the total ground floor available surface for future expansion is about 400 hectares (including 320 hectares for production activities). Regarding eco-innovation, plans to improve water supply and reduce noise are designed in the framework of the ECOMARK project, but no detailed data is available.

Fig. 30 > Strategic zones for the 22@Barcelona project development



after Casellas 2007

Park no. 86: Cicle Pell

Spain

Geography	Spain, Catalonia, Igualada	
Type of park	Industrial	
Size of park	65 ha	N/A jobs
	44 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Planned	
Project leaders	Public	
References	(Outters 2006)	

Origin & Objectives

The ECOSIND project report (p. 155–160) mentions an initiative to relocate tanneries in the region of Igualada, Catalonia. The Engineering University of Igualada (Escola Universitària d'Enginyeria d'Igualada, EUETII) collaborated with 3 Italian universities on this project. The objective was to regroup and coordinate the tanneries to increase their competitiveness by creating synergies and reduce their environmental impact through energy efficiency and waste and water management strategies.
In order to design the new eco-industrial district and identify synergies, different studies have been conducted to assess the environmental impact of the tanneries (Life Cycle Analysis), evaluate the degree of cooperation and data exchange (Social Network Analysis), model flows of resources (Material Flow Analysis), and prepare the integration of the park in the local institutional context. Moreover, numerous environmental requirements have been established for the planning and implantation of the new site.

Success factors

In order to maximize the potential of success in the long term, the project uses a participatory approach and established a dialogue between the companies' involved, local politic decision-makers and the population. The success factors are therefore *incentive*, *value added*, *coordinators* and *cooperation*.

Perspectives

Unfortunately, except for the ECOSIND report (2006), no recent data is available for this project, its concrete achievements and current status.

Park no. 87: Els Pedregals

Spain

Geography	Spain, Valencian Community, Vall d'Uixo	
Type of park	Industrial	
Size of park	380 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency ~~Waste management~~ Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Planned	
Project leaders	Public	
References	(Cruzado Porcar et al. 2002) Internet links www.ecomarkproject.eu/en/casestudies/view/16	

Origin & Objectives

The EIP Els Pedregals has been planned more than a decade ago by the Municipality of Vall d'Uixó in the framework of its Agenda 21 program. However, no specific website or recent publication reports the progress and current status of the park. Nonetheless, the park was recently involved in the ECOMARK initiative.
Companies implied in the park are mainly in the agricultural and manufacturing sectors. The ECOMARK website mentions several *planned* measures concerning energy and material management (unchecked status): a biomass power plant; an energy saving plan for public lighting and energy audits; rain water recovery for irrigation, a campaign for reducing water consumption and *in situ* water treatment enhancement. Concerning logistics and mobility systems, an automated logistic center, a park of vehicles and bicycle lanes will be established.

Success factors

To foster research and innovation, the *clearly designated eco-park* design and planning study has been conducted in cooperation with the Universitat Politècnica de València (UPV) (*Collaboration*). Also, the park is designed to generate more *economic value added* for businesses by reducing their operating costs and through the creation of a by-products center to foster valuable waste exchanges.

Perspectives

Although Els Pedregals has been planned for a long time, its implementation and future development remain uncertain. According to the ECOMARK website, the park has still not been carried out because of economic barriers.

Park no. 88: Parc de l'Alba

Spain

Geography	Spain, Catalonia, Cerdanyola del Vallès	
Type of park	Combined	
Size of park	190 ha	40 000 jobs
	N/A companies	10 000 inhabitants
Eco-criteria	Renewable energy Energy efficiency ~~Waste management~~ Water management Biodiversity Material flow	~~Cultural, social, health benefits~~ Mobility, transport Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Public	
References	(Outters 2006) Internet links www.parcdelalba.com www.polycity.net/en/cerdanyola-barcelona-project.html www.20minutos.es/noticia/1005400/0/	

Origin & Objectives

In the framework of the ECOSIND project, the municipality of Cerdanyola del Vallès has been studied with the objective of implementing an integrated energy planning including renewable energies and a centralised trigeneration power system. More recently, the municipality has been integrated in the Polycity project (2006–2011, part of the EU Concerto initiative), which fostered the development of sustainable and innovative urban planning, including synergies with the industry.

In this context, a new industrial zone concept has been designed in Cerdanyola del Vallès, the “Parc de l'Alba”, which actively promote sustainable development policies regarding energy and water consumption, mobility, eco-efficient buildings, as well as ecosystems protection and regeneration. The Polycity project focused on the integration of renewable energies (biogas, solar) and the potential synergies between the ST-4 polygeneration plant (inaugurated in March 2011 and producing heat, cold and electricity) and the residential areas.

Success factors

The municipality of Cerdanyola del Vallès and the Parc de l'Alba initiative benefit from a strong political support from regional government and are situated in a very strategic location, the “country's most important concentrations of knowledge centers and a dense industrial and business network”, according to the park brochure (*policy*, *location*). The park includes, universities, research and innovation technological centers (*cooperation*).

Perspectives

Since the development of the park started in 2006, it is still at an early stage and it will be most interesting to observe the progress accomplished in a few years.

Park no. 89: Parque tecnológico de Valencia

Spain

Geography	Spain, Valencian Community, Paterna	
Type of park	Industrial	
Size of park	104 ha	N/A jobs
	460 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Public	
References	Internet links www.ecomarkproject.eu/en/casestudies/view/22 www.ptvalencia.es/index.php?mapa=parqueDescripcion&accion=ejecutar	

Origin & Objectives

The regional government promoted the industrial area of Paterna in 1982 in order to create a space for new businesses and foster innovation and the implantation of technical centers. The objective was to create synergies and promote new technologies. The park also incorporated the ECOMARK initiative.
The Technologic Park of Valencia includes a great *diversity* of companies and claims to value innovation, research, good labor conditions and respect of the environment. Among the 460 companies, mostly operating in the service and R&D sectors, are also technological institutes, a business incubator and formation centers. To promote sustainability and raise environmental awareness, the park organizes environment formation and conferences.

Success factors

The area is served by public transport (metro, bus, train) and benefits from the proximity of highways and international airport and seaport. There is also a mobility management center and a project of carpooling (web platform under construction). Besides, the Technologic Park of Valencia collaborates with the scientific park of the University of Valencia and is member of the APTE (Technologic Parks Association in Spain). The main success factors are *coordinators, cooperation, location,* and *diversity*.

Perspectives

Overall, little information is available regarding the eco-innovation activities of the park. Future developments are unknown.

Park no. 90: Parque Tecnológico Galicia Tecnópole

Spain

Geography	Spain, Galicia, San Cibrao das Viñas	
Type of park	Industrial	
Size of park	55 ha	2500 jobs
	95 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ Noise prevention Environmental Mgmt System
Status	In use	
Project leaders	Public	
References	Internet links www.es.wikipedia.org/wiki/Tecnopole www.tecnopole.es/ www.ecomarkproject.eu/en/casestudies/view/18	

Origin & Objectives

The Tecnópole was founded in 1992, supported by regional governments and local universities. Nowadays, the administration council is mainly composed by the Government of Galicia (45%) and private banks (42%), and, to a lesser extent, universities, local governments and professional associations. It is a science & technology park that was not originally conceived as an eco-park, but it participated in the ECOMARK project since 2009 and part of its activities focuses on eco-innovation.
The park includes a technologic center, a business incubator, and consists of companies operating in various activities: automotive, electronics, ITC, services, renewable energies, etc. There is also a renewable energy experimental center and several power plants: an experimental wind turbine of 125 kW, a sun tracker and 100 kW of solar photovoltaic energy. The industrial area conducts all the wastewater to a water treatment plant and includes a service for selective waste collection. Specific plans for energy efficiency and reduction of water consumption exist, and an acoustic map of the industrial area has been designed. Regarding environmental management, the Tecnópole seems to be a pioneer for ISO 14001 and EMAS certification in business parks.

Success factors

The park possesses a technological transfer center (*cooperation with S&T*) and collaborates with several Spanish universities. Moreover, it is a member of Science Parks in Spain (APTE) and of the International Association of Science Parks (IASP). A computer application (“adeo”) centralizes the quality and environment control to measure the progress of companies and offer them an easy access to the data they need to comply with the norms (*coordinators*). Besides, the Tecnópole also promotes a guide for good environmental practices. Moreover, the park seems to benefit from a good location: it is situated near main roads, train, seaport, airport and a service of public transport from the nearest main city has been set up (*location* and *diversity*).

Perspectives

Due to the constant arrival of new companies, the administration council agreed to make the current surface bigger. The approved expansion consists of 43 hectares. The Tecnópole surface will be of almost 100 ha, of which 80% of the buildable area will be for tertiary use and 20% for industrial use. New transports infrastructures will be built and the installation of an electric supply for electric vehicles is planned.

Fig. 31 > Ground plane of the Tecnópole indicating the "yellow containers" for recyclable waste

after Parque Tecnolóxico De Galicia 2013

Park no. 91: Parque tecnológico y logístico de Vigo

Spain

Geography	Spain, Galicia, Vigo	
Type of park	Industrial	
Size of park	87 ha	5000 jobs (over 3500)
	77 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management Water management Biodiversity ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ Noise prevention ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Public	
References	Internet links www.ecomarkproject.eu/en/casestudies/view/20 www.ptlvigo.es/ www.zonafrancavigo.com/zonafrancavigo_es/	

Origin & Objectives

After more than 15 years of planning and negotiation, the Technology and Logistics Park of Vigo was opened in 2004 with the aim of promoting R&D and innovative solutions to improve the textile sector competitiveness. It participated in the ECOMARK project.

Almost 60% of the companies in the park operate in the textile sector. Other important activities are logistic and transport, along with the automotive sector. Green zones represent 25% of the park area and a specific program to recover forest areas in the park and surrounding areas has been designed. There is also a new regulation for waste sorting (paper, plastic, textiles, organic), and the presence of only 3 main sectors in the area seems to facilitate a coordinated waste management. A water network with regulation tanks contributes to reduce consumption. Companies on site implement systems for noise prevention or have devices for measuring the acoustic impact of their industrial activities.

Success factors

A management center offers support and advice concerning environment management at the company and the park level (*coordinators*). However, regarding its innovation potential, the Technology and Logistics Park of Vigo admits to suffer from a lack of collaboration between companies and research centers.

Perspectives

Overall, little information is available concerning the eco-innovation activities of the park. Besides, most of the initiatives related to eco-innovation are only planned for the moment. There are future plans for training on environmental issues, generalizing best practices, conducting awareness campaigns, reducing energy consumption of public lighting, developing public transports and building a technical center to foster eco-innovation.

Park no. 92: Polígono As Gándaras

Spain

Geography	Spain, Galicia, Porriño	
Type of park	Industrial	
Size of park	215 ha	4000 jobs
	50 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ Noise prevention ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	Internet links www.ecomarkproject.eu/en/casestudies/view/17 www.poligonoasgandaras.net	

Origin & Objectives

The Association of Entrepreneurs of As Gándaras has been created in 1985 to allow an integrated management of the industrial area and generate synergies between businesses on site and within surrounding area. The Polígono As Gándaras was also part of the ECOMARK project and, in its framework, developed environmental management plans to improve its performances.
Companies on the site are mainly from the automotive sector. For now, they manage their own waste, mainly paper and cardboard, liquid waste, glass, plastics, organic waste, gas waste and toxic waste. But, there is a plan to coordinate waste management. Besides, there is a network for wastewater (treated in a new plant) and rainwater recovery. An acoustic map of the industrial area has been designed and a mobility plan has been established, too.

Success factors

The Association of Entrepreneurs gathers 90% of the companies present on the site, which will facilitate a coherent and integrated management of the park (*Coordinators*). Many actions are centralized: the park has a logistics center, and a management center that informs companies about environmental policies, certifications, grants and best practices, organizes training activities about natural areas, clean technologies, eco-design, certification, etc., and collaborates with universities for research and development (*Incentives*, *Cooperation with S&T*). Besides, an e-market gives visibility to companies wishing to find users for their by-products and another web platform coordinates a car-pooling program (*economic value added*). The park also developed a communication strategy including campaigns about best practices, conferences, a website, visits from schools, and a manual designed for industries and companies to foster EIP emergence.

Perspectives

The park infrastructure already exists and presents numerous assets for its future development as an eco-park. But, most of the initiatives related to eco-innovation are only planned for the moment. The environmental plans include the conservation and recovering of the surrounding wetlands, as well as energy efficiency and the installation of photovoltaic and wind power plants to supply common areas (mainly lighting). It will be interesting to observe progress accomplished within the framework of the ECOMARK project, which ended in December 2012.

Park no. 93: Polígono industrial de Alfacar

Spain

Geography	Spain, Granada, Alfacar	
Type of park	Industrial	
Size of park	N/A ha	N/A jobs
	79 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Public	
References	Internet links www.ecomarkproject.eu/en/casestudies/view/23 www.80.38.139.145:82/alfacar/index.php?option=com_content&view=article&id=261%3Apoligono-industrial-de-alfacar&catid=76%3Anoticiasayuntamiento&Itemid=14&lang=es www.formavega.dipgra.es/observatorio/tejido/9_Informe%20ambiental%20alfacar.pdf www.interreg3c.net/sixcms/detail.php?id=6658&_map24sid=&_searched=&_currfloaterlang=en	

Origin & Objectives

The Polígono industrial de Alfacar was part of the European ECOLAND project (2003–2006), designed to support SMEs and promote industrial areas with innovative technological and environmental standards. The objective of the project was to foster SMEs development based on sustainable criteria while minimizing landscape impact and reducing structural costs related to resource consumption and waste production. The park was also part of the ECOMARK initiative.
Most of the companies in the region are bakeries and cake manufacturers. There are also construction workshops. The environmental policy of the companies is considered before they settle in the park and they are encouraged to improve their energy efficiency, reduce packaging, adopt a sustainable waste management system, and increase their use of renewable energy sources (wind, solar, and biomass), by-products and other environmentally friendly technologies. Companies are also encouraged to choose nearest suppliers and to favor those with environmental management systems.

Success factors

As main suppliers are from the surroundings of the municipality, emissions due to transport are reduced, less packaging is required (in addition, reusable containers are used) and the time of storage is minimized along with the amount of expired products. Therefore, the main success factors are *coordinators*, *cooperation* and *incentive*.

Perspectives

In the future, the park plans to take several additional measures: promote the use of thermostats in the heating systems; substitute conventional bulbs with energy saving bulbs and favour the use of natural lighting; check the installations to avoid water leakages; promote the installation of saving water mechanisms in toilets and the installation of timer taps in order to avoid open taps; and build a water treatment plant for the industrial area. Also, a selective waste collection system is planned, along with the creation of a green point to foster the recovery of organic waste to feed animals or produce fertilizers.

Park no. 94: Polígono Industrial El Congost

Geography	Spain, Catalonia, Granollers		Spain
Type of park	Industrial		
Size of park	63 ha	N/A jobs	
	160 companies	N/A inhabitants	
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ Noise prevention ~~Environmental Mgmt System~~	
Status	In use		
Project leaders	Public		
References	Internet links www.ecomarkproject.eu/en/casestudies/view/24 www.granollersmercat.cat/poligonsViewPage.php?cat_ID=96&pol_ID=6		

Origin & Objectives

The industrial park El Congost was built in 1973 and is undertaking reforms since 2009. In the framework of its Agenda 21 program, the local government objective is to develop policies to implement a sustainable mobility system, reduce energy consumption and minimize environmental impacts in the industrial parks of the region. The park was also participating in the ECOMARK project.
According to the ECOMARK website, the municipality of Granollers and several companies of the industrial area already implemented a program to reduce water, energy and chemical products consumption and waste production. At this occasion, a regional "Group for the improvement of environmental management" was established to promote best practices and inform, and a manual about best environmental practices as well as a web page about environmental regulations were created. Among other measures undertaken we can mention a selective waste collection system and an acoustic map of the industrial area (2009). Also, there is a plan for air pollution reduction.

Success factors

The park is located at 3 km from the city center and benefits from the proximity of highway, public transports (train, bus), bike lanes, as well as Barcelona international airport and seaport (40 km). There are mobility managers in the park who promote sustainable mobility. Besides, the industrial park El Congost cooperates with the Technological and University Center of Granollers. Therefore, the main success factors are *incentive*, *cooperation*, *location* and *coordinators*.

Perspectives

Planned are measures for air pollution reduction. Very little data is however available about the park El Congost and its eco-innovation activities. It will be interesting to observe progress accomplished within the framework of the ECOMARK project, which ended in December 2012.

Park no. 95: Polígono O Ceao

Spain

Geography	Spain, Galicia, Lugo	
Type of park	Industrial	
Size of park	100 ha	N/A jobs
	300 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Public	
References	Internet links www.ecomarkproject.eu/en/casestudies/view/19 www.poligonoceao.org/ www.ptlvigo.es/attachments/141_E31_15102007.pdf	

Origin

The Polígono O Ceao was built in 1979 with the support of a business association and is administrated by the Municipality. Since 2009, it participated in the ECOMARK initiative.

Objectives

The 300 companies on the site operate in various sectors: 49% trade business, 24% manufacturing, 12% transport, 10% construction, 5% services. The park has its own wastewater treatment facility, a system for rainwater recovery and offers a service for industrial solid waste collection.

Success factors

The Poligono Association gathers more than 170 companies and offers some services and infrastructures that could contribute to an integrated and effective management of the park (*coordinators*). However, its role concerning the conversion of the park towards more sustainability is not explicitly mentioned in available documents. A strong *collaboration with science and technology institutions,* like Universidad de Santiago de Compostela (USC) also exist, as well as *incentives* from local authorities.

Perspectives

The following measures are to be implemented in the framework of the ECOMARK project: an energy efficiency plan designed on the basis of energy audits; a plan to improve public transportation and traffic decongestion; a system to measure the noise. Also, the creation of logistic station, green points for waste management, as well as a by-products center will be studied. Thus, most of the initiatives related to eco-innovation are only planned for the moment. It will be interesting to observe progress accomplished within the framework of the ECOMARK project, which ended in December 2012.

Park no. 96: Santa Perpètua de Mogoda industrial area

Spain

Geography	Spain, Catalonia, Santa Perpètua	
Type of park	Industrial	
Size of park	134 ha (region)	15 369 jobs (region)
	60 companies (project)	20 479 inhabitants (region)
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Planned	
Project leaders	Public	
References	(Sendra et al. 2007)	

Origin & Objectives

Santa Perpètua de Mogoda is an industrial area 30 km northeast of Barcelona. The town is situated in the basin of the Besos River, and occupies an area of 15.7 km². Nowadays there are more than 500 businesses in the area, and the city has become one of the most industrialized towns near Barcelona. The Universitat Autonoma de Barcelona decided to perform a material flow analysis study at the park scale.

Sixty businesses decided to take part in the study. Despite the diversity of the industrial area, there is a predominance of chemical and metallurgical industries and 90% of the companies are Small and Medium Size Enterprises (SME), with less than 50 workers. The strategy for resource efficiency applied to this area was a material and energy flow analysis aiming at assessing natural resource consumption, waste production and emission from companies to characterize their eco-efficiency.

Success factors

The case study focused on a heterogeneous industrial area, where individual strategies for selected companies should be combined with collective objectives in order to initiate the conversion of this industrial area into an EIP. The main success factor is therefore the *cooperation with science and technology institutions* to highlight resource efficiency potential.

Perspectives

No recent data is available on the outputs of this research project and about the change initiated after the diagnosis. Thus we cannot be sure that any of the eco-criteria were implemented so far.

2.16 Sweden

Sweden has a tradition in caring for the environment and its industry seems to develop numerous strategies to enhance resource use efficiency. It is currently considered as one of the leader countries in Europe in terms of eco-innovation. During the last decade, several projects of IS and other types of eco-innovation have been developed across the country in specific areas. Among them are region-based programmes, like in Jämtländ and Östergötland, as well as urban initiatives, like in Landskrona, Malmö (cleantech city) and Stockholm. Also, a programme established in 2008 by the Swedish Trade Council, SymbioCity (2013), aims at implementing synergies within urban systems and focuses on many aspects like waste-to-energy, urban agriculture (vertical farming), industrial-urban heat recovery, sustainable logistic, transportation and building, etc.

Several park-based schemes are also mentioned in the literature (Hatefipur et al. 2011; Martin et al. 2011; Mouzakitis 2003; Saikku 2006; Siam 2004), but not all of them provide sufficient information on their eco-innovation activities to be presented in detail in this research. Also, eco-innovation activities are developed in isolated businesses or clusters, particularly in the forest industry (Martin et al. 2011), a prominent economic sector in Sweden. Some of these businesses created synergetic links between them and with municipalities (see Södra Cell Mönsterås in the case studies below), but are not always labelled as IS.

Researcher from the Linköping University identified prominent success factors of these initiatives, such as strong local authorities with economic power (from the tax system) and a high level of trust within the Swedish society, which leads to many links between local communities, industry and knowledge centers to develop common solutions. Landfill tax policy and landfill ban fostered the development of waste recovery activities. Moreover, numerous researches on IS and Industrial Ecology are conducted in Swedish universities and institutes (e.g. Lund University (2013), Linköping University (2013) in the Östergötland region, Division of Industrial Ecology of Royal Institute of Technology in Stockholm (KTH 2013)) and stimulate eco-innovation in the country.

No significant or relevant data on the following potential eco-innovation parks is detailed in the literature at the time of this review:

> Industry Park of Sweden
> Silverdal – Stockholm Environmental Science Park
> Vreten

Besides, Sweden hosts an interesting case of energy network described in chapter A1_*Energy_distribution_systems*: the Igelsta CHP plant.

Park no. 97: Hammarby Sjöstad

Sweden

Geography	Sweden, Stockholm	
Type of park	Urban	
Size of park	200 ha	10 000 jobs
	N/A companies	25 000 inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	PPP	
References	Internet links www.hammarbysjostad.se/ www.eco-innovation.eu/index.php?option=com_content&view=article&id=211%3Ahammarby-sjoestad-&catid=75%3Asweden&Itemid=75 www.kth.se/en/itm/inst/industriell-ekologi/forskning/finalized/hammarby-sjostad-evaluation-of-the-environmental-profile-of-an-new-urban-district-in-stockholm-1.77604 www.symbiocity.se	

Origin

The City of Stockholm collaborated with 25 construction companies to build the new district of Hammarby Sjöstad, with the objective to incorporate an “ecocycle approach” in its urban planning. The project was partially financed by the Local Investment Programme, coordinated by the Swedish Environmental Protection Agency (EPA), but private companies financed 80% of the total construction cost. A specific model has been designed for urban eco-cycle solutions applied in this district: the “Hammarby Model”. Fortum (a large Finnish energy company), Stockholm Water Company and the Stockholm Waste Management Administration developed the project.

Objectives

To reduce energy consumption, minimize waste generation and save resources, several schemes have been implemented concerning: construction (sustainable materials, insulation); mobility (public transportation, carpooling); energy efficiency (reuse of heat in wastewater, district heating), and renewable energy supply (solar, biomass, waste); water management (rainwater recovery, waste water reuse); waste management (recycling, waste-to-energy). As a result, in comparison with the referent (i.e. a typical district built in the 1990s), there is a 30–40% reduction of the overall environmental impact of the area (including emissions into the air, soil and water, consumption of non-renewable energy and raw materials).

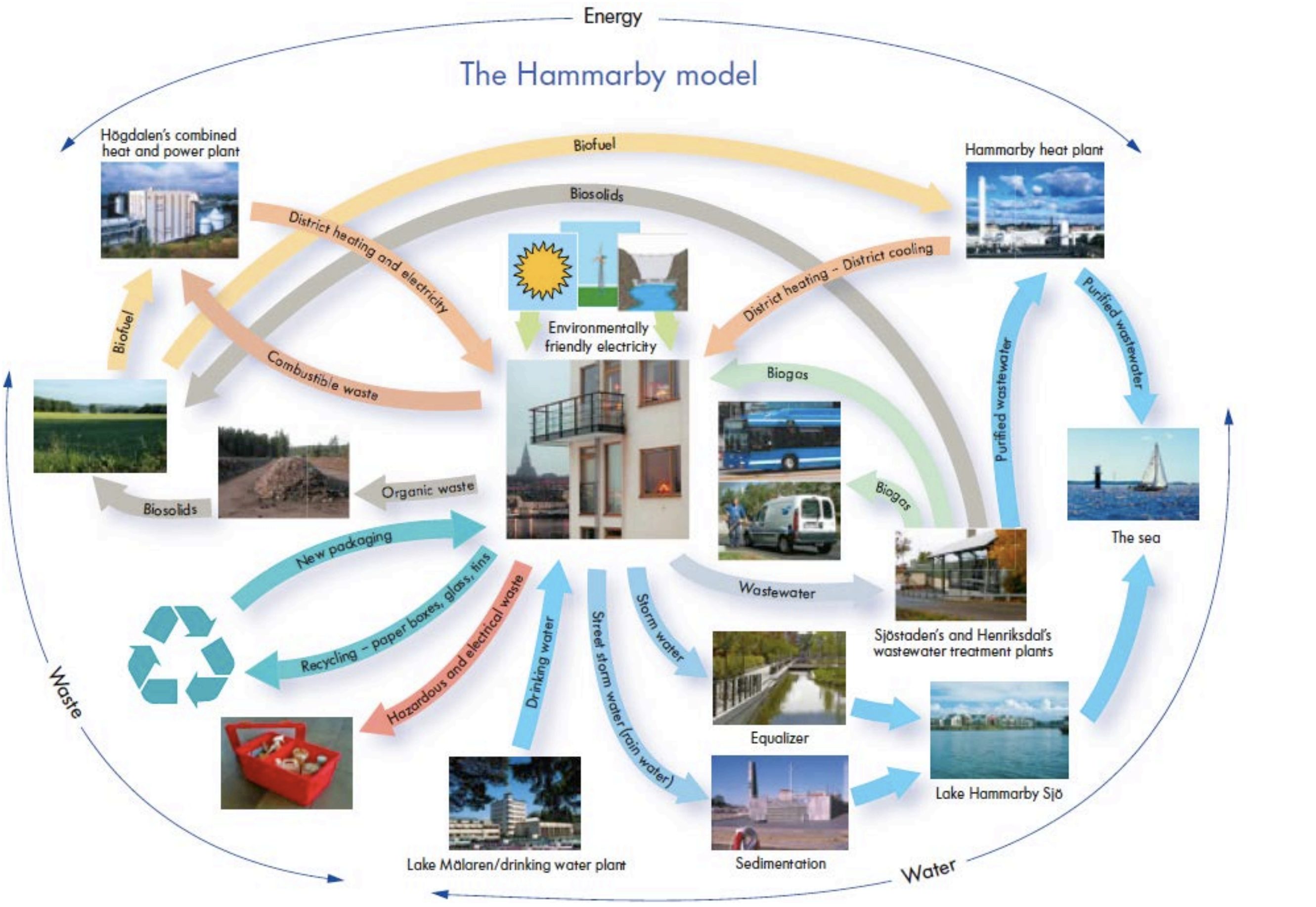
Success factors

According to the European Eco-Innovation Observatory (2011), a “key driver of the project” was a strong cooperation network between public administration, private developers and companies responsible for waste, energy, water and wastewater. The main success factors are therefore *coordinators*, as well as *cooperation with science & technology* and the *location* near the Swedish capital.

Perspectives

In 2008, the department of Industrial Ecology at the Royal Institute of Technology (KTH, Stockholm) conducted an environmental assessment of Hammarby Sjöstad. The report identified some implementation challenges and highlights some key lessons learned for future planning of new urban districts. According to Swedish EPA (2010, cited by (Eco-Innovation Observatory 2013)), Hammarby Sjöstad already serves as a benchmark for heating supply planning in new residential areas in Sweden.

Fig. 32 > The Hammarby model



after Hammarby Sjöstad 2013

Park no. 98: Händelö Island

Sweden

Geography	Sweden, Östergötland, Norrköping	
Type of park	Industrial	
Size of park	600 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management ~~Water management~~ Biodiversity Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Hatefipur et al. 2011); (Martin et al. 2011) Internet links www.elmia.se/en/worldbioenergy/Conference--Excursions/Daily-field-excursions/Pre--Conference-transfer-tour/Tour-2-Biofuels-for-transport/ www.iei.liu.se/envtech/om-oss/michael_martin/1.254447/BIOFUELSYNERGIESPROJECT.pdf	

Origin

Händelö is an island in the Baltic Sea, owned by the adjacent city of Norrköping. Since the municipality decided to develop this area and built infrastructures, Händelö Island attracted the interests of business developers and academia researchers. During the recent years, several industries have settled on this land, which was before mainly dedicated to agriculture. Due to the natural environment of Händelö, industries on the site are also trying to establish a harmonious coexistence between their activities and conservation of nature.

Objectives

The island includes innovative logistics and recycling companies (Cleanaway, Return-pack), Natura 2000 (Eurosite 2013) conservation areas, and a renewable energy cluster. For several years, companies in the cluster have been working together and also with the municipality. Municipal wastes of Norrköping, process waste from Returnpack and biomass from nearby forestry industries feed a CHP plant (E.ON company). Heat is injected in the district heating network, electricity to the grid, and steam to the nearby ethanol production plant (Agroetanol). Agroetanol also produces valuable by-products: protein feed (DDGS company) and distillation residues. These residues are delivered to Svensk Biogas, which uses them -along with other organic residues and sewage sludge-to produce fertilizer and biogas for vehicles. Through this collaboration, they have been able to save resources and optimize the total amount of energy produced from biomass using a combination of first generation biofuels technologies.

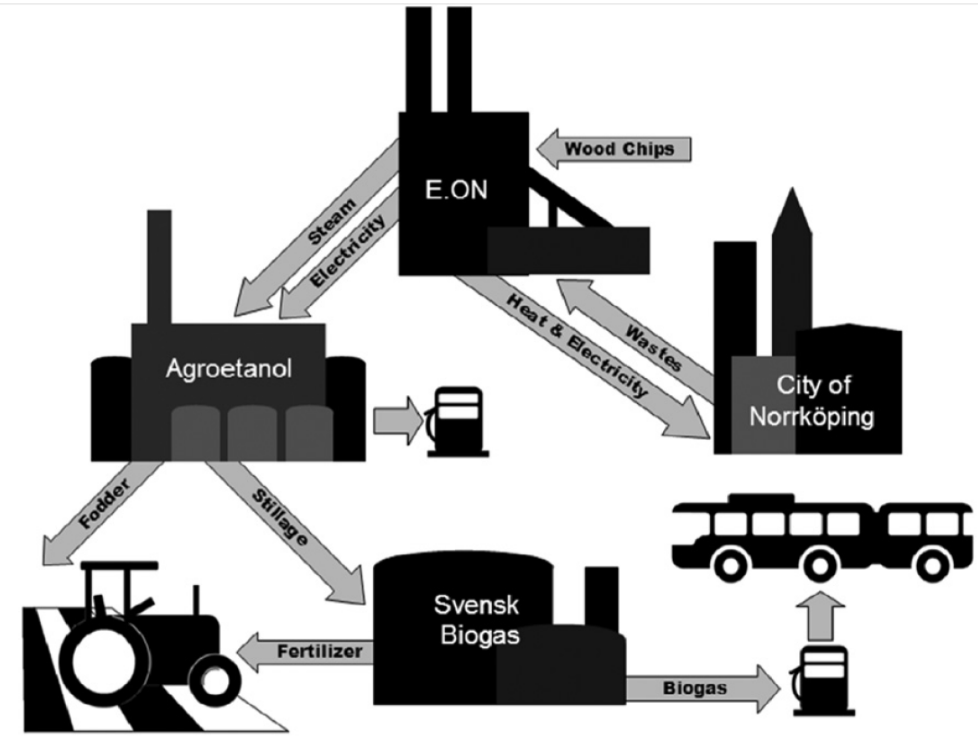
Success factors

Händelö Island benefits from the strategic position of the area with access to the railway and proximity of a harbor (*location*). Also, as it is part of the Östergötland county, local policies and coordinating organization support the development of IS and other eco-innovation activities (*policy*, *coordinators* and *cooperation with S&T institutions*). Moreover, the diversity and configuration of businesses on the island is also an asset (*diversity of businesses*).

Perspectives

According to Martin and Eklund (2011), a biodiesel production facility will probably be built in the cluster area in the near future. As the transesterification reaction used to produce biodiesel needs alcohol and heat, this facility will benefit from the nearby ethanol and heat production plants. It will also produce glycerol, a valuable resource for the production of biogas.

Fig. 33 > Händelö bioenergy symbiosis



after Martin et al. 2011

Park no. 99: Jämtland County

Sweden

Geography	Sweden, Jämtland	
Type of park	Combined	
Size of park	4944'300 ha	N/A jobs
	7000 companies	127 000 inhabitants
Eco-criteria	Renewable energy Energy efficiency ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leaders	Public	
References	(Saikku 2006) Internet links www.reregions.blogspot.com/2009/10/jamtland-conty-council-sweden.html www.jll.se/2.6ba9fa711d2575a2a7800022796.html www.promidnord.net/svenska/verksamhet/projekt/promidnord/promidnord/english.4.18ea1685 1076df63622800012616.html www.energikontoret.z.se/ www.investsweden.se/Global/Global/Downloads/PDF-documents/Case-studies/National-Bio-Energy%20.pdf	

Origin

The county of Jämtland is implementing a long-term programme to become a "fossil-fuel-free region". It is situated in the Mid-Nordic region (also including parts of Norway and Finland), which benefited from INTERREG III (2000–2006), a European interregional cooperation programme for sustainable development.

Objectives

One of the objectives of the ProMidNord project implemented in the framework of this programme was to take advantage of the regional assets to develop renewable energies, mainly wind power and biomass. Since 2005, Jämtland County Council certifies all its operations with ISO 14001 and EMAS, and claims to be the first European county to do so. Among the main regional objectives are to reach energy independence through the use of local renewable resources and to reduce simultaneously carbon dioxide emissions from transport and energy supply. In 2007, the region was producing from renewable energy sources 100% of its electric power (mainly water, wind and biofuels), and more than 50% of its heat production (biofuels, electricity, waste recovery, etc.). Also, a major improvement has been made in terms of energy efficiency for heat production: from 429 to 119 kWh/m²/year between 1973 and 2008.

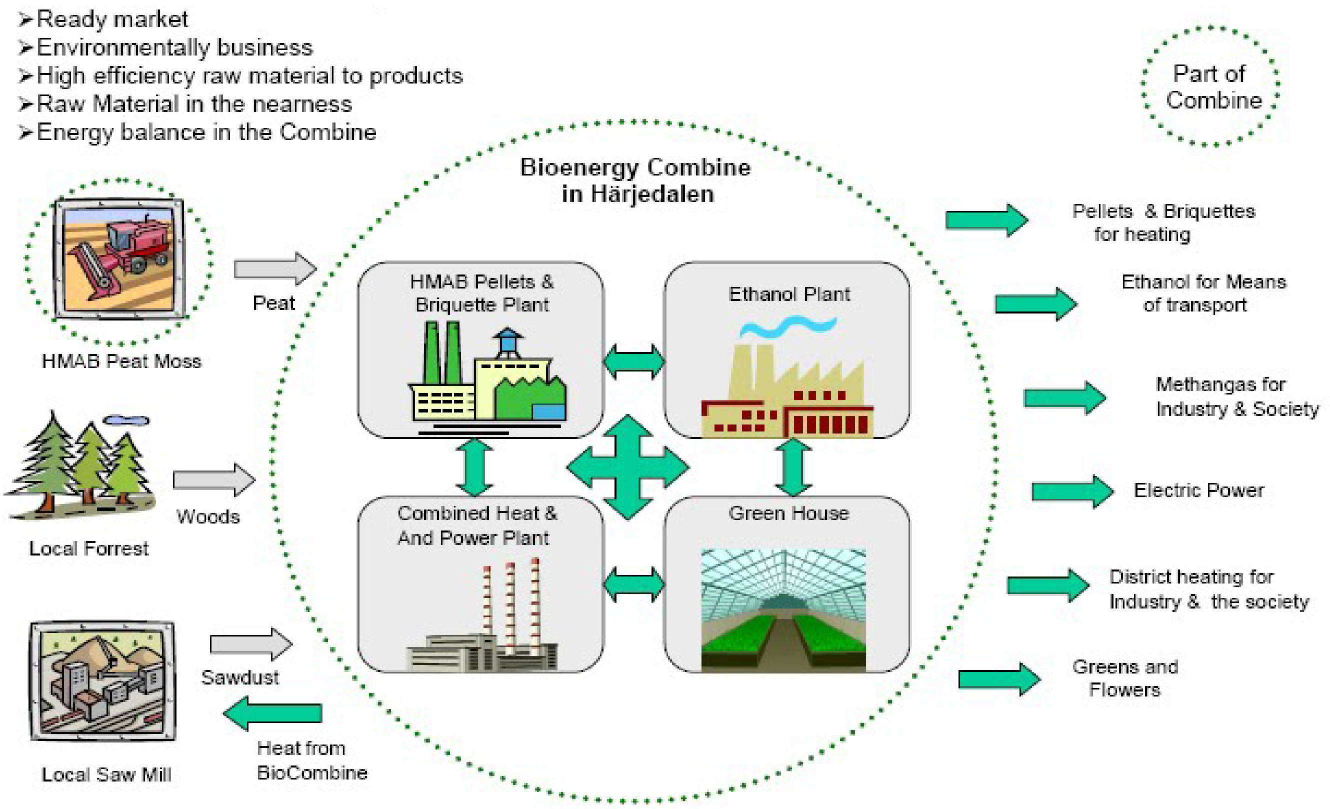
Success factors

Thanks to its environmental management structure, the region can efficiently monitor its environmental objectives and programmes are conducted through the Jämtland Energy Agency, including renewable energy development (EnergYZer) and environmental education (EK-smart). This regional agency benefits from local and central government funding. The success factors are therefore *coordinators, cooperation with science and technology institutions* and *diversity of activities*.

Perspectives

Despite these impressive achievements realized in Jämtland County, its global energy consumption is still growing and more efforts are to be made in the near future. Among planned projects is the implementation of bioenergy production plants and regional synergies in the town of Sveg (province of Härjedalen), jointly with the Chinese company National Bio Energy. Another prominent initiative is the development of a Scandinavian "Green Highway" including the promotion of private vehicles using electric power and biofuels.

Fig. 34 > Bioenergy Combine Project in Härjedalen



after International Study of Renewable Energy Regions 2009

Park no. 100: Landskrona Industrial Symbiosis

Sweden

Geography	Sweden, Skåne	
Type of park	Combined	
Size of park	N/A ha	N/A jobs
	21 companies	38 000 inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Stopped	
Project leaders	PPP	
References	(Mirata et al. 2005); (Saikku 2006); (Duret 2007); (Adamides et al. 2009) Internet links www.ie.tudelft.nl/index.php/Landskrona	

Origin

In 2002, the International Institute for Industrial Environmental Economics (IIIEE, University of Lund) launched the Landskrona Industrial Symbiosis Project. The project involved 21 businesses (mostly SMEs, from 4 to 500 employees) as well as the Technical and Environmental Departments and Office for Trade and Industry of the Municipality of Landskrona. The IIIEE, already leader in company-based environmental performance approach, wanted to demonstrate through this project the potential of a larger scale, collective and systemic approach.

Objectives

The objective of the project promoters was to establish “a collection of long-term, symbiotic relationships between and among regional activities involving physical exchanges or materials and energy carriers as well as the exchange of knowledge, human or technical resources, concurrently providing environmental and competitive benefits”. Companies involved are operating in various sectors (agriculture, chemistry, metal works, auto parts, printing, packaging, waste management, recycling, transport and logistics) and were required to contribute to the project with proper funds and dedicated human resources. Public actors are involved mainly through the wastewater treatment and district heating infrastructures. A network was established and potential synergies were identified and some of them implemented: by-product exchanges, waste recovery for district heating, collective waste management, heat and water cascading schemes, knowledge and Information sharing initiatives, cooperation in transport and logistics, and use of renewable energy and energy efficiency technologies.

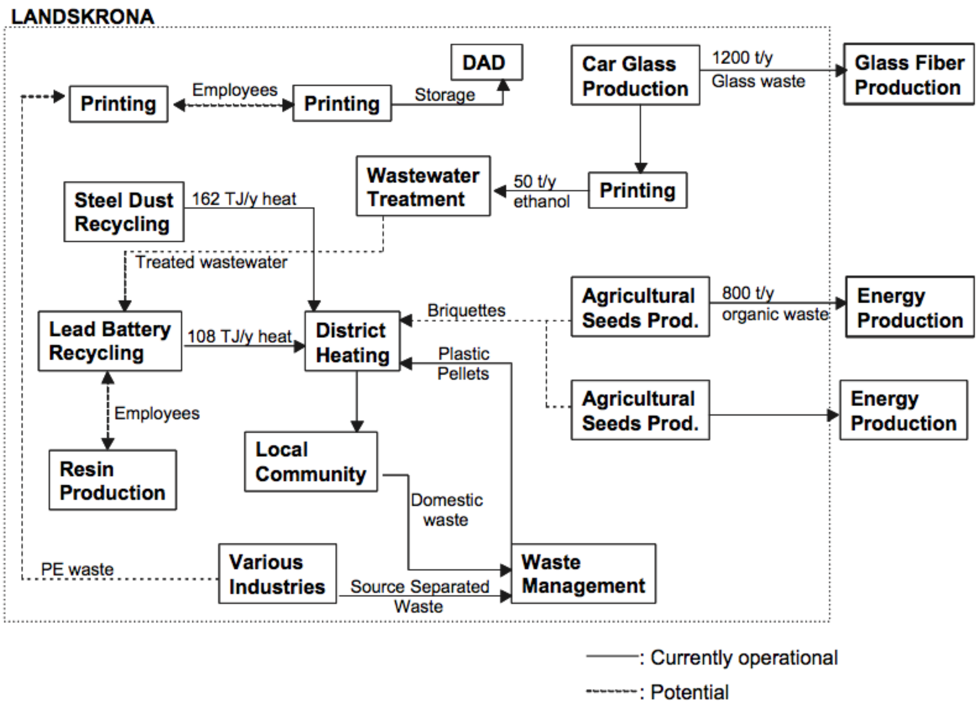
Success factors

One of the main assets of the project lays in a strong *collaborative network with science and technology institutions* including a project designer and coordinator (IIIEE), major industries representatives, universities and research institutes, as well as local and central government, with the financial support of the Swedish Business Development Agency (NUTEK) (*Coordinators*). Also, the short distance separating each stakeholder from another (4 km max.) facilitated the implementation of synergies (*Location*).

Despite some encouraging achievements mentioned in the literature, we found no recent data about the development of the Landskrona project. It seems to have phased out since 2006, when the project budget was finished.

Perspectives

Fig. 35 > Industrial symbioses in Landskrona



after Mirata et al. 2005

Park no. 101: Malmö Cleantech City

Sweden

Geography	Sweden, Skåne	
Type of park	Combined	
Size of park	6930 ha	N/A jobs
	100 companies (cleantech)	300 000 inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management Biodiversity Material flow	Cultural, social, health benefits Mobility, transport Land use optimization Air pollution prevention Noise prevention ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Public	
References	Internet links www.malmocleantechcity.se/cleantech/English.aspx www.symbiocity.se http://www.malmo.se/English/Sustainable-City-Development.html	

Origin

A city dedicated to cleantech development. The initiative develops from the city government willingness to promote a cleantech cluster.

Objectives

Through collaboration between companies, universities, the municipality of Malmö have created a green cluster to develop cleantech-companies. In parallel, Malmö City's environmental profile and attractiveness for both people and companies are strengthened. The Lillgrund Wind Park, 10 kilometers south of Malmö, produces 0.33 TWh of electricity per year (energy consumption of 60'000 households) and the Sege park features the largest photovoltaic plant in Sweden (peak power of 166 kW). Approximately 60% of Malmö´s heat energy is produced by the city incinerator via waste-to-energy and 16% of the district heating is provided by excess heat release from major industrial activities in the city. Citizen food waste is collected to produce biogas, which is used to fuel city buses, garbage trucks, taxis and cars. The overarching goal of the mobility policies in Malmö is that walking, cycling (490 kilometres of bicycle paths) and public transport (powered by electricity, biogas or hydrogen) are the first hand choices for transport of people and goods in the city. Malmö's school district serves almost exclusively organic meals and the city is labelled as fair-trade city for its promotion of ethical consumption. Green roofs and open stormwater channels leading into ponds to stop flooding have created natural environment rich in biodiversity. Air and noise monitoring combined with special campaigns (e.g. "No Ridiculous Car Trips") help improving environmental quality. Sustainable urban planning is a guiding principle in Malmö, with famous examples triggering tourist study tour on sustainable city development in the Augustenborg and Western Harbour (former brownfield) districts. A regional network disseminate learning for sustainable city development.

Success factors

The main success factors are *policy*, *coordinators* and the *location* of the cluster, near the third Swedish city in size. Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

Available information is focusing on the promotion of the cleantech clusters.

Park no. 102: Norrköping and Linköping

Sweden

Geography	Sweden, Östergötland	
Type of park	Combined	
Size of park	3568 ha +4201 ha	N/A jobs
	N/A companies	87 000 +144 000 inhabitants
Eco-criteria	Renewable energy Energy efficiency ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Public	
References	(Hatefipur et al. 2011) Internet links www.iei.liu.se/envtech/om-oss/michael_martin/1.247845/BiofuelsasDevelopingLargeTechnicalSystems_Final.pdf www.cleantechostergotland.se/index.php?page_show=4 www.symbiocity.se/Templates/Pages/Page.aspx?id=137&epslanguage=en#subpageanchor	

Origin

The "twin cities" of Norrköping and Linköping are located in the county of Östergötland and considered by some as the fourth Swedish urban agglomeration considering its population. In 20 years since 1990, environmental policies and activities in Östergötland have already resulted in more than 20% CO_2 reduction. In 2008, the Cleantech Östergötland organization has been founded, including industries and local government. It promotes the establishment of IS and the development of renewable energies and other clean technologies.

Objectives

At the municipal scale, prominent eco-innovation activities in Norrköping and Linköping include renewable energy links (biogas is used for all public transports including taxis) and district heating synergies with industry. Collaboration networks between different actors and organizations have been created to establish symbioses. Material exchanges (wastewater, forest by-products, ashes, household waste, etc.) are operating between various businesses and the municipality of Norrköping through Econova, an enterprise focusing on products and services in the field of biomass, landfills, waste & by-products, and gardening.

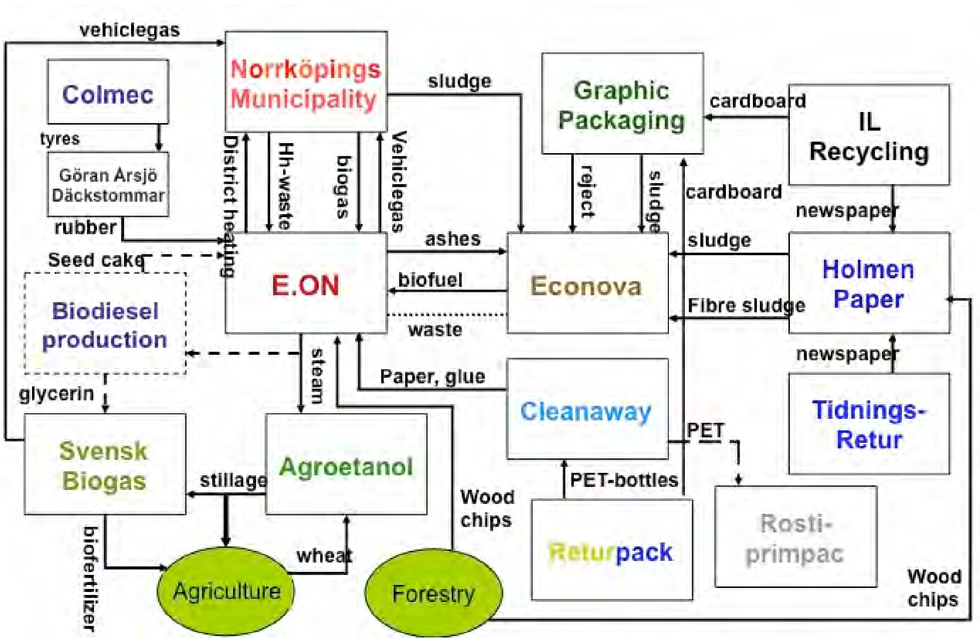
Success factors

Collaboration with the Linköping University regarding IS constitutes a strong asset for the twin cities (*cooperation with science and technology institutions*). Not only for research, but also for communication as in the 4-year Sustainable Norrköping programme, where a visualization center has been established for popular science communication of IS through visualization of material flows. Also, Cleantech Östergötland is acting as a strong *coordinator* and promoter of eco-innovation in the region and the twin city geographical situation is an asset (*location*). The last success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

The twin cities and the whole region of Östergötland seem dedicated to continue fostering clean technologies development and establishing more collaboration network between businesses to implement Industrial Ecology schemes. Cleantech Östergötland offers a newsletter service on its website and also publishes a magazine to communicate on sound eco-innovation activities in this region of Sweden.

Fig. 36 > Industrial symbioses in Norrköping



after Hatefipur et al. 2011

Park no. 103: Södra Cell – Mönsterås Network

Sweden

Geography	Sweden, Kalmar, Mönsterås	
Type of park	Industrial	
Size of park	160 ha	470 jobs
	1 company	4731 inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	PPP	
References	Internet links www.sodra.com www.climatepilots.com/pdf/Sodracell.pdf	

Origin & Objectives

The forestry and wood processing company Södra Cell Mönsterås is one of the world's largest producers of softwood pulp. Approximately 50% of the wood it processes is converted in heating and electricity. One objective of the company is to replace all fossil fuels in its mill by implementing energy efficiency schemes and developing its renewable energy production. Part of the energy produced is directly used *in situ* to feed its industrial processes. But the production of heat and electricity largely exceeds its needs, so that Södra Cell also provides district heating for the municipality of Mönsterås and injects electricity in the public grid.
Exchanges of energy and materials (including wastes and by-products) are established between the 3 facilities implanted in the Mönsterås production site, including a pulp mill, a sawmill and a wood pellet production plant. However, very little detailed information is available concerning these exchanges.

Success factors

The main success factors for this case are *coordination*, *cooperation with the science and technology institution* and clear designation as an *Eco-Innovation Park*.

Perspectives

In the near future, Södra plans to invest in wind power at its mills in Sweden and build wind turbines next to the Mönsterås site.

2.17 Switzerland

At supra-national level, the Basel Convention is the most influential treaty on the Swiss waste policy and legislation. At the national level, the Federal Act on the Protection of the Environment (EPA) (1983) defines the concept of waste and the legal prosecutions in relation to non-compliance. Two federal ordinances describe the types of waste, the principles for its treatment (1990) and the control rules for waste movements (2005). Several types of waste have dedicated laws and ordinances. In general, reuse and recycling is mandatory, if technically possible, without any specific technological standard. Under the polluter pays principle, businesses are responsible for the management of their urban and special waste. A private recycling market controls waste transfer and recovery. Efficient recycling technologies are favoured through a legal authorization process as well as dialogue and collaboration with interested parties.

At sub-national level, the 26 cantons develop and apply their own policies and legislation, but keep an alignment with national orientations. For example, the cantons can fix their own landfill price but are responsible for enforcing the national landfill tax. Since there are no special requirements for by-product exchanges, EIP and IS could, in principle, be regarded as a potential strategy, provided they do not lead to the diffusion of pollutants and respect the legislation on hazardous waste handling and movements (Costa et al. 2010b).

Recently, the Federal Department of Economic Affairs, Education and Research (EAER) and the Federal Department of the Environment, Transport, Energy and Communications (DETEC) presented a Cleantech Masterplan (CMP) (EAER et al. 2010). It analyses the innovation and cleantech potential in Switzerland in terms of resource efficiency and renewable energies (EAER et al. 2010). The Federal Office for the Environment (FOEN) promotes innovation and cleaner production procedures, and initiated the present study. The Federal Office for Territorial Development (ARE) is also involved in innovation and economic promotion for sustainable district (Thorens Goumaz et al. 2012).

No relevant data on the following eco-innovation parks is detailed in the literature at the time of this review:

- Altenrhein Industrial Park
- Riedholz and Luterbach industrial park
- Romont industrial park
- Rose de la Broye eco-industrial park
- Sisslerfeld Industrial Area
- Solvay Industrial Park Zurzach
- Tecorbe environmental technopole
- ZIPLO industrial park
- Zürich Cleantech Innovation Park (only planned activities)

Besides, Switzerland hosts interesting cases of energy network described in chapter A1_*Energy_distribution_systems*: Apo Tegra AG, CADCIME district heating, Energienetz GSG, Geneva-Lake-Nations project and Zurich hydrothermal networks.

Park no. 104: Basel Industrial Area (Klybeck, Rosental, St-Johann, Schweizerhalle)

Switzerland

Geography	Switzerland, Basel	
Type of park	Industrial	
Size of park	144 ha	N/A jobs
	6 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	Internet links www.industries.veolia.com/industries-veolia/ressources/files/1/22380,Brochure-Novartis-UK.pdf, www.valorec.com/htmlHTML/energie/unserprofil.html www.novartis.ch/de/about-novartis/campus/index.shtml	

Origin

Many large pharmaceutical and chemical companies (e.g., BASF, Novartis, Hoffmann La-Roche, Syngenta, Clariant, CABB) operate in the Basel region on the industrial sites Klybeck, Rosental, St-Johann and Schweizerhalle. In recent years, these parks have been connected to form one industrial area and various common services and infrastructures have been developed for the tenants. Moreover, the different plants of the area are also part of the Energy Model Group – Chemistry, a platform that aims to reduce the CO_2 emissions of the sector, mainly through energy efficiency. On the same site, an important R&D center, the Novartis Campus of Knowledge, has been recently established. It plans to host about 10 000 persons and has set up ambitious environmental objectives.

Objectives

The development of services on the sites aims to optimize resource management and to ensure the security of supply for chemical industries. Valorec, a company owned by Veolia environment, is the main provider. It supplies energy (using 70 different energy carriers), takes care of industrial and chemical waste management by providing on-site treatment, recycling and waste-to-energy solutions, fostering exchanges and synergies between companies. Regarding the Novartis Campus, it has been designed to minimize its impact on the environment. Its objective is to be CO_2 neutral and to use 100% renewable energy. Concretely, this involves recycling and recovery of building material, new buildings with higher energy efficiency, and an extensive use of alternative energy sources. The cooling system uses water from the Rhine, which flows nearby, and energy for heating is provided by the Basel waste incineration plant.

Success factors

Currently, the main success factor for the development of eco-innovation on the site is *economic value added*, as the centralized services provided by a third party lead to reduced costs for the tenants. Furthermore, the role of Valorec as a *coordinator* appears to foster sound environmental management. Besides, the *location* of the park is particularly attractive for businesses (economic and S&T hub, transport network).

Perspectives

The recently established Novartis Campus is to become a prominent R&D hub and should foster further development of the site, including on aspects related to eco-innovation.

Park no. 105: Bulle industrial park

Switzerland

Geography	Switzerland, Fribourg, Bulle/Vuadens	
Type of park	Industrial	
Size of park	70 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Planned	
Project leader	Public	
References	Internet links www.regiongruyere.ch	

Origin

In the context of the New Regional Swiss Policy (NPR), the Gruyère region was choosen in 2011 by the canton of Fribourg and Innoreg (a regional association that supports the implementation of the NPR) as a pilot territory for an Industrial Ecology project. The project extends over the existing industrial parks of two municipalities: Bulle and Vuadens. The governance is assumed by both the canton of Fribourg and the *Association Régionale La Gruyère*, a local platform for the economical development.

Objective

The main economic sectors present on the project area are mechanical industry, pharmaceutical industry and agro-food industry. The project has three main motivations: to improve the use of local resources and energy, to develop an industrial sector based on high technologies, and to optimize the management of business present in the industrial park.
The objectives of the project are to analyze the regulation in force and to suggest some adaptation to integrate the eco-industrial concept in the local and regional development strategies. New potential opportunities of IS are also highlighted and analyzed. Nevertheless, very few innovations have been implemented so far.

Success factors

The main success factors are the *diversity* of businesses, the economic *value added* to businesses and the *policy* framework toward eco-industrial development.

Perspectives

Action plans for energy, shared networks and services symbioses implementation using public-private partnerships are currently under development.

Park no. 106: Chablais eco-industrial region

Switzerland

Geography	Switzerland, Vaud/Valais, Aigle/Bex/Villeneuve	
Type of park	Industrial	
Size of park	302 ha	3110 jobs
	204 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency ~~Waste management~~ Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Planned	
Project leader	Public	
References	(Leregional 2012); (Thorens Goumaz et al. 2012)	

Origin

The region was chosen in 2010 by the canton of Vaud as a pilot territory for an Industrial Ecology project. The project extends over the existing industrial parks of three municipalities: Villeneuve near to the Leman Lake, Aigle and Bex. The governance is assumed by both the canton of Vaud and Aigle Région, the local platform for the economic promotion.

Objective

The project has two main motivations: i) integrating Industrial Ecology in the Chablais development strategies and place the Chablais region as a sustainable, attractive and innovative territory, and ii) detecting industrial synergies and optimize the use of local resources and energies. The main economic sectors are chemical industry, agro-food industry, the machinery industry and services.
In concrete terms, steam and water exchanges have already been implemented, leading to significant annual savings: 200 000 t. of CO_2, 60 000 t. of fossil fuels and 220 000 t. of water. There is also a project to create a steam network between Aigle industrial park and the horticultural zone, and to implement a sustainable industrial management in the industrial parks.

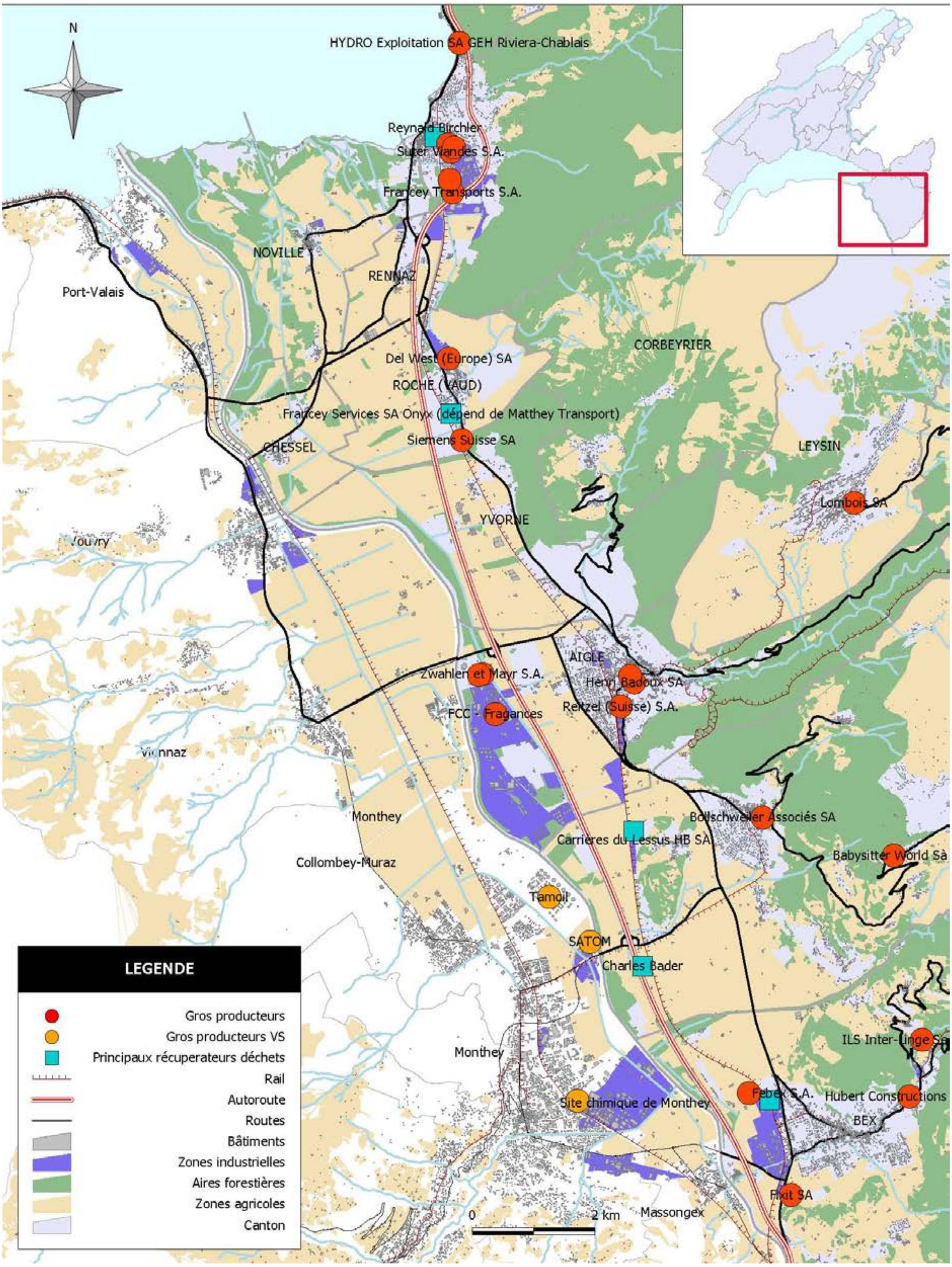
Success factors

Diversity of businesses, economic *value added* and *policy* framework (support to eco-industrial development strategies through regional policy action) are the main success factors. Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

Nowadays the project only involves the Chablais *vaudois* (canton of Vaud, east of the Rhone river). In 2012, the political wish is to integrate the chemical companies and the waste incinerator from de Chablais *valaisan* (canton of Valais, west of the Rhone river).

Fig. 37 > Industrial parks of the Chablais Industrial Ecology project



Park no. 107: Cimo – Monthey Chemical Park

Switzerland

Geography	Switzerland, Valais, Monthey	
Type of park	Industrial	
Size of park	120 ha	2000 jobs
	4 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	Cultural, social, health benefits ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Private	
References	(Thorens Goumaz et al. 2012) Internet links www.cimo.ch	

Origin

Cimo is a Joint Venture between BASF and Syngenta, the two main chemical players of the Monthey chemical park. Huntsman, the third chemical company active in Monthey Chemical Park also benefits from Cimo's services but is not involve in the company management.

Objectiv

Cimo's main activities are the design of facilities for the chemical site, the production and supply of generic flows and energy vectors (electricity from renewable hydropower plants, steam, natural gas, compressed air) and water, as well as liquid and solid waste management for the three chemical players. The energy recovery from the onsite incineration plants results in the production of 150 000 tons of steam per year (25% of the park demand). In addition to the management of raw materials, waste and energy flows, Cimo also provides services like maintenance, workshops, training, engineering, catering, security, communication, barrel and cask cleaning. Polluted sites within the park are either continuously monitored or will be decontaminated.

Success factors

The main success factors are the economic *value added* from the mutualisation, Cimo's coordination role (*coordinators*), the collaboration with science and technology institutions (*cooperation*) and the recent designation as an *eco-innovation park*.

Perspectives

The project ECHO initiated in 2007 by the regional office in charge of economic development (*Antenne régionale du développement économique du Valais romand*) aimed to increase companies' environmental performance and consolidate their economic competitiveness. In 2009, Cimo and the chemical site of Monthey became a pilot project of ECHO. Cimo wanted to gain better knowledge of the potential IS in the chemical sector, to detect and analyze new opportunities of optimization of the material and energetic flows within the company. Consequently, more IS may be implemented in the future.

Park no. 108: Daval Eco-industrial Park

Switzerland

Geography	Switzerland, Valais, Sierre	
Type of park	Industrial	
Size of park	~ 25 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Stopped	
Project leader	Public	
References	(Massard et al. 2007b); (Thorens Goumaz et al. 2012)	

Origin

The initiative began in 2007 with the motivation of the Sierre economic promotion service to develop an innovative industrial development project.

Objective

The objective was to set the basis of the creation of an eco-industrial park around a methanization unit, a district wood boiler and a commercial zone. The economic promotion service oriented the area promotion toward environmental technologies (cleantech) and nanotechnologies. Potential heat and waste exchanges based on the energy issues are identified.

Success factors

The main success factors of the project are the *value added*, the *policy*, the *incentives* provided for the planning phase and the clear designation as an *Eco-innovation park*.

Perspectives

The project was planned in 2007 but stopped in 2008 because of a lack of local resources to supply the methanization unit and the district wood boiler.

Park no. 109: Ecosite workgroup

Switzerland

Geography	Switzerland, Geneva	
Type of park	Combined	
Size of park	28 300 ha	200 008 jobs
	44 716 companies	464 677 inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Erkman 2005); (Favrat et al. 2008); (Costa et al. 2010b); (Massard et al. 2007a); (Massard et al. 2009); (Massard 2011) Internet links www.ge.ch/ecosite, www.ge.ch/scane/, www.ge.ch/ecomat	

Origin

The Canton and Republic of Geneva is active in industrial park management since 2001. The main stakeholders implementing environmental and eco-efficiency strategies are the state energy service (Scane) responsible for the development of a territorial energy planning procedure, and the Ecosite workgroup for the implementation of eco-industrial development strategies. Industrial Ecology was introduced as a legal basis in the Agenda 21 law in 2001 and an Advisory Board involving energy, sustainable development, waste, building, and economic promotion services was created.

Objectives

The article 12 of the law, called Ecosite, stipulates that ‘‘the State facilitates possible synergies between economic activities in order to minimize their environmental impacts’’. The Ecosite workgroup focuses on the implementation of IS in the state industrial areas, on inert material recycling, on good transportation system and on sustainable resource management issues. As an example, a study was performed in 2009 to evaluate the potential to substitute drinking water with ground water for economic activities like waste management, construction and washing of public spaces. In addition, the state energy service applies a systematic territorial energy planning to improve energy efficiency and promote renewable vectors. It also implements energy efficiency actions like waste heat recovery from economic activities.

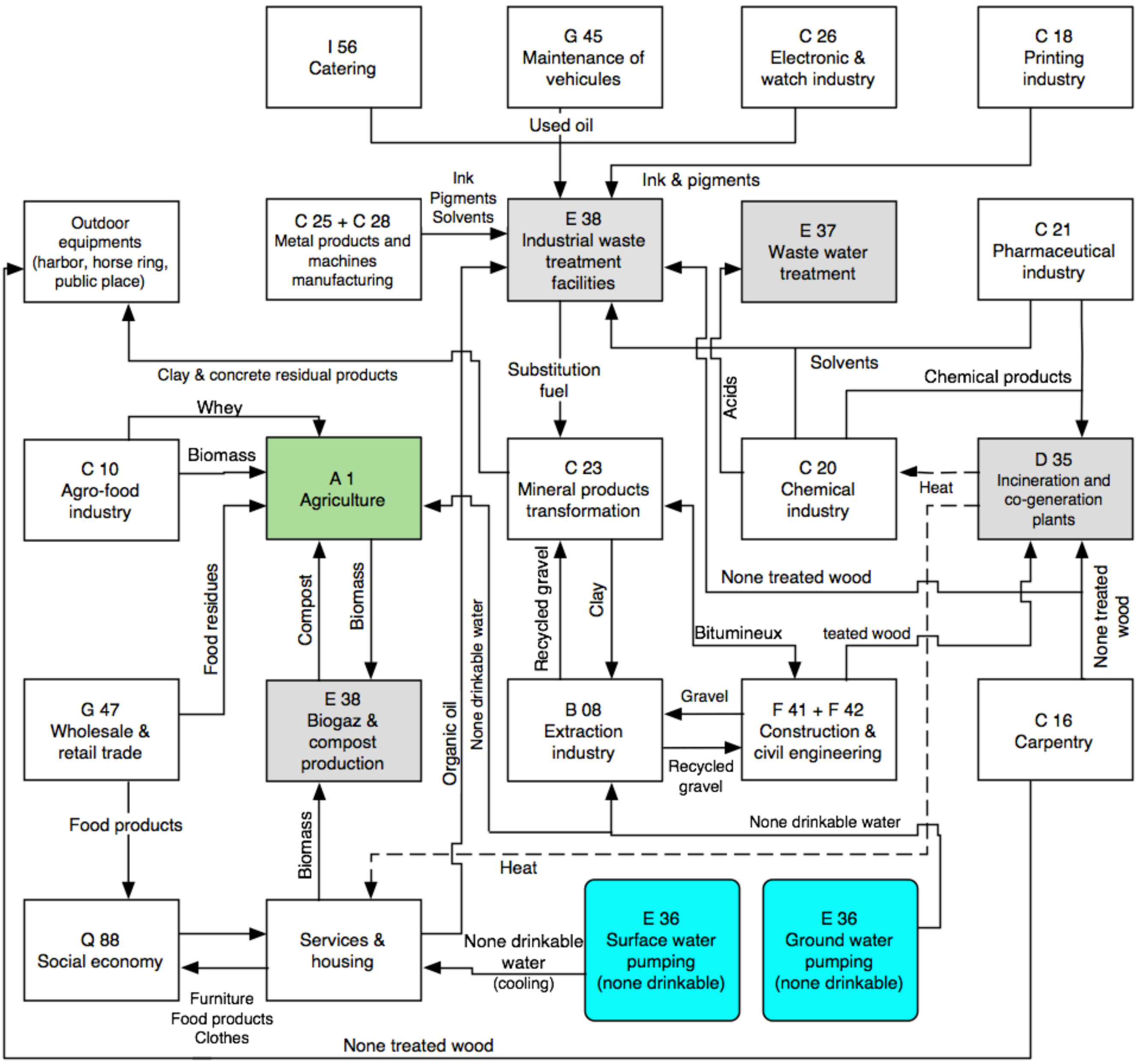
Success factors

The main success factors are strongly supportive policy and regulation frameworks (*policy*). Many *incentives* also exist to reduce payback and risks for companies. The coordination role of the Ecosite workgroup (*coordinators*) and the cooperation with science and technology institutions (*cooperation*) also contribute to the success of eco-industrial development in Geneva. Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

Industrial Ecology and sustainable resource management have been introduced in many policies. Further expected development will focus on the implementation of the territorial energy planning and the development of densified industrial parks to tackle land availability constraints.

Fig. 38 > Existing industrial symbioses in Geneva



after Massard 2011

Park no. 110: Infrapark Baselland

Switzerland

Geography	Switzerland, Basel	
Type of park	Industrial	
Size of park	37 ha	N/A jobs
	9 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Private	
References	(Scheuermann 2012) Internet links www.infrapark-baselland.com/en/index.php	

Origin

Infrapark Baselland, a unit of the Swiss chemical group Clariant, started its operation at the beginning of 2011. Other companies on the site include a training association specialized in pharmaceutical and chemical industry, as well as several other companies mainly operating in the chemical and life sciences sectors.

Objectives

The park management provides technical services covering the entire lifecycle of production plants to ensure a safe and environmentally sustainable industrial development and reveal potential improvements in efficiency. Infrapark Baselland also offers to its tenants a centralized supply for energy (electricity, natural gas, steam, cooling media, compressed air) and other resources (water, nitrogen, acids and alkalis). An onsite waste incineration plant provides part of the energy in the form of heat, high temperature water and steam. Moreover, a comprehensive waste management programme has been set up for waste disposal (including source exhaust air, solvent regeneration, etc.) and wastewater pre-treatment with an onsite plant for industrial effluents loaded with organic substances and/or heavy metals.

Success factors

The park provides services that allow the tenants to focus on their core activities and improve their business efficiency (*value added*). Moreover, the park's management and administration facilities greatly contribute to comply with high security and environmental standards on the site (*coordinators*). Besides, Infrapark Baselland is located in a region with a high concentration of industries and research institutions specialized in the field of chemistry and life sciences, which strengthens the attractiveness of the site for companies operating in these sectors (*location*).

Perspectives

16 more hectares are available for companies to settle in, and Infrapark continues to actively seek for new tenants. No data has been found regarding further development of eco-innovation activities.

2.18 Turkey

According to the Technology Development Foundation of Turkey TTGV (TTGV 2013), the existing Turkish legislation still must be completed in the next years regarding to waste management legislation. The concept of cleaner (sustainable) production is already frequently cited and the need to develop cleaner technologies and approaches in Turkey is admitted.

The foundation recommends to "take the sustainable consumption and production action plan of EU as an example" in the Turkish legislation and "to inform the industry about the best available techniques and its reference documents defined in the EU's IPCC Directive" in parallel (TTGV 2010).

The Industrial Symbiosis Network for Environment Protection and Sustainable Development in Black Sea Basin (SymNet project) was launched by the European Union together with Turkey, Romania, Bulgaria and Moldova in July 2011 for a 24 months period (2011–2013). The project aims " to minimize the environmental degradation while maximizing economic and social development in Black Sea Basin by establishing industrial symbioses system " in four important sectors: manufacturing, logistics, energy and tourism. The Center for Energy, Environment and Economy at the Özyegin University of Istanbul and the Istanbul's EU Pioneers Association manage the project in Turkey (Symnet 2013).

Only the national cleaner production programme, including four pilot projects, is detailed in this survey. No significant or relevant data on the following potential eco-innovation park is detailed in the literature at the time of this review:

> Kocaeli eco-industrial park (Şenlier et al. 2011)

Park no. 111: Eco-Efficiency (Cleaner Production) Programme

Turkey

Geography	Turkey, Seyhan river basin	
Type of park	Industrial	
Size of park	N/A ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency ~~Waste management~~ Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leader	PPP	
References	(TTGV 2010) Internet links www.ttgv.org.tr/en/cleaner-production www.ecoefficiency-tr.org/ www.ttgv.org.tr/content/docs/appendix-3.pdf www.ttgv.org.tr/en/unido-eco-efficiency-programme	

Origin

On the behalf of the Ministry of Environment and Forestry, the Technology Development Foundation of Turkey (TTGV) conducted in 2009 the " Determination of Framework Conditions and Research Development Needs for Dissemination of Cleaner (Sustainable) Production Application in Turkey Project ". Its aims were to create infrastructure for a road map of the dissemination of cleaner production at the national scale in Turkey.

Objectives

In parallel, as part of the UNIDO Eco-Efficiency (Cleaner Production) Programme, TTGV presents four pilot projects successfully completed and currently monitored: recovering of gutting and thawing waters at a sea food company, cooling water recovery in fruit concentrate and fruit juice production line of a beverage company, reuse of heat treatment unit cooling water and improvements in surface finishing at an automotive manufacturing company and water saving with good housekeeping practices, process optimization and change of water softening system at a textile manufacture company.

Success factors

The main success factors are the *incentives* provided by UNIDO and its cleaner production center in Turkey and the *economic value added* provided by the optimization implemented. Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

There is however no detailed information available about the Turkish experiences.

2.19 United Kingdom

During the last decades, a decline of traditional industry and growing waste problems led to more environmental friendly policies and public initiatives. The National IS Programme (NISP) (International Synergies Limited 2013) has been developed since 2000 to address these issues. The NISP was officially launched at the House of Commons in 2005 with the objective of increasing by-products and waste recovery through the establishment of exchange networks. The NISP serves as a coordinator for regional programmes; it offers them support and facilitates information exchanges. In England, it is essentially financed through a landfill tax, redistributed by the Business Resource Efficiency and Waste programme (Phillips et al. 2006). In 2007, 1.7 million tons of waste has been recovered in the framework of the programme, producing a benefit of £ 70 million for the businesses involved. Projects conducted or supported by the NISP also include the design and implementation of new recycling and energy recovery schemes. A full list of case studies is available on the programme website.

More locally, the London Waste and Recycling Board (LWARB 2013) has been established in 2007 and benefits from a fund from central government. The objective of the Board is to attract and give visibility to companies interested in waste reuse, recycling or recovery, to link them up with waste producers, London Boroughs and energy users and to provide new sites for these activities.

Private initiatives also exist to foster the development of eco-innovation activities in the UK, like the Waste & Resource Action Programme (WRAP) (Wrap 2013). Established as a not-for-profit company in 2000, the WRAP is supported by government funding from England, Scotland, Wales and Northern Ireland and conducts projects to promote resource efficiency, waste management enhancement (treatment, recycling and recovery), and an increased use of by-products through the creation of local networks. Also, the Waste minimization clubs have been key elements in the County waste minimization program helping to develop IS (Phillips et al. 2006).

Concerning park-based eco-innovation, several studies have been conducted on resource recovery parks in the UK aiming at improving businesses environmental performances and economic competitiveness (Goss et al.). But despite this interest, few operating examples of EIP can be found in the UK. By contrast, the success of NISP initiative leads to the question of the scale of action: is a regional approach more effective than a park-based approach?

No significant or relevant data on the following potential eco-innovation parks is mentioned in the literature at the time of this review:

- Birmingham
- Crewe business park
- Ecotech Swaffham
- Knowsley Industrial park
- London Remade
- Mersey Bank (MISP)
- Trafford park
- West Midlands (WISP)

Besides, UK hosts an interesting case of energy network described in chapter A1: Milton Keynes.

Park no. 112: Dyfi Eco Park

UK

Geography	UK, Wales, Machynlleth	
Type of park	Combined	
Size of park	N/A ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management ~~Water management~~ Biodiversity ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	Public	
References	(Mouzakitis 2003); (Siam 2004): (Boons et al. 2009) Internet links www.ecodyfi.org.uk/ www.dyfibiosphere.org.uk/ www.info.cat.org.uk/sites/default/files/documents/CommunityWind_CaseStudy.pdf www.cat.org.uk/catpubs/article.tmpl?sku=art38 www.bdcr.org.uk	

Origin

The Dyfi valley is a UNESCO "Biosphere" site, in which people are supposed to "work to balance the conservation of biodiversity with its sustainable use". To promote this concept, the Dyfi Biosphere Partnership gathers county councils as well as socio-cultural, economic and professional organizations. Among the main actors of this partnership is Ecodyfi, an independent body that has been founded in 1997 and is controlled by local players and supported by the Welsh Development Agency.

Objectives

Its main objectives are to "regenerate a sustainable community" in the valley, to create and support businesses embracing sustainability and appreciating the value of local cultural and environmental assets. These assets include bilingualism (Cymraeg and English) and social well-being along with environmental goods and services provided by the valley ecosystems and landscape.

Companies in the park operate mainly in the timber industry, manufacturing and services sectors. Buildings on the park are based around the principles of green design and low energy construction. Ecodyfi and its partners lead various activities in the park: awareness and educational programs, development of sustainable tourism and fair trade, implementation of waste management systems. Also, several organizations in Mid-Wales have come together through Ecodyfi to promote small and medium scale renewable energy schemes in the region, including biomass (mainly wood pellets from woodworking industries), water, wind and solar power systems, grid-connected or off-grid. Some installations are centralised (like the solar water heating systems of the Dyfi Solar Club), and some are owned collectively (e.g. the Bro Dyfi Community Renewables managing a 75 kW wind turbine).

Success factors

The Dyfi Valley site won several regional environmental awards and received a grant support provided by the European Commission via their European Regional Development Fund (*incentives* and *policies*). The Dyfi Biosphere Partnership and Ecodyfi also benefit from their collaboration with the Center for Alternative Technology (CAT) and universities. Together, they conduct research and monitoring activities in the park (*coordinators* and *cooperation*). Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

In addition to managing existing projects, Ecodyfi and its partners regularly launch and implement new activities for the conservation and sustainable development of the Dyfi Valley. Many data are available on the Ecodyfi website, including description of on-going projects, reports and newsletters.

Park no. 113: Green Park

UK

Geography	UK, Cornwall, Reading	
Type of park	Industrial	
Size of park	72 ha	N/A jobs
	28 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management Water management Biodiversity ~~Material flow~~	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leaders	Private	
References	(Mouzakitis 2003); (Siam 2004) Internet links www.greenpark.co.uk	

Origin

Oxford's investment group (Oxfords Properties) developed this park in a pleasant natural environment with a lake at its heart and collaborated with prestigious architects to design its master plan. It is a public open space accessible to all and many amenities are installed on the site: sports infrastructures, a day nursery, restaurants, etc.

Objectives

The objective is first to make it attractive to businesses (mainly from the service sector, IT, pharmaceutical), from large companies to start-ups, but also to integrate sustainability criteria in the park design and management.
Currently, the main features concerning eco-innovation criteria in the park are the following: an operational wind turbine of 2.3 MW is installed on the site; 30% of waste is recycled (the rest is sent to landfill), and recycled toner and printer cartridges are provided to businesses; water consumption has been reduced by 5% in managed buildings (measures concerning toilets and water taps); most buildings and infrastructures are designed including criteria for construction and in use environmental performance (BREEAM certifications and PRUPIM Sustainable Refurbishment and Development Frameworks in place); and a biodiversity plan is in course of implementation by the park landscape contractors. According to its 2011 sustainability report, the park is currently in process for ISO 14001 certification.

Success factors

The park management seems to be actively promoting sustainability schemes on the site. It works with its tenants to reduce energy consumption and increase recycling rates, and also ensures that the park suppliers "comply or commit" to sustainability objectives (e.g. catering policy favors local suppliers). Concerning transportation, the park management implemented a "Green travel plan": subsidized bus service to promote public transport, carpooling scheme (through the park extranet), sustainable mobility (bicycle lanes and hire scheme). The coordination by the park management (*coordinators*), the *incentives* and the *diversity* of economic activities are major success factors. Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

According to its last sustainability report (2011), the park future objectives mainly concerns waste management: an increase of 10% in recycled waste, 40% recycling of paper and packaging, reuse or recycle 80% of non-hazardous construction and demolition waste, and the introduction of a waste management programme for the park businesses. Also, it is planned to increase the number of building with environmental certifications. Besides, the possibility of using grey water for landscape where feasible is considered, as well as the construction of additional wind turbines.

Park no. 114: Humber Industrial Symbiosis Programme

UK

Geography	UK, Yorkshire and Humber	
Type of park	Industrial (region)	
Size of park	1 542 000 ha	N/A jobs
	N/A companies	5 283 733 inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leaders	PPP	
References	(Mouzakitis 2003); (Mirata 2004); (Saikku 2006) Internet links www.csrp.com.au/database/uk/humb/ www.nispnetwork.com www.ie.tudelft.nl/index.php/Humberside	

Origin

Initiated in 2000, the Humber Industrial Symbiosis Programme (HISP) was the first regional programme for IS in UK, following an idea originated by a large global oil and gas company. It gathered dozens of businesses around several projects including infrastructure sharing, pooling of energy distribution systems and chemical flows exchanges. The success of the HISP quickly catalyzed interest in several other regions, namely West Midland and Mersey Bank, and served as the platform to launch the National Industrial Symbiosis Program (NISP).

Objectives

Industrialization of the region began in the 1960’s. Dominant industries are chemicals, oil and gas, food processing, furniture, iron, steel and other metals. Several synergies and waste recovery schemes have been implemented since the beginning of the initiative, creating new added value for industries: a regional CHP plant; a chemical feedstock pipeline bundle to connect industries on the north and south banks of the Humber river; production of pet food from organic waste; waste-to-energy plants (using organic waste); reuse of vegetable oil for bio-diesel production; and all sorts of other industrial waste, by-products or used material recovery or reuse schemes.

Success factors

Since 2003, the HISP is integrated in the NISP and includes the whole Yorkshire and Humber region. It currently works with hundreds of companies using public financing (*incentive*, *policies* and *economic value added*). As the NISP is publicly funded, companies of all sizes and sectors are able to participate and integrate the network, which greatly contributed to the success of the programme according to its promoters. Also, an advisory group of key industry representatives collaborates for its implementation and ensures the relevance of the programme concerning the needs and expectations of businesses (*coordinators* and *cooperation*).

Perspectives

The NISP and its regional sub-programmes are an on-going process always searching for new symbioses to establish even if governmental financing decreases the last years. Detailed case studies concerning new initiatives in the region (and all the others regions participating in the programme) are available on the NISP website, which is regularly updated.

Park no. 115: Ince Park

UK

Geography	UK, Cheshire	
Type of park	Industrial	
Size of park	51 ha	1000 jobs
	N/A companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management ~~Water management~~ Biodiversity Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Planned	
Project leaders	Private	
References	Internet links www.incepark.com/about/ www.inceparkcommunityforum.org/projectupdate/	

Origin & Objectives

The planned Ince Park is presented as a “Resource Recovery Park” by the companies Covanta Energy and Peel Environmental. As the concept is based on IS and EIP principles, it implies the establishment of synergies and collaboration networks. Through the creation of business clusters in the park, the promoters intend to gather many actors involved in reprocessing or recycling different waste materials in order to produce environmental and economic benefits. They intend to transform the UK’s waste “costly problem” into a valuable resource.
The park will comprise an environmental technologies complex as well as an energy-from-waste (EfW) facility. The power plant will convert household and business waste into energy and supply steam, heat and up to 95 MW of electricity to the facilities and businesses on the park. This should increase the viability of recycling and reprocessing goods and materials. The remaining electricity will be exported to the national grid. Besides, a 20ha nature reserve will be created in the park perimeter.

Success factors

Located on the south bank of the Manchester ship canal, the park site benefits from the proximity of water, road and railways. The park promoters plan to install state-of-the-art facilities to exploit these strategic assets. Moreover, the region seems to be home to many “industry leading organizations” operating in the sectors of waste management, renewable energy, petro-chemical, nuclear, engineering and manufacturing. This situation might contribute to the park development and provide valuable waste material flows to feed its activities. The main success factors are therefore the *location*, the *diversity* and the clear designation as an *Eco-Innovation Park*.

Perspectives

The first phase of the project should be the construction of the 95 MW energy-from-waste (EfW) power plant (start in 2011). The construction of a 20 MW biomass energy plant should begin in 2012 and use around 175 000 tones of waste wood each year. In addition, a planning application for an Incinerator Bottom Ash Aggregate (IBAA) facility capable of recycling up to 250 000 tones/year of ash and transform it into a safe aggregate-like material commonly used by the construction industry was submitted on 19. August 2011. More data are available concerning the project development on the park website’s forum, which is regularly updated.

Park no. 116: London Sustainable Industries Park

UK

Geography	UK, London, Dagenham Dock	
Type of park	Industrial	
Size of park	133 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ Mobility, transport Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leaders	Public	
References	(Mouzakitis 2003); (Siam 2004); (ISIE, 2011b) Internet links www.londonsip.com/ www.barking-dagenham.gov.uk/Regeneration/Dagenham/Documents/regen-dag-dock-indust-park.pdf www.en.wikipedia.org/wiki/Dagenham_Dock www.consultation-online.co.uk/LSIP/home www.closedlooprecycling.co.uk/about-us	

Origin & Objectives

With the decline East London's traditional manufacturing industries over the last few years, large areas of 'brownfield' have lain under-used. Dagenham Dock is situated in the London Borough of Barking and Dagenham, an area designated as a national priority for urban regeneration. Since the early 2000's, the borough council has developed, in partnership with the London Development Agency, a concept for Dagenham Dock as a Sustainable Industrial Park, including environmental technologies industry clusters, research centers and fostering collaboration and exchanges of information, waste and by-products.

A remediation phase was first designed to improve the degraded land conditions for businesses and citizens. Then, one of the first "flagship" companies to settle in the park was the Closed Loop London recycling facility, now capable of recycling 35 000 tones of plastic bottles each year. Besides, green supply chain schemes, by-product exchanges, and concepts such as 'triple bottom line', 'Factor 4' and the 'Natural Step' will be promoted among the businesses entering the park. All buildings in the park will meet BREAM green building standards. They are to be built with sustainable construction materials, be energy efficient and include rainwater harvesting systems, green roofs, etc. As a key part of the Park, a network of sustainable locally produced heat and power (mainly from waste) should supply businesses.

Success factors

An Environmental Technology Resource Center for London (ETRCL) is also planned and will be the "center piece" of the park according to its promoters (*coordinators* and *cooperation*). It will conduct practical research on reclamation, recycling and reprocessing of construction waste, aggregates, plastics, glass and other waste products. In close collaboration with the universities, the ETRCL will also be the coordinator for the different operations of the park and provide training and education programs. Moreover, sustainable mobility (public transport, cycling and walking) will be encouraged in the area, and the railway and river transport will be developed (*location*). The park is also clearly designated as eco-innovation park (Eco-Innovation Park).

Perspectives

Even though it appears on several promotional websites, no up-to-date information is available concerning the progress of the park development. Nonetheless, the Industrial Symbiosis Eco-Industrial Development Section Update of December 2011, published by the International Society for Industrial Ecology (ISIE), announces that future tenants “are queuing to locate in the park”.

3 > Survey for Non-European countries

3.1 Australia

The Australian economy is highly dependent from the mining and minerals sector (Van Beers et al. 2007). Despite major environmental issues linked with these activities, especially waste management, industrial ecology remained initially "misunderstood and treated with suspicion" by many firms, local government and communities (Roberts 2004).

According to Roberts (2004), Australia is moving forward with its waste problems as most states and local government developed policies and procedures to reduce the volume of waste and to support recycling. In addition, Australian government considers nowadays the eco-industrial parks "as a way of achieving more sustainable industrial development".

Many eco-industrial initiatives have been developing since the 2000's such as the Synergy Park, the first planned eco-industrial park to be built in Australia, Kwinana EIP, Hunter Industrial Ecology Park or the Port Melbourne project.

The New South Wales Office of Environment and Heritage is developing a sustainability program that considers resource efficiency as a sustainability advantage (NSW Government 2013). The program seems to be based on increasing waste levies and penalizing polluters as a new stance, which should encourage positive change.

Mentions of industrial ecology and industrial symbiosis are now occurring in planning strategies such as the Metropolitan Plan for Sydney 2030 or the Perth Region guidelines for industrial development (Perth Region Nrm 2010). Hopefully in the near future it will become commonplace in all planning policies (Golev 2013; Hahn 2013).

No significant or relevant data on the following potential eco-innovation parks is detailed in the literature at the time of this review:

> Bomen Business Park (Wagga-Wagga, New South Wales)
> Botany Industrial Park (New South Wales)
> Geelong Manufacturing Council (Queensland)
> Gladstone Industrial Area (Queensland)
> Coolum Eco Industrial Park (Queensland)

Park no. 117: Hunter Industrial Ecology Park

Australia

Geography	Australia, New South Wales, Weston	
Type of park	Industrial	
Size of park	40 ha	500 jobs
	12 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Planned	
Project leader	Private	
References	Internet links www.theherald.com.au/news/local/news/general/world-waste-first-hunter-companys-bid-to-lead-recycling-push/2228990.aspx www.abc.net.au/news/2011-07-27/hunter-recycling-park-promises-to-be-world-first/2811900 www.ecomagination.com/australia-enjoys-a-day-at-the-park	

Origin

The Hunter Industrial Ecology Park is a privately funded initiative from Weston Aluminium aiming at implementing innovative recycling technologies in the New South Wales state.

Objectives

The park planning includes more than 12 companies and may process about a million tons of raw waste per year, with less than 5% ending up as landfill. The recycling cluster would take in products such as electronic and chemical waste, coal wash residue, power station ash and carpet cut-offs and turn out products for use in road, rail and drainage construction, the building industry and as fuels. The water will also be recycled. There are also plans for an energy recovery plant, which would recycle the methane byproduct of landfill waste into fuel.

Success factors

The main success factors would be its clear designation as an *Eco-Innovation Park* and the *diversity* of recycling technologies.

Perspectives

The construction of the park is planned over three stages. If the project overcomes the administrative procedures and the financing hurdles, the first stage would be complete in 2013.

Park no. 118: Kwinana Industrial Park

Australia

Geography	Australia, Western Australia, Kwinana	
Type of park	Industrial	
Size of park	12 000 ha	3600 jobs
	15 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(Van Beers et al. 2007); (Harris 2007); (Van Beers 2008) Internet links www.kic.org.au	

Origin & Objectives

Dominated by heavy process industries, Kwinana Industrial Area – the oldest industrial area of Western Australia – plays a very important role in the economy of the region and in the local community. Established in 1991, the Kwinana Industries Council (KIC) addresses a broad range of issues common to Kwinana's major economic players. The air and water monitoring to guarantee the protection of adjacent sensitive marine environment, regional economic impact and material and energy flows studies are of major concerns. The Kwinana Industries Synergies Project was initiated by KIC in the early 2000's with the support of governmental financing.

The industrial area hosts various economic sectors ranging from manufacturing and construction facilities to high technology chemical and biotechnology plants and large resource processing industries. Van Beers et al. (2007) identified 47 existing synergies in 2007 which concerned large volume of inorganic residues (e.g. fly ash, bauxite residue, gypsum), non processed waste (e.g. collection and recycling of dry recyclables), energy and greenhouse gas emissions (reuse of low grade heat and sharing of energy efficiency practices among Kwinana companies) and water conservation. Nevertheless, it appears that all identified potentials were not fully realized.

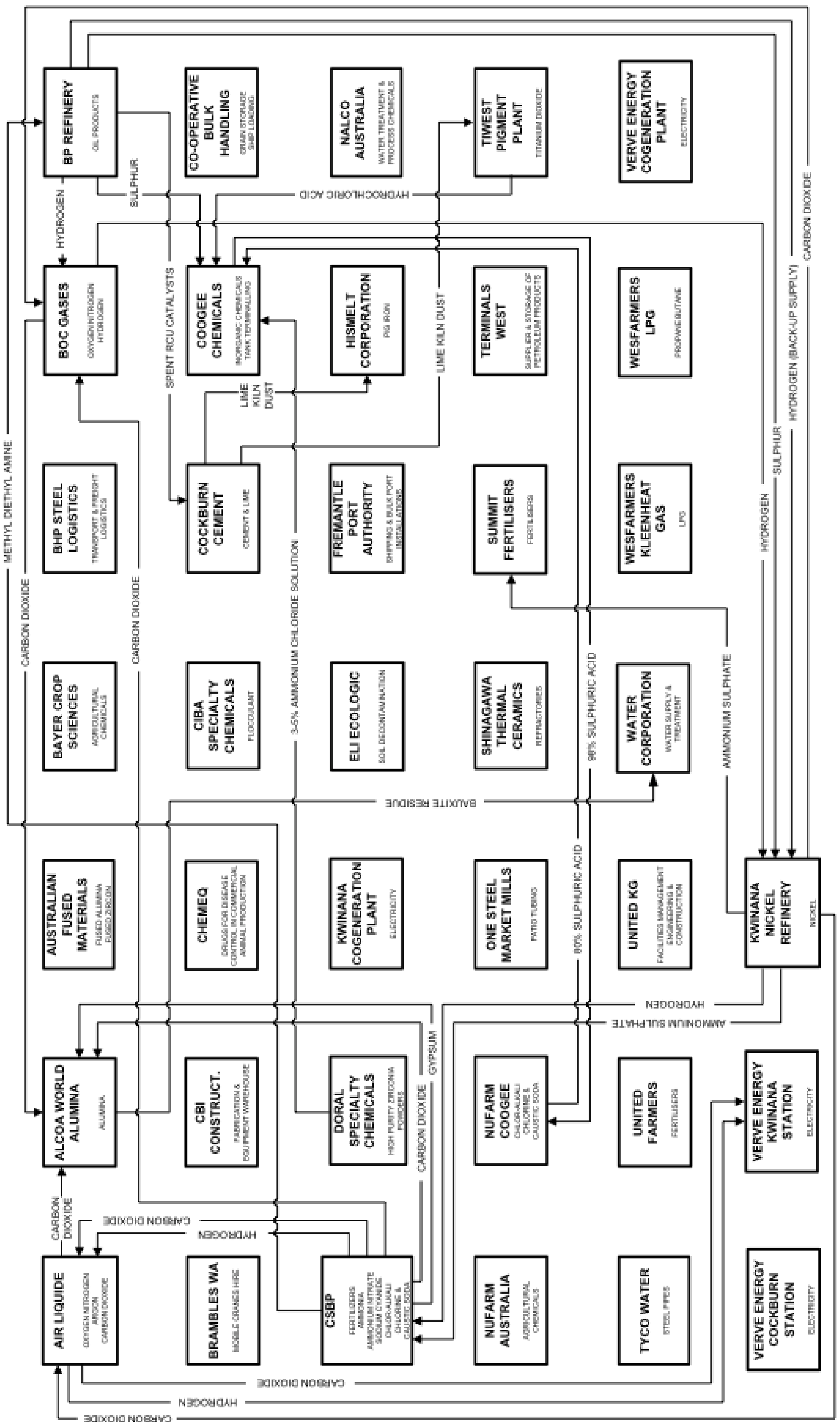
Success factors

Kwinana Eco-industrial Park stands out with regard to the number, diversity, complexity and maturity of existing synergies. The local community expectation with regard to environmental and safety performance, obsolescence of existing process equipment and collaboration between KIC and the Center of Excellence in Cleaner Production from Curtin University of Technology are major success factors. The main success factors are therefore economic *value added*, *coordinators*, *cooperation with science and technology institutions* and clear designation as an *Eco-Innovation Park*.

Perspectives

Future developments are unknown.

Fig. 39 > Industrial symbioses in the Kwinana Industrial Area



after Van Beers 2008

Park no. 119: Port Melbourne Industrial Area

Australia

Geography	Australia, Victoria, Melbourne	
Type of park	Industrial	
Size of park	458 ha	N/A jobs
	9 companies	14 000 inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leader	Private	
References	(Giurco et al. 2011); (Kazaglis et al. 2007) Internet links www.smartwater.com.au/knowledge-hub/resource-recovery/industrial-ecology/identification-of-industrial-ecology-opportunities-in-melbourne.html, www.awa.asn.au/VicAwards2010.aspx	

Origin

Giurco et al. (2011) describe the origin of the initiative of Port Melbourne as a project addressing urban water scarcity due to ongoing drought and increasing population. The project team includes the Institute for Sustainable Futures (ISF) from the University of Technology of Sydney, the Center for Sustainable Resource Processing (CSRP) from the Curtin University of Technology, the University of Melbourne and the Royal Melbourne Institute of Technology (RMIT). The project is supported by the Victorian Smart Water Fund since 2007 and aims at exploring the potential for industrial ecology opportunities in Melbourne.

Objectives

Detection of potential industrial symbiosis was already ongoing for several years when the project begun. Companies involved are majors Australian companies operating in various manufacturing sectors like food production, plasterboard production, automotive and metal component manufacture, printing and concrete production. Water recycling is the first objective of the above-mentioned project. According to the project team, this initial action may encourage economic players to pursue their efforts to reduce impacts related to energy and waste.

Success factors

The project seems to be in its early stages of implementation. The success factors that could already be highlighted are the companies' commitment to exploring industrial symbiosis: the increasing cost of water and energy is perceived as a strong motivation to explore saving options (*economic value added*). The high *diversity of businesses* and the *cooperation with science and technology institutions* are also strong assets for the success of the project.

Perspectives

According to the Smart Water Fund, " the project led to the formation of a Port Melbourne Industrial Ecology Working Group, which aims to further identify and develop opportunities (*coordinators*). It brings together the participating companies, South East Water (Melbourne state-own water provider), the EPA and Sustainability Victoria and a 'Sustainability Covenant' is currently being developed, and negotiation on the governance structure is currently underway ". In 2010, the Australian Water Association awarded South East Water for its Industrial Ecology Program. However, the park still is in early development stages.

Park no. 120: Synergy Industrial Park

Australia

Geography	Australia, Queensland, Carole Park (Brisbane)	
Type of park	Industrial	
Size of park	37 ha	N/A jobs
	N/A companies	N/A inhabitants
~~Eco-criteria~~	~~Renewable energy~~ Energy efficiency ~~Waste management~~ Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(Roberts 2004) Internet links www.dsdip.qld.gov.au/land-for-industry/synergy-park.html	

Origin

The first Eco-Industrial Park to be built in Australia originated from a Queensland government program to give a boost to over 640 ha of land acquired in the 1960's to develop a large industrial district with the intent of attracting large-scale manufacturing and assembly industry development. The 1990's economic crisis led the government to promote an integrated industrial development hoping to enhance the industrial estate's economic attractiveness. Thus, a private-public partnership allows the planning and development of the Synergy Park in 1998 based on eco-industrial development concept. Private partners were investors in the food and beverage sector and stakeholders interested in infrastructure provision and waste management.

Objectives

The objective of the Eco-Industrial Park is to reduce establishment and operational costs whilst together with energy efficiency (co-generation plant) and water use reduction (onsite segregation of effluents to favor reuse). The government also advocated the use of shared infrastructures and clustering to create synergies between businesses. A central warehouse was built to allow shared logistics and controlled movements of vehicles.

Success factors

The success factors of the project were the financial *incentives* from the state and local governments – for planning, services and infrastructures, the *coordinators* – through the organization of public consultation, the *economic value added* opportunities and the *clear designation of the industrial area as an eco-innovation park.*

Perspectives

The authors found no recent data about the development of the Synergy Park of Carole Park.

3.2 China

In response to alarming resources and pollution issues resulting from its growing economy, the current national development strategy in China is to implement "scientific development through ecological innovation" (Wu 2012). A complex institutional framework including various environmental laws (on Cleaner Production, energy, etc.) support it (China Environmental Law 2013). Among them, the law on Circular Economy (adopted in 2008), largely based on the industrial ecology approach, fosters the establishment of collaboration networks and eco-industrial park development. Since the late 1990s, China seriously explored the potential of eco-industrial development, a concept introduced in various research programs with a strong support from central government (Geng et al. 2007; Zhang et al. 2010). The objective is to boost both economic and environmental performances through resource efficiency schemes, including energy cascading, waste recovery, eco-design, etc.

Programs to implement industrial ecology and circular economy approaches have been conducted for more than a decade. Noticing the ineffectiveness and high cost of end-of-pipe measures to reduce pollution, the State Environmental Protection Administration (SEPA, predecessor of the Ministry of Environmental Protection established in 2008) fostered a more integrated approach through the development of eco-industrial parks (Shi et al. 2012). In 2001, SEPA initiated four large demonstration projects in Dalian, Tianjin, Suzhou and Yantai; in 2006, the agency released "the first national standard to guide eco-industrial parks in the world" (Geng et al. 2008). In 2005, the National Development and Reform Commission (NDRC) launched the first batch of pilot demonstration projects dedicated to the implementation of circular economy.

Today, dozens of national demonstration parks, areas or regions and hundreds of similar projects are being developed across the country. Only a small selection of these initiatives is presented in this report. ISO 14001 certification at the company scale is often the first step in the development of these projects (Saikku 2006). Most of these initiatives are led and monitored by central and local governments or large state-owned companies. Moreover, through eco-industrial projects, firms can obtain various financial and administrative supports, such as low rate loans, tax relief, and priority in land supply (Mathews et al. 2011).

Local governments are also promoting the development of 'eco-cities' (two cases are presented below: Caofeidian and Tianjin). More than 100 municipalities are proposing to build such "eco-cities", "eco-towns" or "low-carbon cities" (Wu 2012), but few of them offer concrete and conclusive results so far (Liu 2013). One of these prominent projects, Dongtan Eco City (near Shanghai) was expected to house some 500 000 people in 2040. But it has been widely criticized because of its location (large bird reserve) and the allocation of arable land for non-agricultural purposes (Danish Architecture Centre 2013). Nonetheless, it remains an interesting (and costly) planning experience that inspired other developers of similar projects around the world.

No significant or relevant data on the following potential eco-innovation parks is detailed in the literature at the time of this review:

- China Dalian Sino-Ocean Goldstone IT Industry Park
- Shandong Rizhao Economic Development Zone
- Swiss-China EIP Zhenjiang
- Taicang Xintai Alcohol Distillery Co., Ltd.
- Wuxi New District
- Xinzhuang Industrial Zone
- Yantai Economic and Technological Development Zone

Park no. 121: Beijiang Power Plant Complex

China

Geography	China, Tianjin	
Type of park	Industrial	
Size of park	142 ha	N/A jobs
	4 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(Li 2011) Internet links www.mckinseyquarterly.com/How_green_are_Chinas_cities_2734	

Origin & Objectives

Located in Tianjin's Binhai New Area and built in a saline wasteland, the Beijiang Power Plant complex is presented as an example of resource efficiency regarding water management, energy management and land conservation. The project's first phase was launched in 2005 by the city to construct two 1000 MW generators providing about 200 000 m³ of freshwater a day as a co-product of power generation and desalinization processes.
In addition to power generation, the complex houses a desalinization system, a sea salt production unit and a chemical plant. A symbiotic network has been established onsite that includes waste heat recovery and by-products exchange (like use the coal ashes for brick production). The Beijiang Plant signed agreements with building material companies to ensure a 100% ash recovery. Moreover, the use of thick saltwater saves 22 km² of salt pond areas.

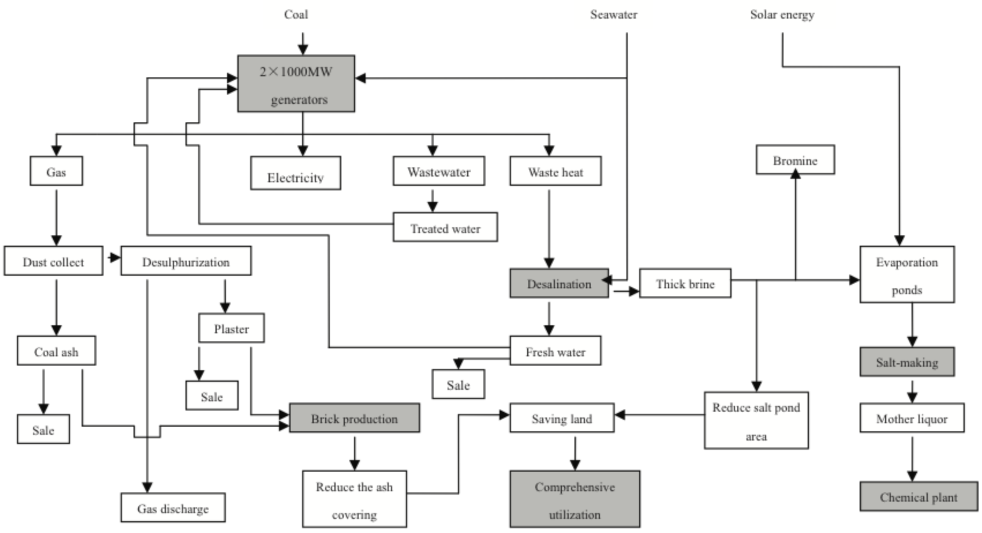
Success factors

Along with *coordinators* (PPP) and *economic value added*, *location* is a key success factor for this project: the complex has been planned to ensure main complementary industries are located near to each other.

Perspectives

Phase two began in 2010 and will add two more similar 1000 MW units. According to McKinsey "the whole system is expected to provide 400 000 tons of fresh water a day, as well as 11 billion kWh of power, 450 000 tons of salt, and 60 000 tons of minerals a year".

Fig. 40 > Eco-industrial chains of Bejiang Power Plant Complex



after Li 2011

Park no. 122: Caofeidian Eco-city

China

Geography	China, Hebei, Tangshan	
Type of park	Combined	
Size of park	15 000 ha	N/A jobs
	N/A companies	1000'000 inhabitants (planned)
Eco-criteria	Renewable energy Energy efficiency Waste management Water management Biodiversity ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leader	Public	
References	(Mühlberger De Preux 2012) Internet links www.en.tswstc.gov.cn/, www.swecogroup.com/en/sweco-group/Solutions/Sustainable-City/The-new-Caofeidian-eco-city-will-be-climate-neutral/	

Origin

Caofeidian Eco-City (or Tangshan Caofeidian Project) is a large urban development project led by the Administrative Committee of Tangshan Caofeidian Industry Zone, which commissioned the Swedish consulting group Sweco to perform an analysis and elaborate a strategy for the sustainable planning of the first development phase. This project is part of the first batch of circular economy pilot areas, launched in 2005 by the central government.

Objectives

According to its promoters, the City will be climate-neutral, develop its own water supply system and use up to 95% of renewable energies, including wind and solar power, as well as biogas produced from organic waste recovery. 80% of the wastewater will also be reused. To monitor the city's sustainable development, a 52-indicator system has been designed. Also, an "eight-dimension" technical system is being constructed and comprises the following: water use and disposal, waste management and recovery, new energy development, transportation security, greening ecology, public utilities, urban landscape, and ecological construction. Besides, the city will also include an ecological park for the conservation and study of adjacent coastal biotopes.

Success factors

The project is located in a coastal area connected to quick and low-cost national and international transportation systems, including railways networks with Chinese adjacent major cities like Beijing and Tianjin as well as international waterways (*location*). Caofeidian is clearly designed as an "Eco-City" (*Eco-Innovation Park*) and benefits from strong political support (*policies*) and leadership (*coordinators*). Moreover, its promoters aim to attract a large *diversity* of economic activities, including technology research and development, leisure and exhibition, finance and trade, technical services, education and training, and urban services.

Perspectives

The first part of the project (30 km²) will host 400 000 inhabitants and should be completed in 2020. Eventually, the city should reach a population of 1 million covering an area of 150 km². Unfortunately, little information is available regarding the project's current concrete progress.

Park no. 123: Dalian Development Area (DDA)

China

Geography	China, Liaoning, Dalian	
Type of park	Combined	
Size of park	8000 ha	186 000 jobs
	N/A companies	600 000 inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	Under construction	
Project leader	Public	
References	(ISIE, 2010b) Internet links www.amlinkint.com/English/business-setup/industrial-park-list/dalian.html www.chinadaily.com.cn/m/dalian/2010-06/10/content_9962369.htm www.english.dda.gov.cn/Business/	

Origin

Dalian Development Area (DDA, formerly Dalian Economic and Technological Development Zone) was established in 1984 as the first national economic and technological development area and is certified with ISO 14001 since 1999. It became an "ISO 14000 National Demonstration Zone" in 2000 and fosters several projects of eco-industrial development.

Objectives

Major sectors currently operating in the area are petrochemical industry, electronic & information, software industry, advanced equipment manufacturing and shipbuilding. Other important industries are bioengineering and pharmaceuticals, auto parts and food processing. The DDA administration encourages energy saving and environmental friendly projects and set up the Dalian National Eco-Industrial Park. The construction of this park of 1200 ha began on June 2010. It represents a total investment of CNY 15 billion (about USD 2.4 billion) and will develop waste recycling and recovery industries in the area.

Success factors

DDA benefited from preferential policies for coastal economic and technological development area as well as from the NDRC program to rejuvenate Northeast China. Key success factors are therefore *policy*, *diversity* and *location*, with the availability of several ground, air and water ways, as well as the clear designation as an *Eco-Innovation Park*.

Perspectives

According to the DDA website, "key directions of industrial development in the near future are the manufacture, research and development of hi-tech industry, the port transportation industry and the logistics industry." Concerning the Dalian National Eco-Industrial Park, it was supposed to be operational with 50 companies by the end of 2010, but this information could not be verified.

Park no. 124: Dezhou Solar Valley

China

Geography	China, Shandong, Dezhou	
Type of park	Combined	
Size of park	330 ha	800 000 jobs
	>120 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leader	Public	
References	(Grobbelaar 2012) Internet links www.chinasolarcity.cn/Html/dezhou/index.html, www.inhabitat.com/china-building-the-biggest-solar-energy-production-base-in-the-whole-world/dezhou-solar-valley-2/	

Origin

Dezhou is the largest solar thermal R&D centre in China. It accounts for 16% of the national solar thermal market with annual sales revenue of USD 19 billion (CNY 120 billion). Industry and government have invested over USD 740 million in Dezhou to set up this world-leading hub, known as the “Solar Valley”, which aims to centralize solar technology research and development, manufacturing, education, capacity building and demonstration.

Objectives

The Solar Valley includes companies, but also apartments, parks, educational facilities (including a solar university), tourist attractions, as well as a sports and entertainment complex. Various solar technologies are developed and incorporated on site, such as solar water heating, desalination, and air conditioning. Solar water heaters are installed in 95% of new urban communities in Dezhou, and 50% of surrounding towns. Solar electricity is also widely used for street lighting, and for powering buildings and tourist buses. Besides, there are approximately 40 energy efficient buildings in Dezhou, and the headquarters of the world’s leading manufacturer of solar thermal tanks (Himin) is currently the largest solar-powered office building in the world. Moreover, an Energy Management System (EnMS) has been introduced in 8 key energy-consuming companies. As a result of this EnMS pilot programme, according to UN-Habitat (2012), 63 000 tons of coal and the equivalent of 160 000 tons of CO_2 emissions have been saved.

Success factors

The role of the government as a facilitator, investor and promoter working closely with large solar industries clearly is an important success factor for this cluster (*coordinators*). Dezhou Solar Valley also benefits from recent *policies* in China (including *incentives*) that clearly foster solar energy development in the short term, with ambitious objectives for 2015 and 2020. The strong links between industries and research centers also represent a significant success factor (*cooperation with S&T*). In this context, developing and manufacturing solar technology in the Solar Valley is clearly a very profitable business (*value added*).

Perspectives

The Dezhou Solar Valley is still under construction and, according to UN-Habitat (2012), to date no formal evaluation of the project has been conducted.

Park no. 125: Ecopark Hong-Kong

China

Geography	China, Hong-Kong	
Type of park	Industrial	
Size of park	20 ha	N/A jobs
	6 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management ~~Water management~~ Biodiversity ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ Air pollution prevention Noise prevention ~~Environmental Mgmt System~~
Status	Under construction	
Project leader	Public	
References	Internet links www.epd.gov.hk/epd/english/environmentinhk/waste/prob_solutions/eco_front.html www.ecopark.com.hk/en/index.aspx www.wastereduction.gov.hk/en/household/source_intro.htm	

Origin & Objectives

EcoPark is the first cluster in Hong-Kong for waste recycling and environmental engineering. It was mainly designed to contribute to the government new waste management strategy (2005–2014) and promote the local recycling industry.

The park currently houses industries operating in reuse and recycling activities for various types of wastes: cooking oil (converted into biodiesel), waste electric and electronic equipment (WEEE), metals, plastics, wood, car batteries, rubber tires and construction materials. Tenants have to comply with the park's environmental covenants including inter alia waste, polluting emissions and noise management requirements. Besides, EcoPark includes "green" infrastructures and equipment: various recycled materials for footpaths and roads (e.g. "air pollutant removal" paving blocks), green roofs, solar fin system, a 240-panels solar array, sun pipes to diffuse natural light into the office buildings, etc.

Success factors

EcoPark benefits from a strong political support and funding from the Environment and Conservation Fund. Moreover, its administration requires regular reports from the tenants and audits their performance in terms of compliance with the park covenants. Success factors are therefore *policy* and *coordinators*. Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

The park is still in its early development and is currently looking for more tenants to incorporate.

Park no. 126: Guitang Group

China

Geography	China, Guangxi, Guigang	
Type of park	Industrial	
Size of park	14 700 ha	3800 jobs
	7 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(Fang et al. 2007); (Geng et al. 2007); (Chertow 2007); (Shi et al. 2010); (Zhang et al. 2010) (Mathews et al. 2011); (Shi et al. 2012) Internet links www.ethipedia.net/len/node/861 www.eoearth.org/view/article/151922/	

Origin

Originally a large state-owned sugar-refining company founded in 1954, the Guitang Group progressively evolved into an industrial complex producing various new outputs with its own by-product streams, mainly molasses (sugar refining residue) and bagasse (fibrous waste from sugar cane). It was the first national eco-industrial park designated by the central government in 2001.

Objectives

The objective of the Guitang Group is to reduce pollution and disposal costs and to seek more revenues by utilizing by-products. It is composed of several industries that share resource and energy flows under a common corporate management. In addition to refined sugar, they produce pulp and paper, ethanol, fertilizer, calcium carbonate (for cement production), and alkali. The bagasse is also partially recovered for the cogeneration of heat and power. Moreover, Guitang Group implemented a wastewater reuse program and reduced freshwater consumption by 40% and wastewater emission by 51% to the year 2007. According to Zhang and Yuan (2010), “National Pilot EIPs such as Guitang Group offer good examples of resource-conserving, environment-friendly industrial parks, and provide valuable experience for further establishment of similar parks”.

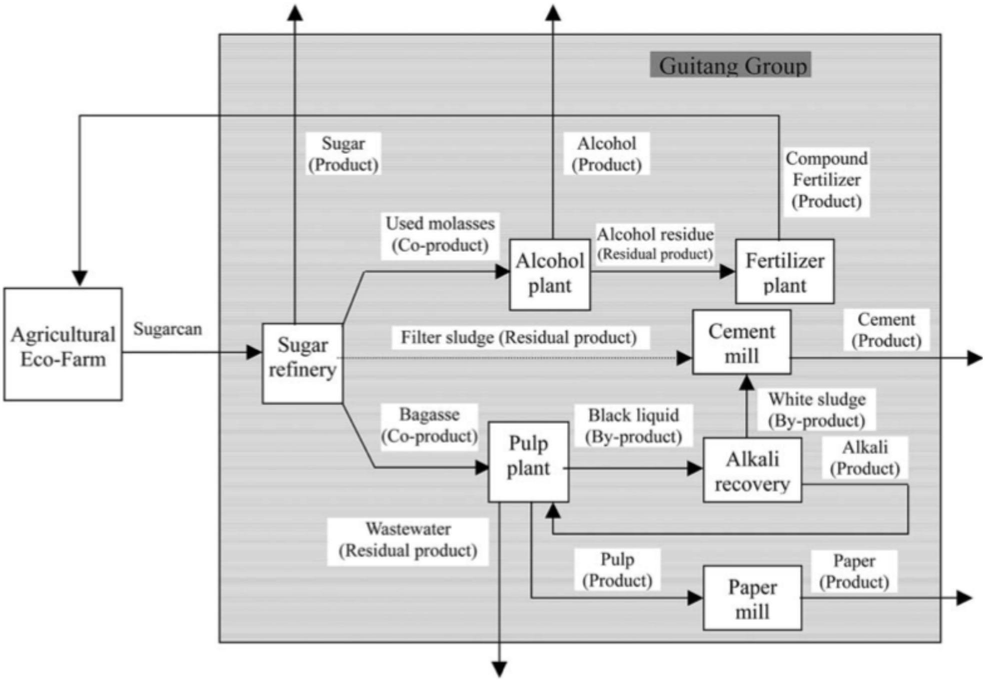
Success factors

The financial benefits are significant for the Group thanks to waste recovery, resource efficiency and reduced costs for waste disposal. *Value added* is therefore a prominent success factor, along with *policy*, *location* and the *clear designation as eco-industrial park.*

Perspectives

Future developments are unknown.

Fig. 41 > The Guitang Group Industrial Symbiosis



after Zhu et al. 2004

Park no. 127: Lubei National Eco-industrial Demonstration Park

China

Geography	China, Shandong, Wudi	
Type of park	Industrial	
Size of park	40 000 ha	5300 jobs
	52 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency ~~Waste management~~ Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Fang et al. 2007); (Mathews et al. 2011) Internet links www.eoearth.org/view/article/151922/ www.lubei.com.cn/ (in Chinese) www.ie.tudelft.nl/index.php/Lubei_National_Eco-industrial_Demonstration_Park	

Origin

The Lubei Park is a large chemical site that has developed complex industrial symbioses network in the framework of the national circular economy strategy.

Objectives

Synergies have been implemented within the production processes of the different entities. For example, a sulfuric acid plant uses high sulfur coal to produce sulfuric acid (partly sold, partly fed into an ammonium phosphate plant) and coal slag, a by-product recovered for cement production. Other synergies include water and energy cascading and numerous by-product recovery schemes (Fig. 42).

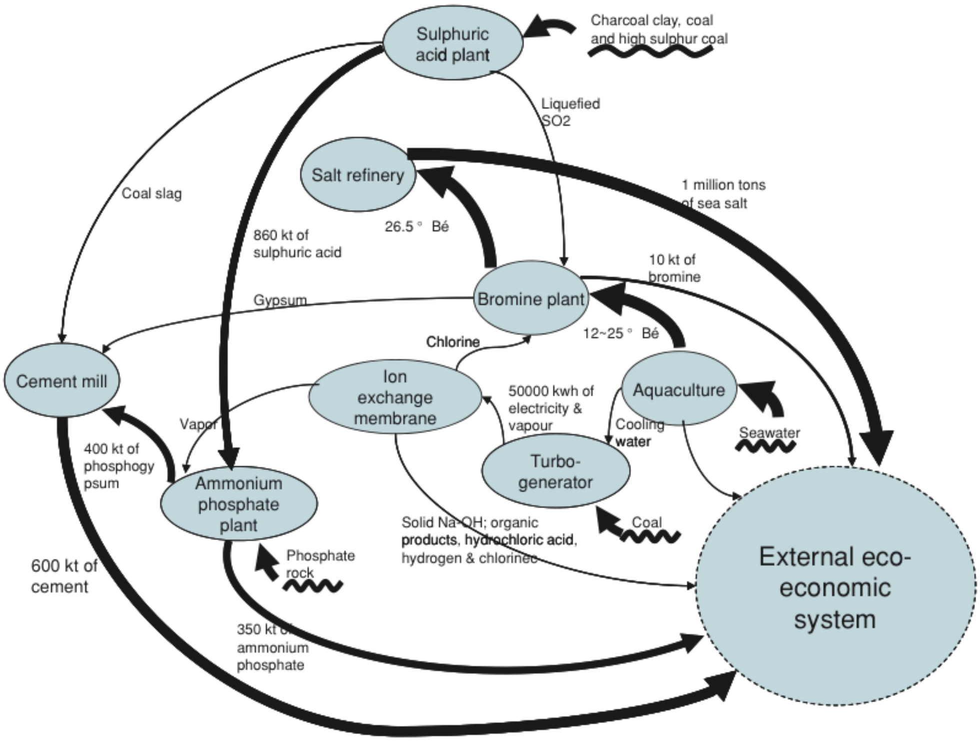
Success factors

The Lubei Group (state owned) achieved significant savings thanks to these measures (*value added*) and benefits from a strong government support (*policy*). Designation as *Eco-innovation park* and the *diversity* of economic activites are also relevant success factors for this park.

Perspectives

A website is regularly updated and provides news about the park development. This website is only available in Chinese.

Fig. 42 > Selected industrial symbioses in Lubei Industrial Park



after Mathews et al. 2011

Park no. 128: Qingdao New World Eco-Industrial Park

China

Geography	China, Shandong, Laixi (Qingdao)	
Type of park	Industrial	
Size of park	500 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leader	Public	
References	(Mathews et al. 2011) Internet links www.qdxtd.com.cn/ (in Chinese) www.rightsite.asia/en/article/green-development-zones-take-root	

Origin

Qingdao New World Eco-Industrial Park approved by SEPA in 2006 was set up as a resource recovery and waste treatment center. Unlike most existing industrial areas in China that participate in national demonstration programs, it has been purposely designed and built as an eco-industrial park.

Objectives

The park promotes recycling through by-products exchange and waste recovery between enterprises (both inside and outside the park), and includes systems for solid wastes reuse, treatment and disposal, as well as a regional hazardous waste disposal center. It was awarded with ISO 14001 certification in 2006.

Success factors

The Qingdao New World Corporation and the Chinese Research Academy of Environmental Sciences have jointly set up the National Environmental Protection Research Center for Solid Wastes Reuse Technologies. The Center's focuses on several research domains including recycling, solid waste treatment, hazardous waste identification, techniques for recovering polluted soil, and new energies. Success factors for the park development are therefore *policy*, *coordinators*, *cooperation with S&T* and *Eco-innovation park.*

Perspectives

Current status is unknown, as the park website (in Chinese) only details its development process until 2008.

Park no. 129: Shenyang Tiexi eco-industrial park

China

Geography	China, Liaoning, Shenyang	
Type of park	Industrial	
Size of park	12 600 ha	N/A jobs
	47 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	Cultural, social, health ~~benefits~~ ~~Mobility, transport~~ Land use optimization Air pollution prevention Noise prevention ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Fang et al. 2007); (Dai 2010) Internet links www.guardian.co.uk/environment/2011/oct/17/smoggy-chinese-city-green www.ie.tudelft.nl/index.php/Shenyang_Tiexi_New_District_EIP_Initiative www.mckinseyquarterly.com/How_green_are_Chinas_cities_2734	

Origin & Objectives

Shenyang is famous in China for its heavy industry (including several large iron and steel plants) and the severe pollution it generated. During the last two decades, the city took several measures to improve its environment, removed this type of industrial activity from its core (many obsolete facilities were closed) and redeveloped the brownfield zones, including the Tiexi District. In 2002, in response to environmental concerns and resource shortage, the government of Shenyang invited the *Environmental Research Institute* of Shenyang, Tongji *University*, and EU–Liaoning Shenyang Urban Layout Office to design the Shenyang Tiexi eco-industrial park.

After a first phase of demolition and soil decontamination, new businesses including various industrial sectors have settled in the area. According to Fang (2007): "9 industrial lines and recycling networks were set up among 47 important enterprises. This was achieved by moving, changing and regrouping, as well as adjusting the industrial structure and layout of the processes. Material flow, energy flow, technology integration, information and infrastructure were shared among them." The Fig. 44 provides more specific examples of resource flows established in the park.

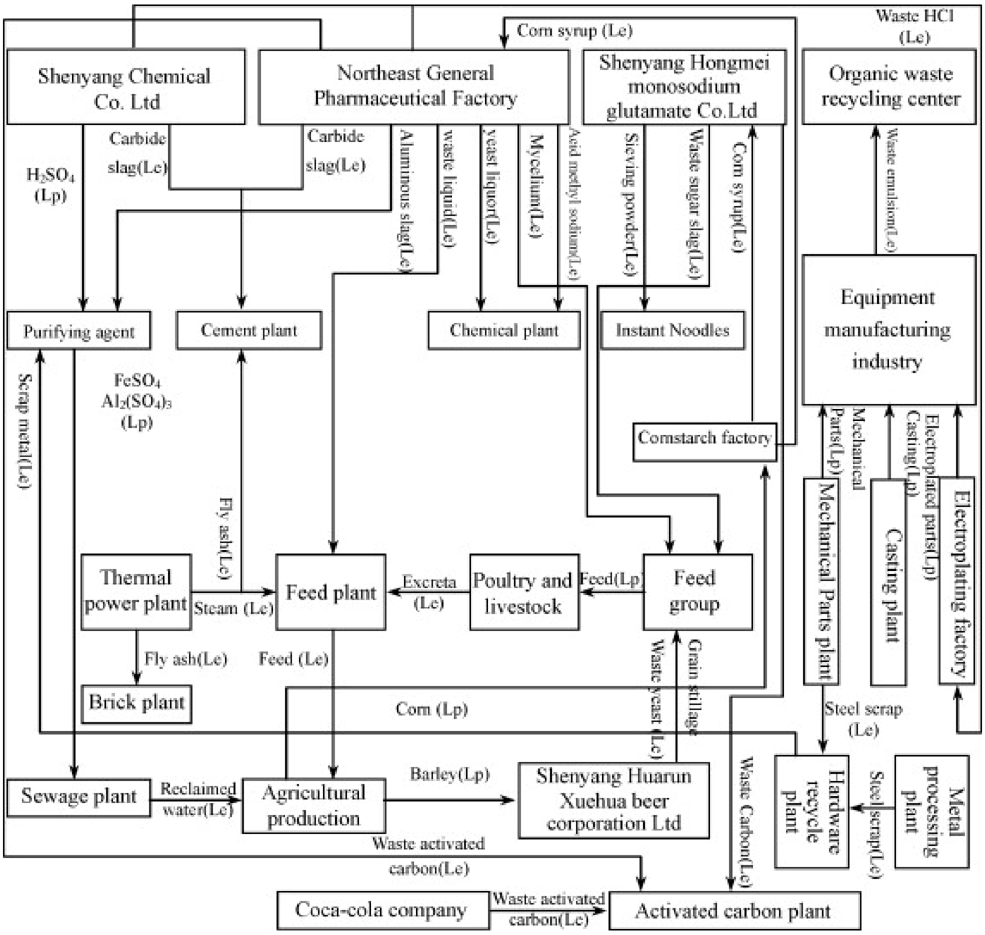
Success factors

In addition to a strong political support from municipal construction and development ministries and district-level governments, the local environmental protection bureau established a citizen complaint line for air and noise pollution to incorporate people participation in the city reconstruction schemes. Success factors identified for this park development are *policy*, *coordinators*, *cooperation with S&T*, *diversity* and *Eco-innovation park.*

Perspectives

Despite some interesting achievements, the park seems still in its early development phase, and many measures could be taken to further improve its environmental performance.

Fig. 43 > Resource flows in the Shenyang Tiexi EIP



after Dai 2010

Park no. 130: Suzhou Industrial Park

China

Geography	China, Jiangsu, Suzhou	
Type of park	Combined	
Size of park	28 800 ha	N/A jobs
	N/A companies	950 000 inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leader	Public	
References	(Zhang et al. 2010); (Mathews et al. 2011) Internet links www.sipac.gov.cn/english/news/ www.sipac.gov.cn/english/categoryreport/InfrastructureAndEcology/201203/t20120306_141783.htm	

Origin

A cooperation project between China and Singapore established the Suzhou Industrial Park (SIP) in 1994. SIP was approved in 1999 as the first National ISO14000 Demonstration Area and firms in the park began to establish eco-industrial linkages in 2002. The park was designed as one of the Circular Economy Pilot Projects in 2005.

Objectives

In addition to local companies, 2400 foreign-funded businesses have settled in the area. They operate in various sectors: chemical, pharmaceutical, health care, machinery, electronics, information technology, and software. Several measures have been implemented to improve their performances: integrated value chain scheme, e-waste recycling and by-product recovery. Some industries in the park seems to achieve ecological standards tens of times superior to national levels in terms of chemical oxygen demand (COD) and sulfur dioxide (SO_2) emissions. The park also built the largest gas-fired combined cycle CHP plant in the country. It produces power, serves as district heating, and reuses treated wastewater for cooling.

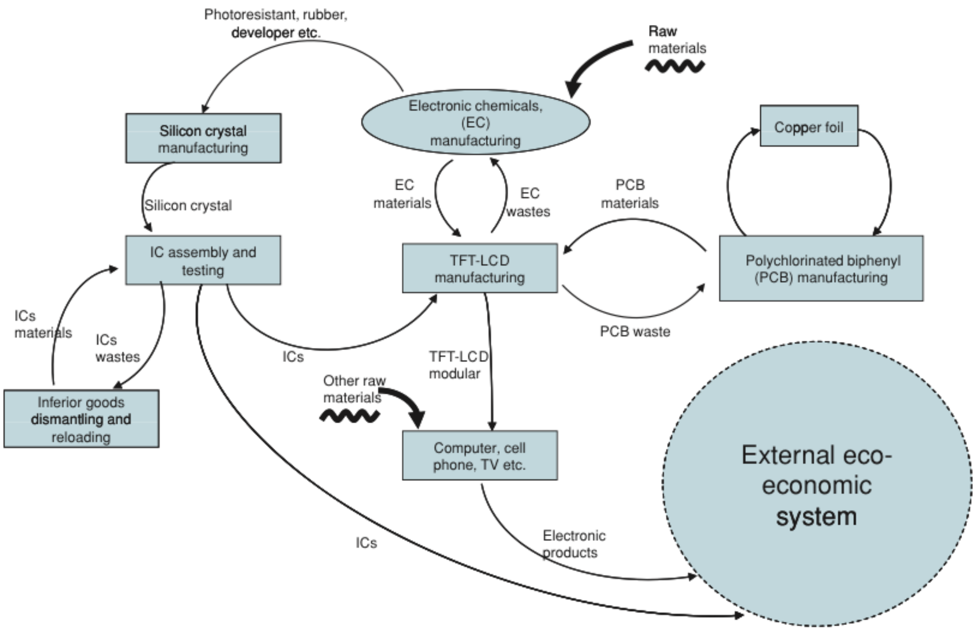
Success factors

In 2008, SIP and the Suzhou New and Hi-tech Industrial Development Zone were both recognized as two of the first three approved EIPs in China (*Eco-Innovation Park*). Moreover, an evaluation released by Ministry of Commerce ranked SIP n°1 (for 3 consecutive years) in terms of environmental protection, energy conservation and emission reduction among the 90 national-level development zones. Success factors for SIP development are mainly *policy*, but also *coordinators*, *diversity* and *location*.

Perspectives

The park was recognized 2011 as a National Pilot Park in Building Ecological Civilization and they are currently working on an ecological optimization plan including goals as developing economy, happy life, beautiful environment, harmonious society and civilized behaviors.

Fig. 44 > Selected industrial symbioses in Suzhou Industrial Park



after Mathews et al. 2011

Park no. 131: Tianjin Eco-City

China

Geography	China, Tianjin	
Type of park	Combined	
Size of park	3000 ha	N/A jobs
	N/A companies	350 000 inhabitants (expected)
Eco-criteria	Renewable energy Energy efficiency Waste management Water management Biodiversity ~~Material flow~~	Cultural, social, health benefits Mobility, transport Land use optimization Air pollution prevention Noise prevention ~~Environmental Mgmt System~~
Status	Under construction	
Project leader	Public	
References	(ISIE, 2011c) Internet links www.tianjinecocity.gov.sg/, www.tianjinecocity.gov.sg/events/2012/20120305.htm www.tianjinecocity.gov.sg/events/2012/20120301.htm , www.tianjinecocity.gov.sg/bg_kpis.htm www.scientificamerican.com/article.cfm?id=chinas-city-of-the-future-tianjin-rises-on-wasteland	

Origin

In 2008, the coastal area where the Tianjin Eco-City is being developed was a wasteland. Since then, the Chinese and Singapore governments launched a joint initiative to restore the soil, decontaminate the waterways and build a sustainable city supposed to house 350 000 people by 2020 and become a model for replication.

Objectives

The city planners focused on several aspects: water management (pipeline leakage monitoring, rainfall and grey water recovery), building insulation, renewable energies (solar, wind and geothermal), energy-saving solutions for urban lighting (in collaboration with the Dutch firm Philips), waste management (with a planned underground pneumatic piping network, using air pressure to move urban waste), etc. Carbon-intensive industries are banned from the city. In 2010, nearly half the investments for the city development came from Singapore clean-tech companies (green manufacturing, waste management and recycling, etc.). Regarding mobility, urban planning is designed to foster walking, cycling and public transports.

Success factors

Key success factors identified are *policy*, *incentives*, *coordinators* and *cooperation with S&T*. City planners launched several incentive programs to attract clean tech R&D in the city and the project benefit from a very strong political backing. Moreover they will monitor and assess the city development with a set of “Key Performance Indicators” focusing on various social and environmental dimensions: water, air and noise pollution, nature conservation, green buildings, waste management, affordable housing, public amenities, health, renewable energies, etc. Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

After four years of development, the first companies and residents have settled in Tianjin Eco-city, and on 5 March 2012 the first public housing have been opened for application (only for those working in the Eco-city and with an annual family income not exceeding USD 19 000). Besides, Keppell Corporation (Singapore) has plans to establish an integrated logistics distribution center and to conduct water and wastewater projects in the city. Although the developers’ objectives are very promising, the economic viability (investment costs, housing costs) of Tianjin Eco-city schemes, however, is questioned in the literature.

Park no. 132: Tianjin Economic & Technical Development Area (TEDA)

China

Geography	China, Tianjin	
Type of park	Combined	
Size of park	8100 ha	356 000 jobs
	>14 000 companies	159 500 inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ Environmental Mgmt System
Status	In use	
Project leader	Public	
References	(Geng et al. 2008); (Zhang et al. 2010); (Shi et al. 2010); (Mathews et al. 2011); (Shi et al. 2012) Internet links www.en.investteda.org/FactsFigures/ www.en.investteda.org/whyteda/ecologicalenvironment/default.htm	

Origin

The Tianjin Economic-Technological Development Area (TEDA) was established in 1984 and is one of the first three eco-industrial areas approved by the State Council. The objective was to create a leadership in recycling and green manufacturing. Since the early 2000s, TEDA started to incorporate circular economy principles at the industrial park level and become one of the first pilot demonstration areas.

Objectives

Various industrial symbioses were established -some of them spontaneously, for economic purposes– between the park tenants and firms outside TEDA; they include water and energy cascading, waste recovery and by-products exchanges. Shi (2010) identified 81 inter-firm symbiotic linkages mainly involving utility, automobile, electronics, biotechnology, food and beverage, and resource recovery clusters. TEDA also includes commercial and residential areas. In 2000, it was granted ISO 14001 certification and designated as one of the National ISO 14000 Demonstration Zones.

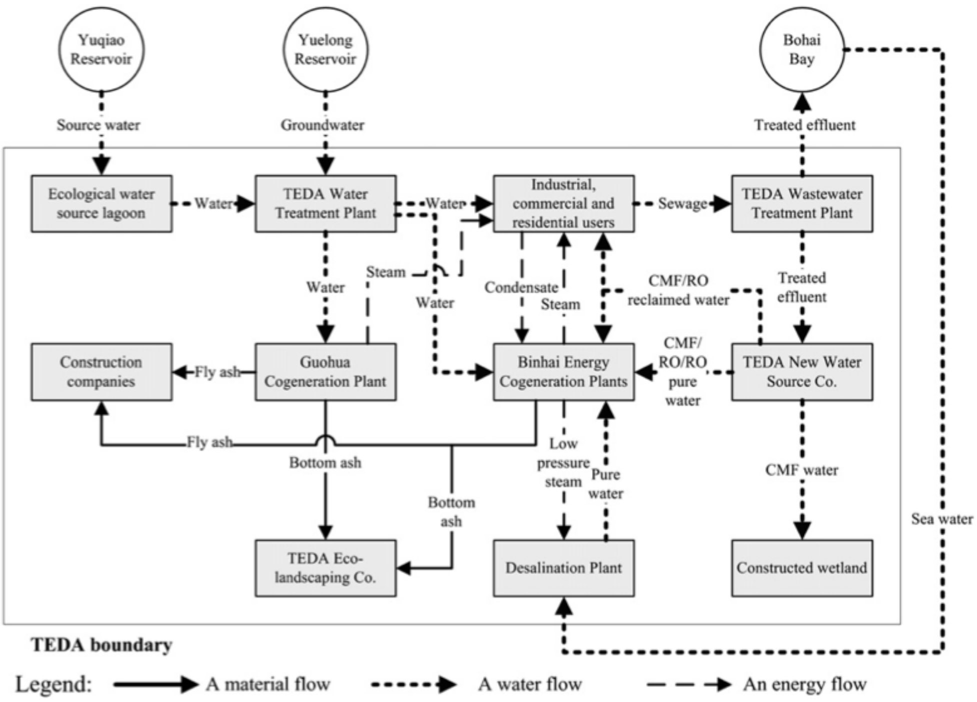
Success factors

Key success factors for TEDA are *value added*, *policy*, *coordinators*, *location*, *diversity* and *clear designation as eco-innovation park*. Many efforts are made concerning communication: TEDA administrative commission publishes a weekly newspaper including environmental news, local and national environmental policies and regulations and register people's complaints regarding environmental concerns. Besides, TEDA has been ranked as the most attractive economic development zone for foreign investment by China's Ministry of Commerce for 10 consecutive years (1998–2007).

Perspectives

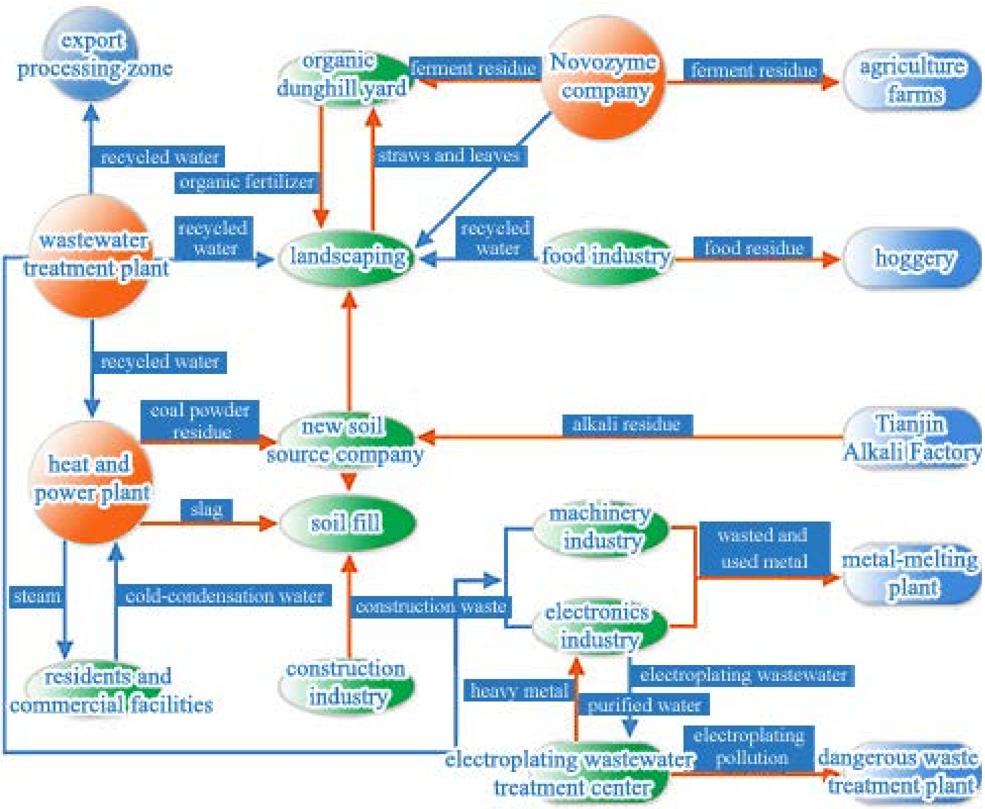
The TEDA website provides plenty of information on its current situation and regularly communicates on new development projects. For now, its eco-innovation activities are still in an early stage of development.

Fig. 45 > Symbiotic exchanges associated with the public utility sector



after Shi et al. 2010

Fig. 46 > Industrial symbioses in TEDA



after TEDA 2013

Park no. 133: Yixing Economic Development Zone (YEDZ)

China

Geography	China, Jiangsu, Yixing	
Type of park	Industrial	
Size of park	1870 ha	N/A jobs
	719 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ ~~Waste management~~ Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Liang et al. 2011) Internet links www.yxedz.com/default.php?mod=c&s=ssebef54f	

Origin

The Yixing Economic Development Zone (YEDZ) was founded in 2006. The water quality in this area is a serious concern and led to a stricter governmental supervision for the zone, including stringent water emission standards. Consequently, tooking measures to reduce the overall consumption and pollution generated by its activities, the YEDZ mainly focused on water resource management.

Objectives

The first development phase includes 1870 ha and involves five main industries: electric circuit, textile and clothes, fine chemical, electro-mechanization and auto parts. In 2007, leading industries present high water consumption and water pollutant emissions. Policies are proposed to improve the situation by 2015 through the implementation of more efficient technologies, but also water recycling and cascading schemes.

Success factors

The main success factors for eco-innovation activities in YEDZ are *policy* and *diversity*.

Perspectives

According to Liang (2011) the proposed policies are feasible and planned synergies could drastically reduce the amount of water pollutants produced by industries.

3.3 India

Environmental issues in India are many: air and water pollution, waste management and wildlife natural habitat conservation. Economic development and growing population are the most recognized causes of India's environmental degradation. Since the late 1980's, the Supreme Court of India is pro-actively committed to solve environmental issues. India made significant progress between 1995 and 2010 in addressing environmental issues and improving environmental quality. New changes in the environmental jurisprudence were introduced under the arising number of public interest litigation and legal actions. New principles to protect environment and re-interpretation of environmental laws were done and new institutions and structures were created (Wikipedia 2013).

Since 2000, local agencies and the German Agency for International Cooperation (GIZ), under the impulsion of the Government of India, launched many initiatives to develop eco-industrial parks: first in the Andhra Pradesh State, one of the leading industrial states of India, then in the State of Gujarat (Vatva and Naroda industrial parks). Other states have also expressed an interest in replicating the eco-industrial park concept (e.g. Maharashtra, West Bengal and Tamil Nadu).

Many others experiences have been identified and reported since 1995 by the Resource Optimization Initiative (ROI) (Roi Resource Optimization Initiative 2013) in the textile, leather, paper and sugar industries in the Tamil Nadu State, the foundries of Haora (West Bengal state) and the Damodar Valley Region (Eastern India) (Erkman et al. 2003).

Recently Manesar City (50 km from New Delhi) announced in 2011 its plans to become " a pilot site for the nation's first eco-city pilot initiative, developed jointly with Japan ". " The objective of this project is to build a new industrial community to maximize the welfare of the people and minimize carbon emissions by integrating technology across water, energy, waste, transportation and safety infrastructures " (ISIE 2010b; MSN 2013).

In December 2011, a consortium of Japanese companies, comprising Toshiba, Tokyo Gas and NEC, have signed a pact with Haryana State Industrial and Infrastructure Development Corporation (HSIIDC) for building 'smart communities' or 'eco cities' in the Delhi-Mumbai Industrial Corridor region (DMIC) (ISIE 2011).

No significant or relevant data on the following potential eco-innovation parks is detailed in the literature at the time of this review:

> Agro Eco Industrial Park, Genome Valley, Hyderabad
> Ankleshwar Industrial Estate
> Dahej industrial park, Gujarat
> GK Industrial Park, Kerala
> Gujarat Industrial parks
> Punjab industrial parks

Park no. 134: Andhra Pradesh Special Economic Zone

India

Geography	India, Andhra Pradesh, Visakhapatnam district, Atcutapuram and Rambilli	
Type of park	Industrial	
Size of park	2300 ha	N/A jobs
	14 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management Biodiversity ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	Internet links www.dw.de/eco-parks-offer-firms-a-low-carbon-road-to-growth/a-6532982-1 www.giz.de/de/downloads/giz2012-eco-industrial-parks-andhra-pradesh-india-en.pdf www.ecoindustrialparks.net/e25098/e54573/e34217/ www.apsez.co.in/	

Origin

In 2008, the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the Indian Ministry of Environment and Forest (MoEF) launched a 2 years long project aiming to support the planning and development of eco-industrial parks in the Andhra Pradesh, one of the leading industrial states in India (GIZ 2013b). “ It aims to upgrade existing industrial parks, which are more than 30 years old and home to hundreds of small and medium sized firms across sectors such as chemicals, food processing and engineering ” (Phalnikar 2013). The project concerned four existing industrial parks. The Andhra Pradesh Special Economic Zone was the pilot one.

Objectives

The objective of the EIP was to implement measures in the fields of energy efficiency, renewable energy and addressing environment and climate change issues: transport network, storm water drainage system, cogeneration and biomass power plant, common waste treatment and disposal, treatment of sewage and reuse, waste management, green belt (forest plantation) and trainings for disasters risk management. Companies involved are operating in various sectors: equipment industry, construction industry, metal industry, chemical industry and energy production.

Success factors

The main assets of the project are the economic value added of the measures (*value added*) and the clear designation as an *Eco-Innovation Park*.

Perspectives

The Andhra Pradesh Special Economic Zone has its own economic promotion website. The GIZ (German Agency for International Cooperation) and the MoEF have launched together a structure called Advisory Services in Environment Management (ASEM) Programme which continues to maintain the momentum of the Andhra Pradesh Eco-Industrial Parks project (GIZ).

Park no. 135: Nanjangud Industrial Area

India

Geography	India, Karnataka, Nanjangud	
Type of park	Industrial	
Size of park	215 ha	N/A jobs
	60 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Bain et al. 2010)	

Origin

A study conducted in 2010 by researchers from the Resource Optimization Initiative (ROI, India) and Yale University (USA) examined the material flows in Nanjangud. The study analyzed recycling and recovery activities among industries of the area. It quantified waste materials generated by 42 companies, “accounting for materials that remain at generating facilities, materials that are directly traded across facilities and those that are either recycled via the informal market or disposed” (Bain et al. 2010). Researchers found extremely high rates of energy and material recovery in the Nanjangud Industrial Area.

Objectives

According to the study (data from 2007–2008), 99.5% of the industrial waste and by-products (897210 tons/year), is recovered for reuse or recycling. 81% is reused within the generating facilities, 13% through symbiotic exchanges and over 90% of residuals exiting facility gates are reused within 20 km of the industrial area. The Nanjangud Industrial Area includes diverse industries: SMEs, large-scale Indian companies and multinational corporations. The main actor in the area is a sugar refinery that produces 87% of the total residuals recovered. In total, 11 symbiotic linkages across companies in the area were uncovered and verified during the study (see figure below). These material flow exchanges include biomass residues, carbon dioxide, spent acid, non-hazardous ash, granite polishing residues, etc.

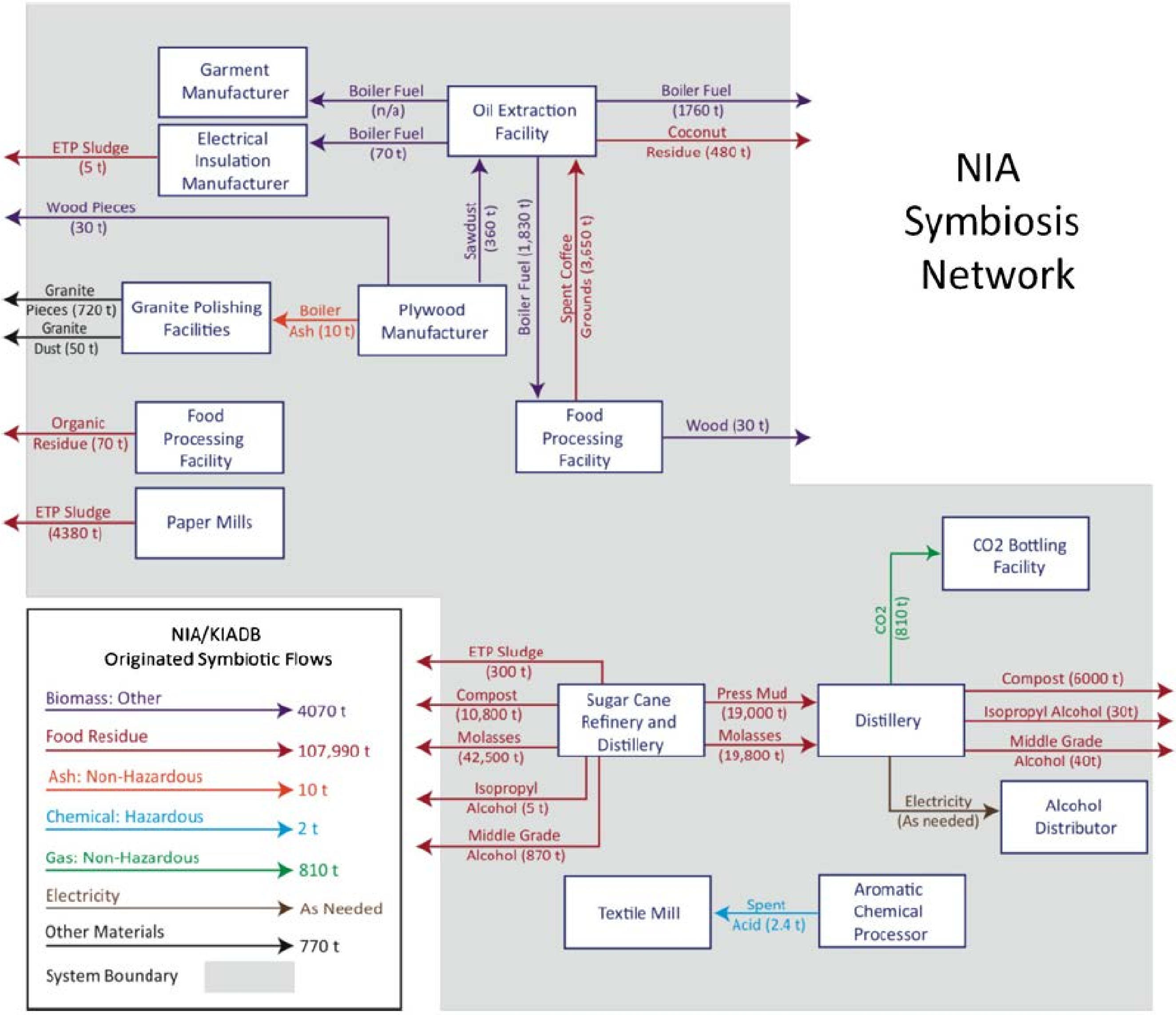
Success factors

The Nanjangud Industrial Area benefited from its collaboration with ROI and Yale University (*cooperation S&T*). Moreover, the Nanjangud Industrial Association gathers most of the companies in the area and represents an important coordination body (*coordinators*). Also, the *diversity* of companies in the area and cooperation between formal and informal sector have been key success factors for the development of recycling and recovery activities. The involvement of these actors also implies that economic benefits are made out of these activities (*value added*).

Perspectives

The ROI-Yale study revealed several ways to improve industrial symbiosis in the area, especially regarding the recovery of non-hazardous ash and waste plastic. But at this time no further data is available regarding the eco-industrial development of the area.

Fig. 47 > Symbiotic flows originating from companies in the Nanjangud industrial area



after Bain et al. 2010

Park no. 136: Narela Industrial Estate

India

Geography	India, Delhi, New Delhi	
Type of park	Industrial	
Size of park	248 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ ~~Waste management~~ Water management Biodiversity ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Bain et al. 2010) Internet links www.dsiidc.org/cms/Narela-Industrial-Complex	

Origin

The Delhi State Industrial and Infrastructure Development Corporation Ltd. (DSIIDC) was declared a ‘Land Development Agency’ in 1978 for the industrial development of Narela, New Delhi. The Narela Industrial Estate was “designed to utilize cooperative solutions to minimize environmental and economic costs” (Bain et al. 2010).

Objectives

The Narela Industrial Estate was built with a common effluent treatment plant. Treated wastewater is used to irrigate a green belt around the estate. To support the design of green spaces 55 000 trees have been planted. It also includes common guesthouses, common storage facilities, and common worker tenements. Unfortunately, management issues extended the construction period from 1978 to 1998. As a result, few tenants settled in the industrial sites and common facilities have been underused, leading to a “sub-optimal functioning”.

Success factors

Although the Narela Industrial Estate benefited from a strong political support (*policy*), it was not really a successful initiative. Further study would be necessary to identify new strategies for this area future development.

Perspectives

No data is available regarding current status and planned activities regarding this initiative.

Park no. 137: Naroda by-product exchange

India

Geography	India, Gujarat, Ahmedabad	
Type of park	Industrial	
Size of park	2300 ha	N/A jobs
	14 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Unnikrishnan et al. 2004); (Bain et al. 2010); (ISIE 2010b); (ISIE 2010a)	

Origin

Gujarat Industrial Development Corporation founded the Naroda Industrial Estate (NIE) in 1966. NIE comprises approximately 700 companies and 35 000 employees. Main industrial sectors are chemical, pharmaceutical, dyes, dye intermediates, engineering, textile and food production. More than 80% of firms are active within the Naroda Industrial Association (NIA), which founded a Charitable Hospital, a bank and realized a collective industrial wastewater treatment plant. The initial project intended to implement an Eco-Industrial network and prevent pollution thanks to a cooperative approach. The local leadership – NIA associated with the Local Bureau of Confederation of Indian Industry (CII) – collaborated with international agencies and institutions such as University of Kaiserslautern to provide technical assistance and guidance on eco-industrial methods (funded by the German Ministry for Education and Research).

Objectives

Naroda's project aimed primary to identify industrial waste types and quantities by mapping raw material and wastes streams within the industrial area. Following steps were evaluated to enable potential links for resources recovery activities and to develop effective partnerships. Lastly, the issue was to institutionalize the approach to make it sustainable. A large NIA member's baseline survey enabled to collect material, water and energy flows. Beneficial industrial symbiosis initiatives were summarized by: (i) converting spent acid with high concentrations of H_2SO_4 to commercial grade $FeSO_4$, (ii) selling sun dried chemical gypsum to cement manufacturers, replacing the need for disposal, (iii) reducing the hazardous content of iron sludge produced by dye manufacturing industries, so that it could be used by brick manufacturers, in addition to reducing the amount of iron sludge being produced, and (iv) converting approximately 100 t per month of industrial food waste to biogas. More than a decade later, however, activities other than a common effluent treatment plant are still in the planning stages. A planned pilot project would create a 'waste exchange bank' to facilitate the future exchange of residuals across companies.

Success factors

Key success factors are in this case the local leadership that involves private and public partners and enabled a high level of participation to the baseline study of the project. The initiative showed that local partnerships were already in place and this specificity can also explain project's success. Also, the Naroda Industries Association collaborates with the Center for Environmental Education and international agencies to bring eco-industrial networking and development into play in the region (*coordinators* and *cooperation S&T*).

Perspectives

As described above, to enhance the practical implementation of the beneficial links identified between companies to recover resources, a 'waste exchange bank' was planned in 2010.

Park no. 138: Taloja Industrial Estate

India

Geography	India, Maharashtra, Raigad District	
Type of park	Industrial	
Size of park	2300 ha	N/A jobs
	900 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Unnikrishnan et al. 2004); (Bain et al. 2010)	

Origin

Existing since 1970, Taloja Industrial Estate benefited from the easy accessibility and proximity of Mumbai city to grow. In 1985, Taloja Industries Association (TIA), which represents all settled industries, was founded to promote and maintain good relations between firms and their employees thanks to seminars and meetings organization. Among the 900 units that occupy over 907 hectares, a large majority are small-scale industry (790), then medium-scale industries (70) and large-scale industries (40). Due to economic recession, only 450 are currently remaining. Next to food, fertilizer, engineering, textile and trading, the main industrial sector is chemicals. In 2004, the National Institute of Industrial Engineering Mumbai realized a baseline survey to assess the industrial ecology and environmental performance potentials on 34 firms selected on a willingness basis. They collected data through company interviews and then highlighted potential environmental improvements and resource networks.

Objectives

The main objectives were the followings: (i) to study the pollution prevention practices in selected industries in the Taloja Industrial Estates, Maharashtra; (ii) to assess the usage of LCA in the selected industries; (iii) to apply the concepts of industrial ecology and networking in the pollution prevention practices in selected industries in Taloja and (iv) to develop strategies for better environmental management in the region.

The study showed already existing waste recovery solutions such as: scrubbed tail gas from a petrochemical industry sold to another petrochemical industry for the manufacture of maleic anhydride, and brewery wastes sent to a neighboring chicken farm for use as poultry feed. Several other potential by-products exchanges involving chemical solvents have been identified. However, no further progresses have been reported.

Success factors

Existing Taloja Industries Association (*coordinators*) is the first success factor, but firm's commitment was also dependent in a selection process based on willingness.

Perspectives

Further details on current status and future development of the project are unknown.

Park no. 139: Vatva Industrial Park

India

Geography	India, Gujarat, Ahmedabad	
Type of park	Industrial	
Size of park	491 ha	N/A jobs
	1800 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(ISIE, 2011d) Internet links www.vatvaassociation.org	

Origin

Vatva Industrial Estate was set-up in 1968 and is one of the oldest and largest estates in the Gujarat State. It houses various industrial activities: plastics, light & heavy engineering, machinery & components, chemicals, paints, pharmaceuticals, foundries, textile, etc. Established in 1971, the Vatva Industries Association gathers 1200 companies and contributes to the estate's sustainable development.

Objectives

The Vatva Industries Association Charitable Trust offers onsite medical care at charitable rates "for workers and their families, and for public coming from far distances". Also, the Green Environment Cooperative Services Society Ltd. (GECSS, an independent body promoted by the Association) collects liquid and solid industrial waste for proper disposal or treatment. About 600 polluting industries benefits from a large treatment facility managed by the GECSS and collectively financed by the members of the association. Besides, the Gujarat Cleaner Production Center is working with the German cooperation agency GIZ on behalf of the Gujarat Industrial Development Corporation (GIDC) to develop eco-industrial activities. The industrial estates of Vatva and Naroda have been selected to demonstrate the application of industrial ecology principles in existing industrial parks. The first is the elaboration of Environmental Information Reports for these two estates.

Success factors

As a proactive coordinator, the Vatva Industries Association is a strong asset for the estate's sustainable development (*coordinators*). Moreover, the involvement of an international cooperation agency (GIZ) and a technical center will contribute to monitor and guide activities in the field of eco-innovation (*cooperation S&T*).

Perspectives

Further details on current status and future development of the estate activities regarding eco-innovation are unknown.

3.4 Israel

According to Dr. Vered Blass from Tel Aviv University (Blass 2013) “Israel promotes the issue of collection and recycling of waste, but is still at the early stages of the revolution.” The information collected for this study reveals no current and clearly defined eco-innovation park initiative in Israel. A list of Israel industrial parks is available online (Israel Science and Technology Directory 2013). Most of the information are however only available in Hebrew and are not translated.

A venture capital fund established in 2006 was created to provide value added growth capital to exceptional entrepreneurs building Israel’s energy, water and environmental technology leaders (Israel Cleantech Ventures 2013). Their goals are however not related to eco-innovation at the park scale.

No significant or relevant data on the following potential eco-innovation parks is detailed in the literature at the time of this review:

- The 26 parks list provided by the Israel Science and Technology Directory (2013)
- Kishon River Eco-Park (river rehabilitation)

Park no. 140: Matam Park

Israel

Geography	Israel, Haifa	
Type of park	Industrial	
Size of park	22 ha	8000 jobs
	50 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	Internet links www.gav-yam.co.il/GavYam/site/matam/eng/index.html www.en.wikipedia.org/wiki/Matam,_Haifa	

Origin

Matam Park was created in the 1970’s by the Haifa Economic Corporation, the Haifa city’s economic development organization. A partnership company between the Matam Company and the occupants of the park – Shatam Company – assumes the central management of the park.

Objectives

Most economic players are operating in the information technology sector: Intel, Microsoft, Google, Yahoo, Elbit Systems, etc. The main services provided by Shatam Company are a centralized air-conditioning system (buildings are connected to an energy center, supplying them with cold water for air conditioning and hot water for heating), cafeterias, children’s day centers, a medical clinic, transport facilities (free shuttle service), a post office, a petrol station, parking areas, maintenance services and security services.

Success factors

The organizational setup (*coordinators*) and economic value added for the tenants of the Park (*value added*) are the main success factors. However, Matam Park is not self-designed as an eco-innovation park.

Perspectives

Shatam Company plans on continuing erecting new buildings (10 ha new area planned) and enlarging its high level of services and infrastructures in Matam Park.

3.5 Japan

Japan has a long story of material flow analysis. As an island, resources paths and transfers are considered as important economical and environmental issues (Takiguchi et al. 2008). The Japanese government established a comprehensive legal framework in order to move towards a recycling based society (Boons et al. 2011; Matsumoto 2009; Van Berkel et al. 2009b): the *Basic Law for Establishing a Recycling-Based Society*, the *Waste Management Law*, the *Law for Promotion of Effective Utilisation of Resources*, etc.

This led to Japan's ECO-Town Program (launched in 1997), which is ought to foster industrial symbiosis and urban symbiosis. The Eco-Town program has two main Objectives

1. To stimulate local economies by nurturing the growth of environmental industries that take advantage of the industrial capabilities in each region, and
2. To create integrated systems in harmony with the environment, and to involve industry, the public sector, and consumers, with the aim of creating a resource-recycling society in a given region.

According to van Berkel et al. (2009b), the core method for the Eco-Town implementation is the 3R concept (Reduce, Reuse, Recycle). 26 approved Eco-Towns exist, 14 of which focus on the promotion of environmental industries.

All Eco-Town projects are a response to two trends in the Japanese economy: massive landfilling and declining economy / industry. Almost all Eco-Town projects are initiated and lead by municipalities. The government policies and subsidies, as well as the awareness and education of local communities are the core success factors for eco-innovation activities in Japan.

Aside from the most documented Eco-Towns, the section details a few eco-innovation parks experiments in Japan. No significant or relevant data on the following eco-towns was found at the time of this review:

- Aomori
- Bingo
- Ehime
- Gifu
- Lida
- Sapporo
- Tokyo
- Chiba
- Hokkaido
- Kochi
- Hyogo
- Kamaishi
- Suzuka
- Kurihara
- Okayama
- Omuta
- Osaka
- Toyama
- Yamaguchi
- Yokkaichi

Park no. 141: Eco-Town Aichi

Japan

Geography	Japan, Chubu region, Aichi	
Type of park	Industrial	
Size of park	517 ha	N/A jobs
	20 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Van Berkel et al. 2009a); (Fujita 2006) Internet links www.ie.tudelft.nl/index.php/Aichi_Eco-town_Plan www.nett21.gec.jp/Ecotowns/data/et_b-aichi.html www.aichi-shigen-junkan.jp/aichi_ecotown/pdf/ecotown-e.pdf	

Origin

The motivation of Aichi Eco-Town project is the necessity of revitalizing the local economy and the promotion of environment-consciousness in the business activities. It mostly encompasses waste reduction and recycling promotion. The main stakeholder is the Aichi Prefectural Government.

Objectives

The objective of the project is to use the Aichi industrial know-how to develop recycling processes for industrial wastes that would otherwise continue to accumulate (e.g. mixed wood waste, sludge and dust) due to shortage of waste disposal sites. Companies involved are operating in various sectors: wood-plastic industry, construction industry, recovering industry, chemical industry and glass industry. The recycling businesses are based on citizens’ participation and environmental education programms are provided to sensibilize residents to eco-friendly lifestyle.

Success factors

The main success factors are the *policy* support and the *incentives* provided by the national government. Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

We found no recent data about the development of the Aichi Eco-Town Project.

Park no. 142: Eco-Town Akita

Japan

Geography	Japan, Tohoku region, Akita	
Type of park	Industrial	
Size of park	433 943 ha	N/A jobs
	N/A companies	258 873 inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Fujita 2006) (Van Berkel et al. 2009a) Internet links www.akita-ecotown.com/english/ecotown.html	

Origin & Objectives

According to van Berkel (2009b), the objective of Akita Eco-Town project is to implement “ a new resource recycling system, by using mine- and refinery-related technologies and infrastructure for metal recycling and by valuable uses of wastes from forestry, agriculture and wood products industry ”.

The main companies involved are operating in metal, forestry, energy, recycling and agricultural sectors. The Akita Eco-town Center is working on two projects: the recycling of small electronic household appliances research and the development of an environment-oriented industry tourism program. Twenty-four wind turbines are also operational and generate 600 kW of electricity to power 10 000 homes annually.

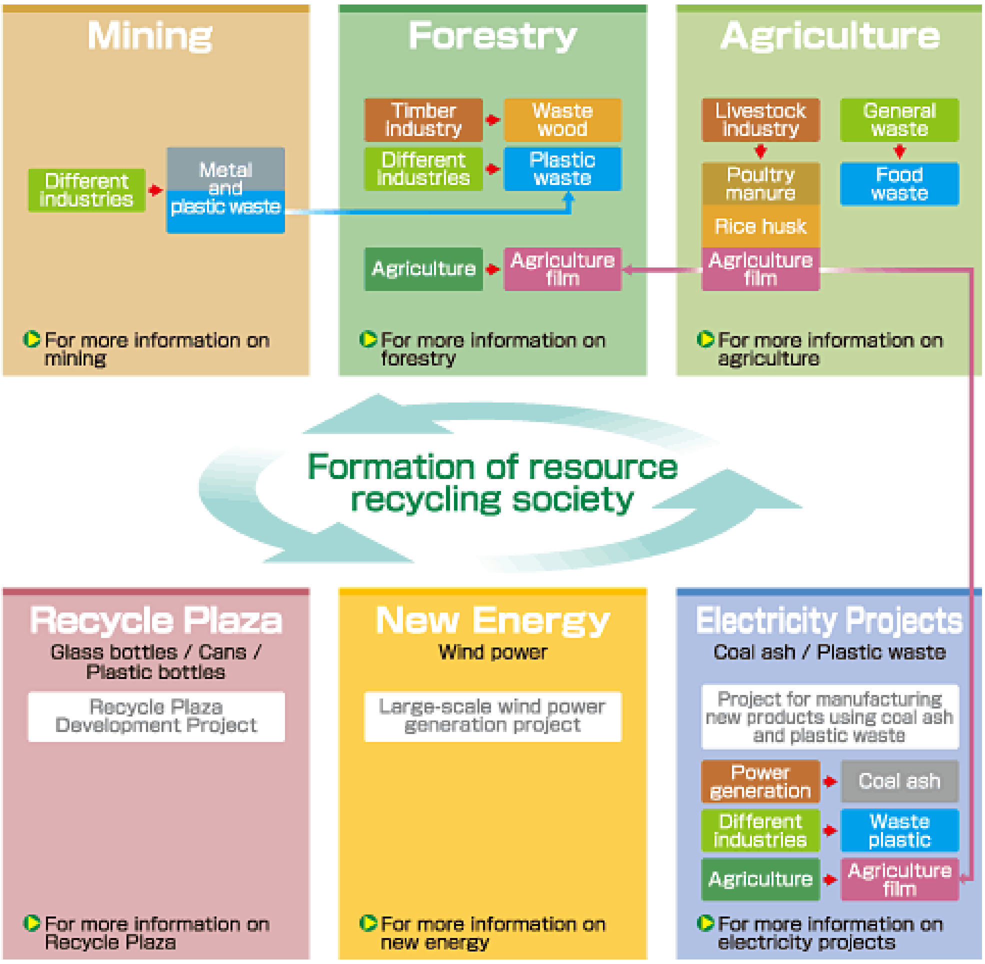
Success factors

The main success factors are therefore the *policy* support and the *incentives* provided by the national government. Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

We found no recent data about the development of the Akita Eco-Town Project.

Fig. 48 > Northern Akita Eco-Town project



after Akita Eco Town Center 2013

Park no. 143: Eco-Town Kawasaki

Japan

Geography	Japan, Kanto region, Kawasaki	
Type of park	Industrial	
Size of park	2800 ha	N/A 400 jobs
	15 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ Land use optimization Air pollution prevention ~~Noise prevention~~ Environmental Mgmt ~~System~~
Status	In use	
Project leader	Public	
References	(Van Berkel et al. 2009a); (Morikawa 2000); (Fujita 2006); (ISIE 2011f); (Mathews et al. 2011) Internet links www.env.go.jp/en/recycle/asian_net/Annual_Workshops/2010_PDF/SiteVisit/kawasaki_ecotown.pdf www.uncrd.or.jp/env/spc/docs/1st_3r_forum_presentation/Session2-2g2_Maki.pdf www.japanfs.org/en/pages/031241.html www.kawasaki-eco-tech.jp/2012/english/index.html	

Origin & Objectives

The Kawasaki Eco-Town project aims to support the industrial rejuvenation of the Kawasaki harbor area (2800 ha) previously predominantly used by heavy industry. Launched in 1997, it promotes effective use of residential, commercial and industrial wastes generated in the city and their recycling into raw materials that can be used by industries located in the city (e.g. cement, iron and steel works). The main stakeholders are large heavy-chemical companies, the Liaison Center for Revitalizing Coastal Area and the Kawasaki local government.

The objectives of the Eco-Town are to create a resource-recycling society and to revitalize the coastal area through reduction of industrial activities impacts on the environment (leading to the concept of Zero-Emissions Industrial Park in 2002 on 8 ha, which is a small area of 400 jobs within the whole industrial park), industrial symbiosis implementation and ISO 14000 series certification (obtained in 2005) of all businesses. Companies involved are operating in the recycled paper industry, the metal industry, and the cement industry as well as waste collectors and recycling firms. Thanks to the Eco-Town program, the park established until 2007 at least 14 recycling and symbiotic projects, involving industrial flows and municipal and commercial wastes. A new symbiosis has emerged in March 2011 between a food and seasonings manufacturer and the Kawasaki Biomass Power Station (supply of soybean residues as biomass resource). The local government runs an air pollution observing system and collaborate among stakeholders to mitigate air pollution.

Success factors

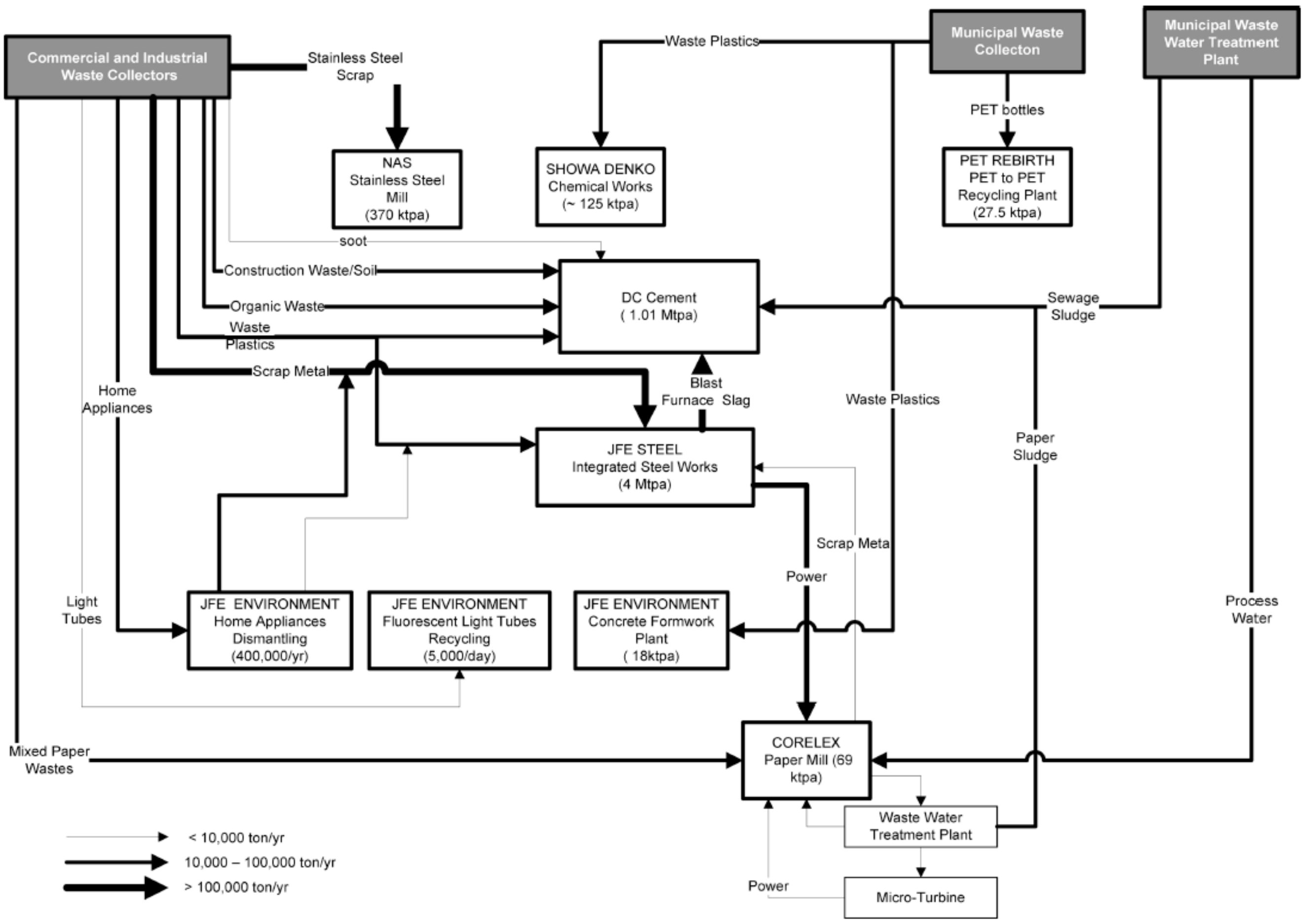
The main success factors are the *policy* support and the *incentives* provided by the national government. In addition, the main assets of the project lie in its Zero-Emissions Industrial Park identification since 2002 (Eco-Innovation Park), its proximity to the energy facilities and the transportation infrastructures of Tokyo City (*location*), the cooperation with science and technology institutions (*cooperation*) and a high concentration of Japan's leading large industrial firms, and also a large number of medium – and small-size enterprises in the field of resource recycling as well as various environment-related facilities (*diversity*).

Perspectives

Kawasaki's Zero-Emissions Industrial Park and its experiences and technologies were presented during the Kawasaki International Eco-Tech Fair in February 2012. No further information was currently available in English.

Fig. 49 > Overview of 2009 symbioses state in Kawasaki. Note

ktpa = kiloton per annum and Mtpa = megaton per annum.



after Van Berkel et al. 2009a

Park no. 144: Eco-Town Kitakyushu

Japan

Geography	Japan, Kyushu region, Kitakyushu, Hibikinada area	
Type of park	Industrial	
Size of park	2000 ha	N/A jobs
	434 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management Water management Biodiversity Material flow	Cultural, social, health ~~benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Van Berkel et al. 2009b); (Fujita 2006); (GEC 2005); (Grobbelaar 2012) Internet links www.enviroscope.iges.or.jp/contents/76/eng/story/storyi7.htm	

Origin & Objectives

Launched by the local municipality in collaboration with its industries, Kitakyushu was the first Eco-Town project approved by the government in 1997. Its objectives are to convert the declining local heavy industries in environmental industries and to reduce environmental impacts on the atmosphere and on the Dokai Bay water qualities, which were highly polluted. The motivation of this Eco-Town project is “to create an international hub for environmental businesses on the site of an old iron and steel works which was the core of the Kitakyushu Industrial Area (fourth largest in Japan). It includes a comprehensive support package for environmental education (e.g. study tour), Research and Technology Development and commercialisation” (Van Berkel et al. 2009b).

The objectives of Kitakyushu Eco-Town are to develop and promote environment/recycling industries, to introduce advanced technologies for recycling and to create new environmental towns at the local level. The project consists of three zones: the Comprehensive Environmental Industrial Complex, the Practical Research Area and the Hibiki Recycling Area. Companies involved are operating in various sectors: recycling sector (PET bottles, office equipment, automobiles, household electrical appliances, fluorescent lights, medical equipment and mixed construction waste), steel industry, chemical industry, ceramic industry, automotive industry and cement industry. A research cluster on recycling and waste treatment technologies and a cluster of small sized waste treatment companies co-exist. This led to impressive innovations in the recycling industry, such as the early introduction of florescent tubes reuse or the automotive recycling rate that reaches 99%. Wind power generation has been in operation in Hibikinada area from 2003. The first six years of Kitakyushu Eco-Town operation has generated direct and indirect investments of about USD 1.34 billion and more than 6400 jobs. The eco-town was included in 2011 in Japan’s “Future City” initiative due to its “City Forest” or “Forest-in-town” projects fostering green spaces within the industrial area and the city.

Success factors

The main assets of the project lie in the presence of a large volume of usable waste materials, well-developed infrastructure (*location*), the availability of resource-recycling technologies from existing manufacturing industries and research institutions (*cooperation*) and in the demand for recycled products and savings in transaction costs (*economic value added*). The town is also clearly defined as an E*co-Innovation Park*. The clustering also allowed similar businesses to share efforts. In addition, the main success factors are also the *policy* support and the *incentives* provided by the national government, combined with an old culture – and therefore motivation – of industrial pollution prevention.

Perspectives

After having promoted mainly recycling and reuse activities, Kitakyushu Eco-Town created the "Next Generation Energy Park", which aims to foster the use of renewable and alternative energies such as photovoltaic panels, wind power and coal gasification. Besides, the city was included in 2011 in Japan's "Future City" initiative thanks inter alia to its promotion and creation of green spaces within the industrial area and city. Those developments are currently in progress.

Park no. 145: Eco-Town Minamata

Japan

Geography	Japan, Kyushu region, Minamata	
Type of park	Industrial	
Size of park	20 ha	120 jobs
	35 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(GEC 2005); (Fujita 2006); (Yoshida 2007)	

Origin

Minamata City is sadly notorious because of the " Minamata disease " among people around the city in the 1930's and 1940's. The Chisso factory's discharged wastewater containing methyl mercury, the by-product of the acetaldehyde and vinyl chloride production processes, into the port of Minamata causing abnormalities in animals, plants and people (mostly brain and nerves affections). As a consequence, the population of the city launched various initiatives that finally leaded to the Minamata Eco-town concept. The goal of the Minamata Eco-Town is to motivate the industries' activities and the municipal administration towards actions to revive and preserve the environment. Environmental education trips are e.g. organized.

Objectives

The Eco-Town aims to develop a new industrial park – the Minamata Industrial Park or " Recycling Center " – to accommodate new plants and companies and bring those scattered in the city together to the park. The industrial park should " create a recycling business hub, where the waste collected from all around the community is recycled "(GEC 2005). Companies involved are operating in the recycling sector: bottle reuse and recycling facility, waste plastic compound resin recycling facility, consumer appliance recycling facility, fertilizer-manufacturing facility.

Success factors

The main assets of the project are its geographical advantage due to proximity of land route and high-speed vessel connects (*location*), the cooperation between citizens and enterprises, the municipality subsidies for business projects approved by the government (*incentives*) and the regulation relaxation to ease the leasehold of the sites and increase the occupation rate of the park (*policy*). Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

We found no recent data about the development of the Minamata Eco-Town project.

Park no. 146: Eco-Town Naoshima

Japan

Geography	Japan, Shikoku region, Naoshima island	
Type of park	Industrial	
Size of park	813 ha	N/A jobs
	N/A companies	3600 inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(GEC 2005); (Fujita 2006)	

Origin

Naoshima Eco-Town gained approval in 2002. The motivations are to create environmental education based on local resources, to involve multi-stakeholders in town planning and to implement waste treatment project in Teshima. The stakeholders are the Kagawa Prefecture, municipal government, Mitsubishi Material and residents.

Objectives

The objectives of the project are to establish recycling system with refining technologies and education programs “utilizing the facilities, the review of local nature and culture, courting eco-tours, etc” (GEC 2005). The main economic sectors are metal industry (Mitsubishi Material Factory) and recycling industry (incinerating and melting plant of recycle waste, Kagawa Naoshima Environment Center). The stakeholders have engaged in various environmental activities in Naoshima Eco-Town. They established “Eco-Island Naoshima Promotion Committee” in 2004, and launched software projects including public-relationship activities for the Eco-Town, promotion of environment-conscious urban planning, creation of environmental education sites, and improvement of facilities.

Success factors

The success factor of the Naoshima Eco-Town project is the national and Kagawa Prefectural subsidies (*incentives*) and policies (*policy*). Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

We found no recent data about the development of the Naoshima Eco-Town project.

Park no. 147: Fujisawa Eco-Industrial Park

Japan

Geography	Japan, Kanto region, Fujisawa	
Type of park	Combined	
Size of park	35 ha	N/A jobs
	1 company	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Planned	
Project leader	Private	
References	(Côté et al. 1998); (Morikawa 2000) Internet links www.iisd.org/business/viewcasestudy.aspx?id=64	

Origin

In 1999, the EBARA Corporation of Japan – a high-tech industrial machinery industry – decided to make zero emissions one of its primary goals and "has begun to implement a plan to convert the 35 hectare Fujisawa industrial area into a complete eco-industrial park that will become a model demonstrating the zero emission concept feasibility. The EBARA Corporation is both the leader and the founder of the project.

Objectives

The eco-industrial park project includes 700 households, commercial facilities and an industrial manufacturing operation. To achieve the zero-emissions objective, new technologies and features in energy conservation and cascading, renewable energy, conversion of waste into energy, solar greenhouses, waste water treatment using wetlands, reuse of treated waste water, conversion of ash and other wastes into cement and ceramics, reuse and recycling of materials should be developed and mandated by EBARA Corporation. The park will be supported by a zero emission center, an environmental clinic and a logistics center.

Success factors

The success factors are the EBARA Corporation awareness of environmental performance and competitiveness improvement (*value added*), the collaboration with the ZERI global network (Zero Emissions Research & Initiatives) and the United Nations University (*cooperation*). Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

We found no recent data about the development of the Fujisawa eco-industrial park.

Park no. 148: Kokubo Eco-Industrial Park

Japan

Geography	Japan, Chubu region, Yamanashi Prefecture	
Type of park	Industrial	
Size of park	60 ha	5500 jobs
	24 company	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Private	
References	(Morikawa 2000); (Côté et al. 1998); (Shimazaki 2006) Internet links www.iisd.org/business/viewcasestudy.aspx?id=64	

Origin

Kokubo industrial estate was created in 1975. The Kokubo estate tenant cooperative launched in 1994 an initiative to convert the estate into an eco-industrial park. The motivation was to seek economic advantages by adopting waste reduction measures while improving environmental performance. This motivation is the result of an increasing stress on resources and the environment in the region, as well as the tightened environmental regulations.

Objectives

The park objectives are to become a zero-emissions park through, amongst others initiatives, the implementation of opportunities for recycling and by-product utilization that could reduce costs as well as deal with environmental concerns. Companies involved are mainly operating in the electronic industry.

Success factors

The main success factor is the organization into a group of industrial tenants represented by an independent department and a full-time director for the eco-industrial activities in the park (*coordinators*). The cooperative director can express the interests of all the park's tenants and facilitate the contracting of providers or the applying for government funding. Even if small, the cost saving is another tangible success factor (*value added*). Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

We found no recent data about the development of the Kokubo eco-industrial park project.

3.6 South Korea

In order to improve their environmental, social and business performance, South Korean industries started to apply voluntarily the approaches of CP and IE soon after the Rio Earth Summit in 1992. Since mid-1990, South Korean government conducted awareness campaigns and imposed more stringent environmental legislations and policies to foster eco-efficiency and pollution abatement. In particular, the Act to Promote Environmental Friendly Industrial Structure (APEFIS), enacted by the Ministry of Commerce, Industry, and Energy (MCIE) in 1995 led to the establishment of an institutional system for the development of CP and environmental management systems (EMS) like ISO 14001 (Park et al. 2008). More recently, the country also adopted a National Strategy for Green Growth and provides in its current Five-Year Plan (2009–2013) a comprehensive policy framework for its implementation (OECD 2011).

Regarding spatially located initiatives, the Korea National Cleaner Production Center and the Korea Institute of Industrial Technology launched in 2005 a 15-year program to promote eco-industrial parks based on the principles of CP, IE and EMS to reduce industrial emissions and strengthen economic growth through eco-innovation (Mathews et al. 2011; Park 2010b; Park et al. 2008). To implement this program, Korea Industrial Complex Corporation, designed by the MCIE as the new supervising agency in 2006, established 8 regional EIP centers. Each center also designated a project champion (academic expert or company manager) to lead the regional project and foster industrial innovation (Behera et al. 2012).

Most of the following case studies are initiatives launched in the framework of this three-phase program. During the first phase (2006–2010), after a prior material flow analysis (MFA) to identify potential industrial symbiosis, 5 demonstration projects have been initiated, involving over 200 participating companies (Park 2010b). The second phase (2011–2015) aims to disseminate the model to 20 other industrial parks and the third phase (2016–2020) will evaluate the model performance to redesign it and correct the flaws.

Park no. 149: Banwol-Shiwha Industrial Complex

South Korea

Geography	South Korea, Gyeonggi, Ansan (Seoul National Capital Area)	
Type of park	Industrial	
Size of park	3180 ha	N/A jobs
	5400 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Park et al. 2008); (Choi et al. 2010); (Park, 2010a) Internet links www.indigodev.com/korea_eip.html www.eip.or.kr/eng/case.html www.iel.umn.edu/na.html www.gin.confex.com/gin/2010/webprogram/Paper3264.html	

Origin

The Banwol-Shiwha Industrial Complex is one of the largest of its kind in Korea and houses mainly SMEs operating in various sectors. Prominent activities are small manufacturing, auto parts, metal, chemical, textile, dying, pulp & paper industries and waste incinerators. As part of the national EIP program, the Korea Industrial Complex Corporation (KICOX) stimulated the establishment of industrial symbioses in the area.

Objectives

The main documented symbiosis concerns waste acid recycling and copper collection from printed circuit board among a small number of companies. Hwabaek Engineering supplies Daeduck GDS (a printed circuit board manufacturer) with recycling equipment and collects high purity copper powder that is sold to Seowon. Daeduck GDS and Isu Exaboard installed a facility for waste acid recycling and copper collection equipment.

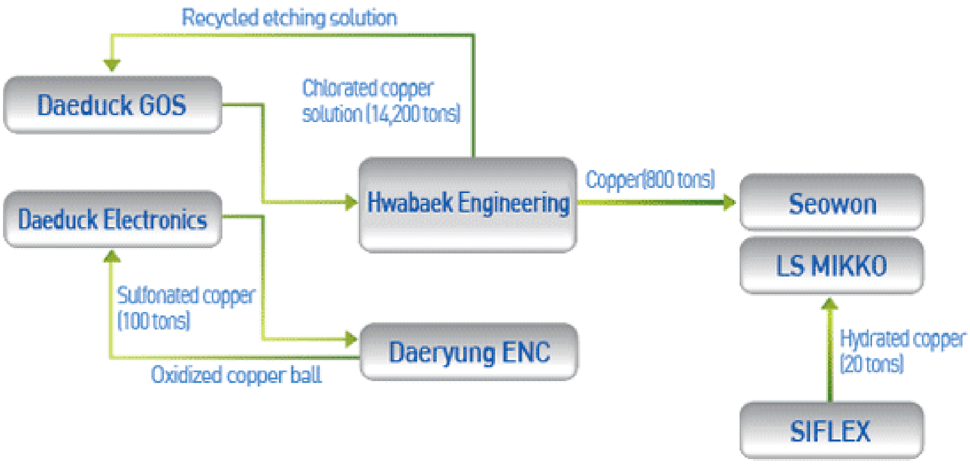
Success factors

By-product marketing and reduction of material inputs (hydrogen peroxide and hydrochloric acid) represent substantial new *added value* for printed circuit board manufacturers, which is a key success factor for industrial symbiosis viability. Besides, Banwol-Shiwha Industrial Complex *cooperates with many S&T bodies* including Hanyang University, LG Innotek R&D Center, Korea Institute of Industrial Technology and Korea Electrotechnology Research Institute. *Coordinators*, *location* and *diversity* are also success factors for eco-innovation development in this park. Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

The waste acid/alkali and copper collection symbiosis is expected to be adopted by other large printed circuit board manufacturers in the Banwol-Shiwha industrial complex. Besides, experiments have been conducted to establish waste recovery networks among dyeing industries.

Fig. 50 > Industrial symbioses in the Banwol-Shiwha Industrial Complex



after E-Cluster 2013

Park no. 150: Cheongju Eco-Industrial Park

South Korea

Geography	South Korea, Chungcheongbuk-do, Cheongju	
Type of park	Industrial	
Size of park	409 ha	N/A jobs
	200 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Park et al. 2008); (Park 2010a); (Park 2010b) Internet links www.indigodev.com/korea_eip.html	

Origin

Cheongju Eco-Industrial Park belongs to the first batch of pilot areas developed in the framework of the national eco-industrial park program launch by the Korea National Cleaner Production Center. Major sectors in the park are textile, food processing, petrochemical, pulp & paper, electronics, metal manufacturing and non-ferrous metals industries.

Objectives

In 2010 six eco-industrial projects were identified in the park. Mainly led by industries, they resulted in the construction of resource circulation networks, including waste acid recycling. The main benefits of these networks are the creation of value added (reduced waste disposal costs and raw material inputs) and the reduction of environmental pollution.

Success factors

Identified success factors for this park are *value added*, *location*, *diversity*, and clear designation as an *Eco-Innovation Park.*

Perspectives

Searching on the Internet and the literature, little detailed information is available on the park current eco-industrial activities and future development.

Park no. 151: Gwangju Green City

South Korea

Geography	South Korea, South Jeolla, Gwangju	
Type of park	Urban	
Size of park	50 124 ha	N/A jobs
	N/A companies	1475'745 inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management ~~Water management~~ Biodiversity ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Gwangju 2011) Internet links www.gjsummit.com/sub/sub.php?subKey=05010100 www.en.wikipedia.org/wiki/Gwangju	

Origin

Gwangju is the sixth largest city in South Korea. Recently, it has been developing a comprehensive environmental policy framework and aims to become a "green city". Gwangju hosted the Summit of the Urban Environmental Accords in October 2011.

Objectives

To promote environmental sustainability, the city adopted a series of eco-innovative measures. It is encouraging the development of clean tech industries in the region: an "OLED R&D town" will be established by 2013 and renewable energies are also promoted through various projects. Besides, the Gwangju Green Action program entered an agreement with some 90 local institutions (public and private sectors) to reduce their carbon emissions and is running a trial carbon trading system. The city also established a "Carbon Bank System", where citizens can earn "carbon points" which can be used as cash by voluntarily reducing consumption of energy. Moreover, a city-wide afforestation program is conducted and ecosystems are restored to preserve the region natural assets.

Success factors

Main success factors for the development of eco-innovation in Gwangju are *policy* and *coordinators*. Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

Future developments concerning eco-innovation also include the construction of a waste-to-energy facility near a hygienic landfill (already including a landfill gas facility) and further promotion of "Green buildings" with eco-friendly construction materials and private houses with solar panels and electric car charging stations.

Park no. 152: Macheon-Chilseo-Sangpyeong Eco-Industrial Network

South Korea

Geography	South Korea, Gyeongnam	
Type of park	Industrial	
Size of park	581 ha	N/A jobs
	550 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Kim 2007); (Park et al. 2008) Internet links www.indigodev.com/korea_eip.html	

Origin

The Ministry of commerce, Industry and Energy has launched a pilot eco-industrial park project in the Gyeongnam province. The center in charge of its implementation is the Gyeongnam Regional Environmental Technology Development Center. After investigating 9 industrial parks in the province, the center proposed the construction of the Chilseo–Macheon–Sangpyeong network.

Objectives

The objective is to establish symbiotic networks unifying a few industrial complexes through by-products exchanges for organic compounds and heat cascading. Various types of companies (mainly SMEs) are present in the area and include non-ferrous metal, steel, machinery, food, textile, pulp & paper and chemical industries.

Success factors

Main success factors are *coordinators* and *diversity*. The project suffers from one significant weakness though; the three sites involved are around 50 km apart. It is hard to imagine eco-efficient heat symbiotic exchanges in this situation. Another success factor is the clear designation as an *Eco-Innovation Park.*

Perspectives

Further details on current status and future development of the project are unknown.

Park no. 153: Mipo and Onsan EIPs (Ulsan EIP Project)

South Korea

Geography	South Korea, Ulsan	
Type of park	Industrial	
Size of park	5554 ha	>100 000 jobs
	1000 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Park et al. 2007); (Park et al. 2008); (Park 2010b); (Park 2010a); (Mathews et al. 2011) (Behera et al. 2012) Internet links www.unescap.org/esd/environment/infra/suncheon/documents/Case_studies/ULSAN-Eco-industrial-Park.pdf, www.indigodev.com/korea_eip.html	

Origin

The city of Ulsan is considered the industrial capital of South Korea. As the region experienced severe environmental pollution up through mid-1980, government imposed stricter policies. This induced a raise in companies' investments to enhance their environmental performance. In 2005, the region has been selected as one of the 8 national demonstration eco-industrial park projects. The major goal of the Ulsan project is to foster innovation and to upgrade the Mipo-Onsan national level industrial complexes by transforming them into eco-industrial parks.

Objectives

In addition to one of the world's largest petrochemical site, dominant industries in Mipo and Onsan complexes are automobile manufacturing, shipbuilding, nonferrous metals, steel, and metal manufacturers. While Park and Won (2007) identified 70 symbioses (collective utility systems, by-product exchanges, waste water recovery), Behera et al. (2012), mention only 40 symbioses, out of which 20 are under negotiation and/or design, 7 are under feasibility evaluation and 13 are currently in operation. These 13 symbioses involve 41 companies and include steam production systems (centralized, produced by waste-to-energy facilities), waste and by-products recovery, industrial wastewater recovery and other material flow networks.

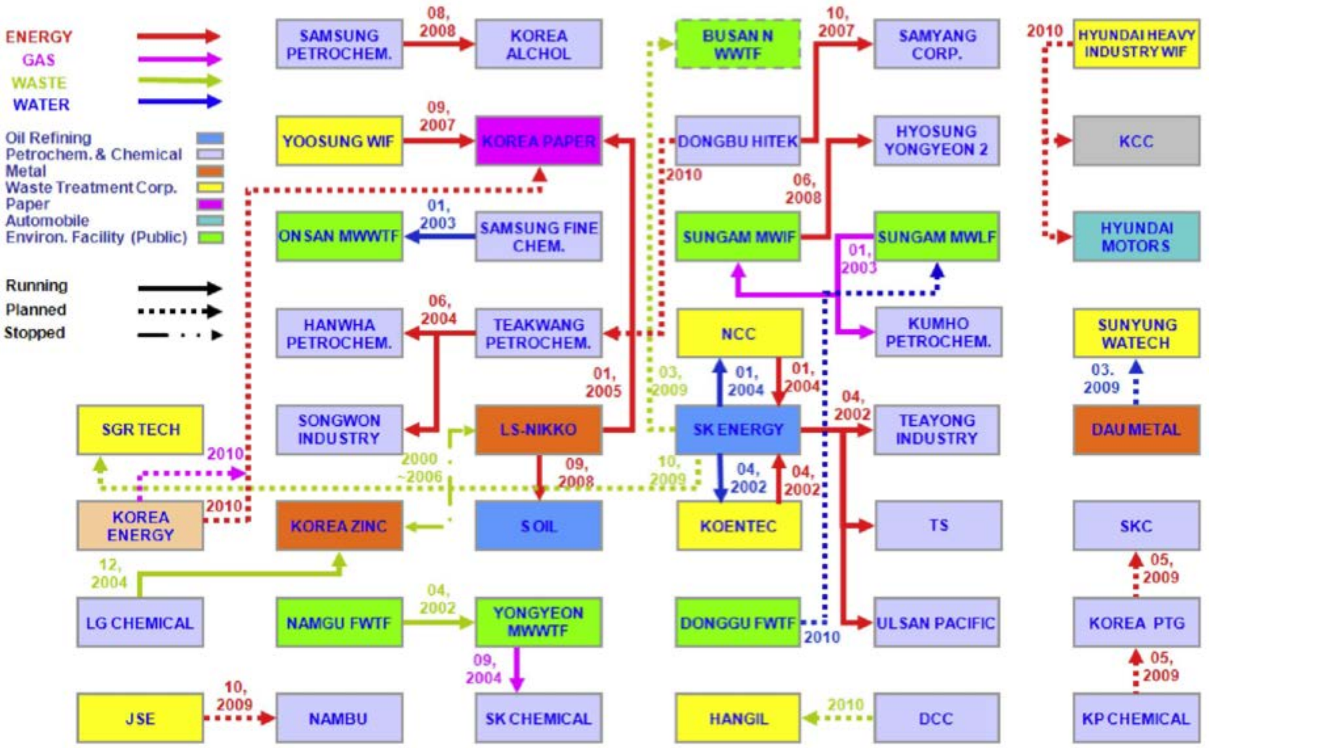
Success factors

In addition to the Korea Industrial Complex Corporation and the Ulsan eco-industrial park center in charge of the promotion and implementation of industrial symbioses, the project involves many key stakeholders like the Ulsan Metropolitan City government (the city of Ulsan was declared "Eco-Polis Ulsan" during 2004) as well as various research and development centers. Government support and facilitation played important role in the promotion and coordination of the project, but financial gain was probably the major driving force. The payback period of 9 of the 13 symbiotic networks was less than 1 year. Key success factors are therefore *value added*, *policy*, *coordinators*, *cooperation with S&T*, *location*, *diversity*, and clear designation as an *Eco-Innovation Park*.

Perspectives

The project is still in its early development but is currently the most prominent eco-industrial park pilot initiative in South Korea.

Fig. 51 > Industrial symbioses in Ulsan National Industrial Parks



after Park, 2010a

Park no. 154: Pohang Eco-Industrial Park

South Korea

Geography	South Korea, North Gyeongsang, Pohang	
Type of park	Industrial	
Size of park	2010 ha	N/A jobs
	220 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Park et al. 2008); (Park 2010b); (Park 2010a) Internet links www.indigodev.com/korea_eip.html	

Origin

Pohang Eco-Industrial Park belongs to the first batch of pilot areas developed in the framework of the national eco-industrial park program.

Objectives

Main sectors operating on the site are steel, metal processing, fine chemical, waste disposal and cement industries. Prominent eco-industrial activities in Pohang eco-industrial park includes sewage sludge recycling and the utilization of steel waste as a substitute for scrap metal (3 large companies cooperate in this by-product recovery network).

Success factors

In addition to *coordinators* and *location*, other key success factors are and clear designation as an *Eco-Innovation Park* and *value added*. Companies collaborating in symbiotic networks make significant benefits while reducing their raw material consumption and polluting emissions.

Perspectives

Further details on current status and future development of the project are unknown.

Park no. 155: Yeosu Eco-Industrial Park

South Korea

Geography	South Korea, South Jeolla, Yeosu	
Type of park	Industrial	
Size of park	3130 ha	N/A jobs
	149 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Park et al. 2008); (Park 2010a) Internet links www.indigodev.com/korea_eip.html www.gin.confex.com/gin/2010/webprogram/Paper3265.html	

Origin

Established in 1967, the Yeosu National Industrial Complex is the largest petrochemical complex in Korea in terms of production. It was selected as one of the national pilot project to minimize polluting emissions due to its activities, adapt to new environmental standards and improve the economic performance and eco-efficiency of the complex.

Objectives

About 11 potential symbiotic networks have been identified and 4 of them have been successfully implemented. These industrial symbioses include mainly waste, wastewater and by-product recovery (hydrogen, wastewater containing aromatic nitro, waste marble, etc.). They resulted in significant emission reduction and financial gains (reduced waste treatment cost and raw material consumption).

Success factors

The payback period for companies' investments should not exceed 4 years on average. Furthermore, like in Ulsan, academics are supporting industrial parks at Yeosu and conduct material flow analyzes to identify new opportunities of industrial symbiosis. Key success factors are therefore *value added*, *policy*, *coordinators*, *cooperation with S&T*, *location* and the clear designation as an *Eco-Innovation Park*.

Perspectives

Further details on current status and future development of the project are unknown.

3.7 United Arab Emirates

The United Arab Emirates Federal Environmental Agency was formed in 1996. Since then, some federal laws and regional conventions were set mainly aiming the protection of the (marine) water and living aquatic resources, air quality protection, diminution of agricultural pesticides and fertilizers use and hazardous waste management. At the emirate level, Abu Dhabi has developed its own waste management law.

A federal environmental program for eco-innovation parks seem not to exist. However some pilot projects (carbon-neutral cities: Masdar, Al Naseem) and associative programs (Emirates Environmental Group, WWF United Arab emirates) are identified.

In particular, the Masdar City project should include the development of a sustainable energy center.

Park no. 156: Al Naseem

UAE

Geography	UAE, Abu Dhabi, Surooj Park in Al Ain	
Type of park	Urban	
Size of park	12 ha	N/A jobs
	N/A companies	1450 inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management Biodiversity ~~Material flow~~	Cultural, social, health benefits Mobility, transport Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leader	Public	
References	Internet links www.propdubai.com/news/1327/index.php www.designbuild-network.com/projects/al-nasseem/	

Origin

Al Naseem Project is an Estidama pilot project launched in 2008. The Abu Dhabi Urban Planning Council (UPC) created the Estidama – sustainability in Arabic – initiative to improve urban development projects with a wide range of sustainability criteria: water and energy use, indoor environmental quality, ecology, transport, pollution, waste management, land use, etc.

Objectives

The Al Naseem project aims to make optimum use of energy and water, take care of the site’s natural conditions and create a city with a high quality of life. According to the available information, “the site will accommodate a spa, a wedding hotel, a central plaza, a mosque, a cultural center, a banquet hall, a souk (shopping area) and sports/daycare center. Cooling will be provided using ancient water methods and façade will be wrapped with structural metallic mesh to prevent solar glare. Cars will be restricted to three drop-off areas to avoid pollution and congestion. The project aims to implement a synergy between modernity and the landscape of Al Ain with seven oases fed by the area's large underground 'Falaj' irrigation network and employ ancient water methods to create a cooling system.

Success factors

The project focusses on sustainable urban development and has the support from the Planning Council (*policy*).

Perspectives

No recent data about the Al Naseem project is however available.

Park no. 157: Masdar City

UAE

Geography	UAE, Abu Dhabi, Masdar City	
Type of park	Combined	
Size of park	600 ha	50 000 jobs
	N/A companies	40 000 inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management Water management Biodiversity ~~Material flow~~	Cultural, social, health benefits Mobility, transport ~~Land use optimization~~ Air pollution prevention ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leader	Public	
References	(Reiche 2010); (Kennedy et al. 2011); (Residua 2007) Internet links www.masdar.ae, www.masdarcity.ae/en/, www.swiss-village.com/	

Origin & Objectives

Driven by the Abu Dhabi Future energy Company (ADFEC), the United Arab Emirates (UAE) decided to launch in 2008 the construction of " Masdar City ", a carbon-neutral and zero-waste city in Abu Dhabi. The City is currently under construction and its completion is scheduled for 2025. The project has three main political motivations and objectives (Reiche 2010); (i) long-term economic diversification strategy for Abu Dhabi Emirate, currently mainly based on exporting fossil fuels, (ii) becomes a global center of excellence for renewable energy research, (iii) serves as a model for how all future cities should be built.

The main economic sector of Masdar City will be the sustainable energy technologies (offices and research centers). The project will build on solar energy supply, recycling waste initiatives and gentle mobility (walking, cycling and public transport). High-efficiency appliances, low-flow showers, a water tariff, smart water meters and treated wastewater recycled for plant irrigation will ensure water conservation. A mix of educational and recreational spaces will allow commuters and residents to reduce transport needs. The project shall not just preserve existing regional biodiversity but enhance it (strategy policies). The Swiss Village was setup to act as an information platform and interest alliance for the Swiss business community with regards to the Masdar City project. Swiss Village includes a dedicated Swiss neighborhood and Cleantech hub in Masdar City.

Success factors

The assets of the project should probably lie in the companies' possibility of having 100% foreign ownership, zero taxes and zero import tariffs (*incentives)* and thus, also the direct business interests for the companies (*economic value added*). The ADFEC has also signed a cooperative agreement preparing the way for US Massachusetts Institute of Technology (MIT) to help develop the Masdar Institute of Science and Technology. This agreement should help the project to succeed in its objectives (*cooperation with science and technology institutions*). The last success factor to mention is the clear designation as an *Eco-Innovation Park* (more precisely as an eco-city).

Perspectives

Recent data on the stage of completion of the project is not available. Nevertheless, the project is not evolving as fast as planned and may rather evolve to a science park rather than an eco-innovation park.

3.8 United States of America

For decades, the interest for industrial ecology has been very strong among researchers and organizations in the USA. In addition, several policies and programmes led by central and local governments but also by civil society and the private sector contributed -sometimes indirectly- to the development of eco-innovation initiatives. For example, the Public Utility Regulatory Policies Act gives incentives to develop co-generation power plants (Chertow 2000). In 1994, the US Environmental Protection Agency (US EPA) offered USD 300 000 grants for eco-industrial park design and development, and also provided guidelines for their successful implementation (Chertow 2000). Moreover, some states developed their own policy to foster eco-industrial activities.

Important national and regional initiatives have been launched during the last 20 years. From June 1997 to May 1999, the Triangle J's Industrial Ecosystem Development Project, mainly funded by the US EPA, has been promoting industrial symbiosis among several existing and planned industrial parks. But after this first successful experience, the US EPA restructuration and a reduced budget for environment prevented the project to go on with its activities (Chertow 2007; Duret 2007). Besides, the US Business Council for Sustainable Development (US-BCSD) held a prominent role in the promotion of industrial ecology projects among the private sector and policy makers.

In recent years, the US-BCSD launched its By-Product Synergy Program (US-BCSD 2013) to establish by-product recovery networks based on a regional approach. In addition to reducing the amount of waste sent to landfill, the programme brought significant cost savings to participating businesses and organizations in several regions, including the Central Golf Coast described in the case studies below.

Regarding park-based initiatives, the U.S. President's Council on Sustainable Development (USPCSD) initiates several projects in the early 1990's. While some could reach the phase of implementation, other initiatives phased out and disappeared by the end of the decade. In addition, without public support, some of these parks moved away from the original eco-industrial concept. The list of eco-industrial parks that failed, stalled or abandoned any eco-innovation activities is significant: Brownsville Eco-Industria, Texas; Civano Industrial Eco-Park, Arizona; East Bay Eco-Industrial Park, California; Fairfield Ecological Industrial Park, Maryland; Phillips Eco-Enterprise Center, Minnesota; Plattsburgh Eco-Industrial Park, New York; Port of Cape Charles Sustainable Technology Park, Virginia; Phillips Eco-Enterprise Center, Minnesota; Raymond Green Eco-Industrial Park, Washington; Skagit County Environmental Industrial Park, Washington; Shady Side Eco-Business Park, Maryland; Trenton Eco-Industrial Complex, New Jersey; The Volunteer Site, Tennessee; etc. (Boons et al. 2009; Chertow 2007; Gibbs et al. 2007; ISIE 2010a).

But, during the last few years, we have witnessed an upsurge of eco-innovative projects in the USA reported by the International Society for Industrial Ecology (ISIE). Public support provides again financial and institutional incentives to develop new parks (ISIE 2010a; ISIE 2010b; ISIE 2011a; ISIE 2011b; ISIE 2011c; ISIE 2011d; ISIE 2011e;

ISIE 2011f; ISIE 2012), and revive sites that abandoned the EI concepts, like the Fairfield Eco-Business Park (ISIE 2010b). Chertow and Ashton (2009) also mention the development, sometimes spontaneous, of many industrial symbioses linkages in Puerto Rico.

While some examples are described in the case studies below, we found too many projects to detail all of them in this survey. The following eco-innovation parks aren’t detailed in this review:

- Barceloneta in Puerto Rico
- Cabazon Resource Recovery Park in California
- Chicago Center for Green Tech in Illinois
- Eco-Industrial Park Brownfield Project in Michigan
- Itasca Eco-Industrial Park in Minnesota
- Port Portland in Oregon
- ReVenture Eco-industrial park in North Carolina
- Rialto Eco-Industrial Energy Park in California
- Wanan Eco industrial park in Puerto Rico

Besides, some urban initiatives are also being developed (ISIE 2011c; ISIE 2012). For example the Boston’s Newmarket district promotes by-product exchanges among businesses and is positioning itself as an eco-industrial district, and the City of Seattle also plans to incorporate industrial ecology principles into its future district development plans.

Park no. 158: By-Product Synergy Central Gulf Coast Project

USA

Geography	USA, Alabama, Mobile	
Type of park	Industrial	
Size of park	N/A	N/A jobs
	170 companies	N/A
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ Waste management ~~Water management~~ ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Private	
References	(Boons et al. 2009); (Francis 2003) Internet links www.pepmobile.org	

Origin & Objectives

The By-Product Synergy Central Gulf Coast project promotes by-product and waste recovery and aims at forming synergies between its participants to create value since the mid-90'. The project's website mentions the first global achievements (1.6 million USD of savings for participating companies, thousands of tons of avoided emissions, etc.), it gives yet little detailed data on the synergies that have been concretely implemented excepted for the chlorine exchange network developed in the mid-1990's. Although the major part of the funding comes from company participation fees, the project benefits from various government grants and received the EPA's 2001 Gulf Guardian Award. The project design is based on the By-Product Synergy Program of the U. S. Business Council for Sustainable Development (US-BCSD, one of the project's partners) and recently gets inspiration from the experience of the United Kingdom's National Industrial Symbiosis Programme (NISP).
By-Product Synergy Central Gulf Coast operates nowadays as a project of Partners for Environmental Progress (PEP), a non-profit business association grouping more than 170 companies of the Alabama Gulf Coast area. The project aims at creating value added within area businesses while minimizing their environmental impacts. By employing a "multi-industry collaborative approach", the objective is to 1) identify opportunities for cost savings and innovations through data collection and analysis, and 2) realize these potentials. The first project phase was implemented from May 2009 through late 2010 and involved 12 companies operating in various industrial sectors. Through waste recycling and reuse more than 8200 tons of materials have been diverted from disposal. In addition, the project operators train companies to identify synergies and expand existing schemes. Moreover, By-Product Synergy Central Gulf Coast provides a forum in which participants can share ideas and learn from each other's experience.

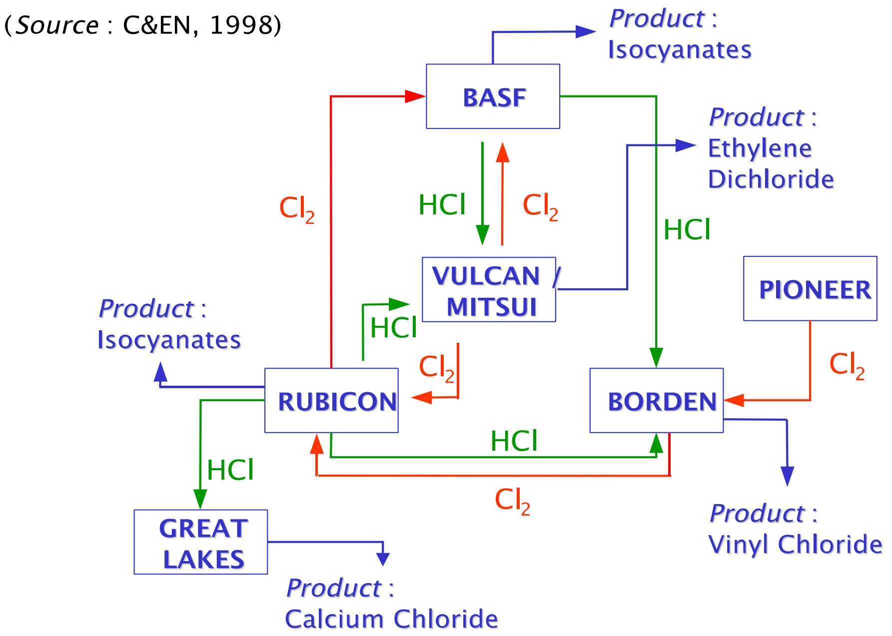
Success factors

Success factors are *policy*, *incentives*, *coordinators* and *diversity*.

Perspectives

The 2nd implementation phase started in December 2011 and ended by the end of 2012. The objective was to involve an additional 20 companies in the project, but no information is available on the actual status of the project.

Fig. 52 > Gulf Coast Chlorine Exchange



after Francis 2003

Park no. 159: Camden Eco Industrial Park

USA

Geography	USA, North Carolina, Camden	
Type of park	Combined	
Size of park	28 ha (phase 1)	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management Water management Biodiversity Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leader	Public	
References	(Crawford-Brown et al. 2009); (ISIE, 2010a); (Bauman 2011) Internet links www.hamptonroads.com/2011/02/solar-farm-looks-be-first-tenant-business-park www.efc.unc.edu/publications/2008/CamdenCountyGreenIndustrialPark.pdf www.camdencountync.gov/departments/economic-development/development-sites/camden-eco-industrial-park www.dailyadvance.com/community/camden/after-delays-camden-eco-park-work-back-track-1479691	

Origin

In 2008, the University of North Carolina (UNC), sponsored by the Golden LEAF Foundation, conducted a feasibility study for the development of a "green" industrial park in Camden County. The study focused on three themes: 1) business opportunities and regional development, 2) environmental impacts, and 3) governance and finance. The estimated cost for the first phase is USD 40–60 million over five years. This includes the construction of basic infrastructures (water lines, sewer, roads).

Objectives

The Camden County created its first economic development commission especially for the park. The work of the commission is mainly to balance environmental concerns against economic imperatives. In this respect, it defined covenants for the eco-industrial park: companies are required to have light environmental footprints and develop by-product exchanges and waste recovery networks. The selection of the tenants is very restrictive, as no heavy industries or even fast food restaurants will be allowed. Moreover, construction for all buildings includes the use of state-of-the-art sustainable materials and techniques. The use of renewable energies is also actively promoted. Green roofs on commercial and industrial buildings and restored wetlands will be used to manage stormwater and provide an amenity for nearby residents.

Success factors

The current institutional context in North Carolina is a prominent asset for the development of eco-innovation parks. A legislative package has been recently adopted and fosters the development of eco-parks, based on the Camden model (the first of its kind in the state). Potential economic incentives include credits for R&D and renewable energy investment, sales and use tax refund, etc. Besides, the construction of basic infrastructures benefited from USD 5.7 million state grants. Prominent success factors for this project are therefore *policy*, *incentives*, *cooperation with science and technology institutions*, and *Eco-innovation park*.

Perspectives

The park is still in its early development stage. The first phase objectives are nearly achieved: water lines and sewer, a renewable energy power plant. The next phases will imply the acquisition of additional land (for a total 121 ha) and include further business development (in addition to the extension of basic infrastructures), but also commercial and R&D facilities, as well as a residential area. In 2011, there was a project of a 1 MW solar farm of 4000 panels but no recent data has been found about its implementation. In 2012, the park's development seems to have been delayed due to the hurricane Sandy.

Park no. 160: Devens planned community

USA

Geography	USA, Massachusetts, Devens	
Type of park	Combined	
Size of park	1780 ha	4000 jobs
	75 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management ~~Water management~~ Biodiversity Material flow	Cultural, social, health benefits ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Gibbs et al. 2007); (Duret 2007); (Boons et al. 2009); (ISIE 2011a) Internet links www.ie.tudelft.nl/index.php/Devens_Planned_Community,_Massachusetts www.devenscommunity.com/about-devens www.devensec.com/ecoreport.html www.ecostardevens.com/ http://www.ecostardevens.com/2011AnnualReport.pdf	

Origin

After serving as a military base for 79 years, Fort Devens was closed in the early 1990s and converted into a planned community by the Massachusetts economic development agency (MassDevelopment). A survey conducted among local population concerning the future development of the area highlighted the importance of nature and resource conservation. Consequently, MassDevelopment gave the Devens Enterprise Commission (DEC) the mission to integrate sustainable development and industrial ecology principles in the development and management of the site.

Objectives

About 75 businesses (mainly SMEs) are operating in the Devens eco-industrial area in the sectors of high tech, logistic, manufacturing, etc. The environmental policy established and promoted by the DEC is mainly based on a programme (Eco Star) elaborated jointly by local public and private stakeholders. This programme aims at fostering networking and environmental commitment among onsite and other local firms. Firms willing to settle in the park have to write an application letter and meet the criteria fixed by the DEC. The Eco Star programme criteria include by-products and information exchanges, joint purchasing, recycling, sustainable building, reduced use of toxic chemicals, mutual aid to reach standards, etc. Besides, through the creation of regional Household Hazardous Waste Recycling Centers, toxic waste collection and treatment services are provided to surrounding communities and businesses generating small quantities of hazardous waste (such as oil-based paint, rechargeable batteries, cleaning solvents, fluorescent bulbs, etc.). Encouraging innovation, the site disposes of a 3 MW photovoltaic power plant, energy efficient-buildings (net zero energy) and permanently protect 460 ha of land.

Success factors

Prominent success factors for this park development are *value added*, *policy*, *coordinators*, *diversity* and *Eco-innovation park*. To support the eco-industrial development of Devens, an Eco-Efficiency Center has been created (as a non-profit organization) and collaborates with the DEC. The Eco Star Programme promoted by the Center is coherent with the 10 Principles of Sustainable Development adopted by the State of Massachusetts and help to implement them by providing educational forums, round table events for industries, technical assistance, waste management services and networking opportunities that result in compact industrial development and creation of value added.

Perspectives

The Eco-efficiency Center publishes an annual report to communicate about its achievements. By continuously promoting good practices and organizing multi-stakeholders events around environmental topics, it greatly contributes to the dynamic eco-industrial development of the area. In addition, new waste management services for firms are planned.

Park no. 161: Guayama Industrial Symbioses

USA

Geography	USA, Puerto Rico, Guayama	
Type of park	Industrial	
Size of park	16 900 ha	N/A jobs
	N/A companies	42 000 inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency Waste management Water management ~~Biodiversity~~ Material flow	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Private	
References	(Chertow 2007); (Chertow et al. 2009); (Van Der Hek et al. 2010) Internet links www.csrp.com.au/database/pr/guay/	

Origin & Objectives

In the city of Guayama, “spontaneous” development of industrial symbioses (IS) began in 2002, when regulatory conditions due to regional water scarcity drove a new coal-fired plant (AES) to use municipal waste water and co-generate steam for a nearby petrochemical refinery (Chevron-Phillips). But this was just the beginning.

Few years later, AES started to market its ash by-products to industrial landfills (to stabilize liquid waste) and construction sites (as aggregate material) and is “continuously looking for IS opportunities”. The successful experience of this anchor industry influenced other companies and raised awareness in the region. Guayama is the site of various other industries including pharmaceutical, cosmetics, mechanical engineering and packaging.

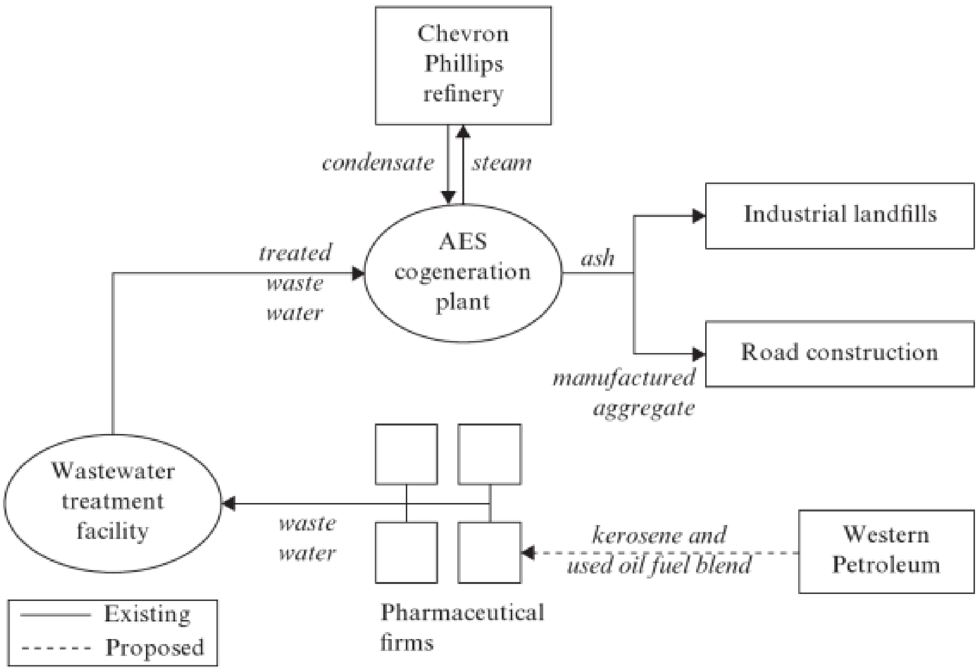
Success factors

In addition to *policy* -regulation regarding water management triggered IS in the region- and *diversity*, relevant success factors in Guayama also include *coordinators*. Industrial symbioses could be further promoted through local business organizations and the existing configuration regarding industrial park management with Puerto Rico Industrial Development Company (PRIDCO) in its center.

Perspectives

For now, only a few companies are participating in exchange networks, but the potential for new synergetic linkages is very promising in Guayama, and also in other industrial areas in Puerto Rico, like Barceloneta.

Fig. 53 > Industrial symbioses linkages in Guayama, Puerto Rico



after Chertow et al. 2009

Park no. 162: Intervale Food Center (Formerly Riverside Eco-Park)

USA

Geography	USA, Vermont, Burlington	
Type of park	Industrial	
Size of park	142 ha	73 jobs
	12 companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency Waste management ~~Water management~~ Biodiversity Material flow	Cultural, social, health benefits ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(Chertow 2007); (Wahl 2008) Internet links www.intervale.org/ www.usc.edu/schools/price/research/NCEID/Profiles/Mini_Sites/Intervale_Food_Center.html www.communityfoodenterprise.org/case-studies/u.s.-based/intervale-center	

Origin & Objectives

Active since 1988, the Intervale Center (formerly Riverside Eco-Park) is a sustainable agricultural-based project initiated by local community members. The City officials recognized the potential of the project, designed as a "partnership of the public, private, and non-profit sectors". The first action was to clean the "Intervale", a parcel of neglected land used as an informal dumping site for all kinds of garbage. Community members restored the soil through composting, gardening and farming. The original development concept for the site was to follow the approach of industrial ecology, to create collaboration and exchange networks, and aims at integrating environmentally and socially sustainable agriculture with cutting-edge technology.

The site includes various types of production farms and a conservation nursery for riparian conservation projects. Exchanges have been established with the Burlington Electric's McNeil Generating Station, which is mainly fed with locally and sustainably grown wood chips and delivers its waste heat (steam) to greenhouses and buildings. Also, urban organic waste is composted on the site for resell and food production. But further development of the industrial ecology schemes seems to have been progressively abandoned after "political vagaries of federal funding and complications with a neighboring industry" in 2002.

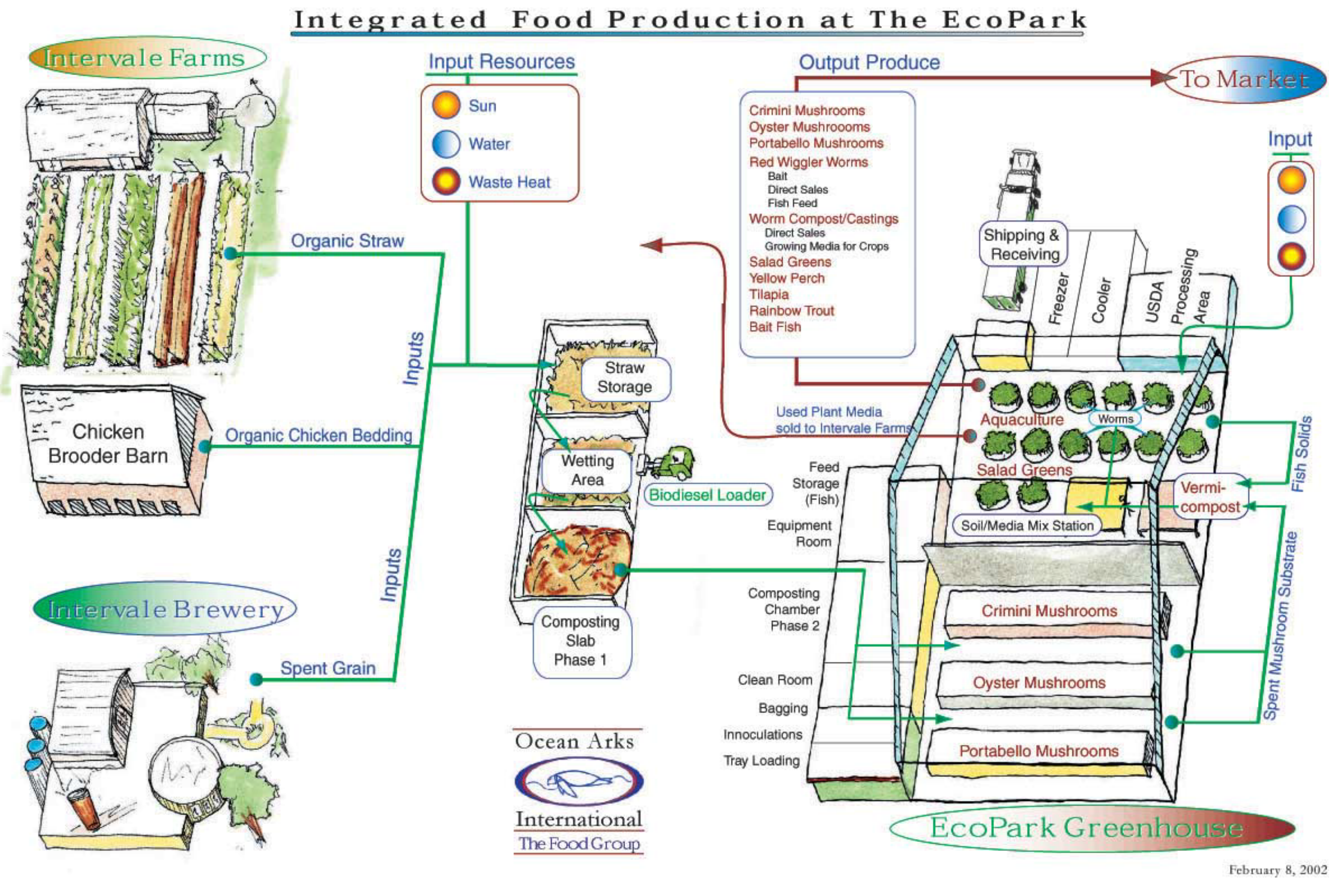
Success factors

The Center includes an incubator for new businesses, a local food education program and offers consulting services for farmers, and a land preservation initiative. Prominent success factors concerning this initiative are *coordinators* and *value added*.

Perspectives

Since 2002, the site focused on organic compost and food production, and development of value-added processing. Altogether, more than USD 1 million of organically grown food for local consumption is produced each year on the site in 2009.

Fig. 54 > Flow resources in the integrated biosystem of Intervale Burlington



after Voinov 2013

Park no. 163: Keystone Industrial Port Complex

USA

Geography	USA, Pennsylvania, Fairless Hills	
Type of park	Industrial	
Size of park	521.64 ha	N/A jobs
	50 companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(ISIE 2010b); (ISIE 2011e); (ISIE 2011f) Internet links www.naikipc.com/ www.kipctv.com www.cmu.edu/steinbrenner/brownfields/Case%20Studies/pdf/kipc%20case%20study.pdf www.epa.gov/oswercpa/docs/success_fairlesshills_pa.pdf	

Origin & Objectives

This brownfield is the former site of U.S. Steel Fairless Works. In operation since 1952, it employed close to 7000 people but scaled back its activities in the 1980's. The old facility housed a coke plant, a steel mill, finishing and forging operations, a power-house and a chemical plant. As these operations severely contaminated soil and groundwater in the area, US EPA and U.S. Steel Fairless Works entered into a Consent Order to clean up the site in 1993. In 2005, the Commonwealth of Pennsylvania designated part of the site as one of 12 Keystone Opportunity Improvement Zones (KOIZ) in the state. The main objective is to create employment, foster the development of new industry in the area.

The redevelopment strategy for this brownfield site is to transform it into a "green industrial complex", including a renewable energy manufacturing cluster, but also metals scrap and coal dust recycling, soil decontamination and reuse, and electrical power production from landfill gas. As for renewable energy, the main tenants are Gamesa, a large-scale producer of wind turbines, and AE Polysilicon, which produces material for photovoltaic panels. They plan to invest USD 104 million in renewable energy facilities and should create 450 jobs. In 2010, the US Department of Environmental Protection awarded Scheuten Solar USA Inc. USD 3 million to build a 5 MW solar power plant.

Success factors

In addition to a strong political support, the Keystone Industrial Port Complex (KIPC) development benefited from various financial incentives, with about USD 12 million in loans, grants, and tax incentives for the development of renewable energy manufacturing. In 2010, KIPC also obtained the Pennsylvania Governor's Award for Environmental Excellence. Moreover, the Commonwealth of Pennsylvania set up a committee of economic development professionals that works with businesses, site consultants, and investors on new projects possessing significant investment and job creation opportunities. Besides, the site has access to railway and deep-water port. Success factors for the KIPC development are therefore *value added*, *incentives*, *policy*, *coordinators*, *location* and *Eco-innovation park*.

Perspectives

KIPC recently joined the US EPA's Sustainability Partnership Program with the objective to improve the environmental (and economic) performance of current and future tenants regarding natural resource consumption, energy use and waste management.

Park no. 164: Londonderry Eco-Industrial Park

USA

Geography	USA, New Hampshire, Manchester	
Type of park	Industrial	
Size of park	40 ha	N/A jobs
	3 companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ Energy efficiency ~~Waste management~~ Water management ~~Biodiversity~~ Material flow	Cultural, social, health benefits ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	Public	
References	(Mouzakitis 2003); (Boons et al. 2009) Internet links www.thriveinlondonderry.com/londonderry-advantage/eco-park.aspx www.csrp.com.au/database/usa/lond	

Origin

Londonderry is a town of 24 000 inhabitants located in southern New Hampshire. The town decided to create an eco-industrial park next to Stonyfield farm observing a spontaneous synergy (water cascading) between two local companies, a plastic recycler and an organic dairy producer (Stonyfield). In 1996, a governance system and covenants were established by the town to foster an improved environmental performance for all tenants through the development of cooperation and synergies, but also individual measures regarding environmental management, resource use, accountability and reporting, etc. It was expected that good practices in the park would progressively also be adopted by the businesses located in the larger surrounding industrial development area.

Objectives

Existing businesses within the park are a cogeneration gas fired power plant (AES, the “anchor” tenant), a medical supply distribution firm (Gulf south Medical Supply), and a multinational engineering and electronics company (Bosch). Collaboration links between them and with external partners include: material flow exchanges, with 11 to 15 million litres of treated water from the Manchester treatment plant used in the cogeneration facility cooling process; shared infrastructures (refrigerated warehousing, recycling equipment, heating and cooling systems). Different kinds of services are also proposed to the employees: van pooling, childcare and nature trails through the park.

Success factors

According to its promoters, cooperation links within the park have been profitable to the tenants, who are financially more efficient thanks to shared infrastructures and joint purchasing and sales for common goods. The park also benefits from its location near the Manchester-Boston Regional Airport. Key success factors are therefore *coordinators, value added*, *location*, and *Eco-innovation park*.

Perspectives

In the Industrial Symbiosis Eco-Industrial Development Section Update of December 2011 (a newsletter of the International Society for Industrial Ecology, ISIE), the Londonderry Eco-industrial Park is considered as “dormant” concerning its eco-innovation activities. Nonetheless, students from the Yale Industrial Ecology Program were contacted by Stonyfield and asked to investigate new development opportunities for the park.

Park no. 165: Red Hills Ecoplex

USA

Geography	USA, Mississippi, Ackerman	
Type of park	Industrial	
Size of park	55 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	Renewable energy Energy efficiency ~~Waste management~~ ~~Water management~~ ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	In use	
Project leader	PPP	
References	(Potts Carr 1998); (Boons et al. 2009) Internet links www.usc.edu/schools/price/research/NCEID/Profiles/Mini_Sites/Red_Hills.html www.choctawcountyms.com/economic-development/available-sites-buildings/red-hills-ecoplex www.choctawcountyms.com/wp-content/uploads/2011/07/EcoPlex-Brochure.pdf www.woodbioenergymagazine.com/magazine/2010/spring/news.php	

Origin

The Red Hills Ecoplex is an industrial ecology project located in the Choctaw County, Mississippi. It has been created to establish synergies around two anchor tenants, the Red Hills Power Plant and the Red Hills Mine. The 440 MW lignite-fired power plant, owned by an affiliate of Suez Energy North America, uses "clean-coal technology" and produces electricity since April of 2002. Mississippi Lignite Mining Company supplies lignite coal to the power plant and has permitted area of 2359 hectares acres with over 200 million tons of mineable lignite.

Objectives

Among the new tenants is a 700 MW steam-electric power plant with natural gas-fired turbines, which production began in January of 2007. In 2010, Raven Biofuels International Corp. started the construction of a cellulosic ethanol refinery, which will feed on locally sourced wood chips and wood waste. But despite the park promoters claiming that it is designed to attract environmentally friendly businesses and build a by-products exchange network, no detailed data is available on existing synergies.

Success factors

Key success factors are *incentives* and *policy*. According to the park developers, businesses locating in the EcoPlex may benefit from various incentives, including environmental technology grants, regulatory allowances and other programmes "based on industrial ecology, energy-efficiency, and environmental design." In addition, the State of Mississippi has set aside a USD 1.5 million funds for infrastructure improvements

Perspectives

The EcoPlex seems to be still in the developmental stage and is currently looking for new "complementary" tenants operating in various sectors, identified for their potential regarding future synergies: food processing, intensive aquaculture, hydroponic green housing, pulp and paper, wood, CO_2 recovery and others industries. Also, as the lignite mine activities expose substantial quantities of clay, the park is searching for companies operating in stone clay and concrete products.

Park no. 166: Royal Phoenix Redevelopment Project (Avtex Fibers Superfund Site)

USA

Geography	USA, Virginia, Front Royal	
Type of park	Combined	
Size of park	66 ha	N/A jobs
	N/A companies	N/A inhabitants
Eco-criteria	~~Renewable energy~~ ~~Energy efficiency~~ ~~Waste management~~ ~~Water management~~ Biodiversity ~~Material flow~~	Cultural, social, health benefits ~~Mobility, transport~~ Land use optimization ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leader	PPP	
References	(Boons et al. 2009); (EDA 2011) Internet links www.avtexfibers.com www.epa.gov/superfund/accomp/success/avtex.htm www.epa.gov/reg3hwmd/npl/VAD070358684.htm www.wceda.com/resources/available-site/royal-phoenix/	

Origin

This former industrial site, located in Warren County, has been severely polluted during almost 50 years by hazardous waste disposed on site by a manufacturing plant producing rayon (an old manmade textile fibers and filaments composed of regenerated cellulose) and other synthetics. In 1989, polychlorinated biphenyl (PCB) water contamination has been linked to the Avtex Fibers plant, which was forced to close soon after. The site became then one of ten pilot sites selected for the EPA's Superfund Redevelopment Initiative (SRI), a national program to redevelop former hazardous waste sites and has been renamed as the "Royal Phoenix" site. Under the oversight of the U.S. Environmental Protection Agency (EPA), FMC Corporation (FMC) is performing various cleanup activities, including removal of contaminated soil, building demolition, debris treatment and removal, sewer excavation and landfill capping. This allowed to remove from the site more than 200 000 tons of waste material and contaminated soils. FMC is also controlling erosion, collecting and treating contaminated storm water, and maintaining site security. Cleanup plans for ground water and surface water are also ongoing.

The decontamination activities started in 1989.

Objectives

Through a multi-stakeholder approach involving EPA, local government, private sector and communities, participants developed a redevelopment plan that divides the site into three areas: a river conservation park, a recreation park, and an eco-business park. The plan for the conservancy and recreation areas includes the following: ecological restoration and conservation of native habitats with recreation opportunities; themed trails will present the story of the site's pollution, cleaning up and restored ecology; soccer fields and a skateboard park. Measures concerning eco-innovation in the business park are focused on buildings rehabilitation, design and construction: sustainable construction materials, reduced life cycle and operation/maintenance costs, and improved indoor environmental quality for employees. Office buildings in the park should meet the LEED (Leadership in Energy and Environmental Design) standards (USGBC 2013).

Success factors

With its Superfund Redevelopment Initiative, US EPA is working in partnership with various stakeholders, which strengthens the long-term viability of the contaminated sites redevelopment plans. Development Authority (EDA) is taking the lead on planning the eco-business park, but US EPA has exclusive authority to release land for reuse, which is an additional guarantee that environmental concerns will be concretely included in the site's development. Key success factors for this site are *policy*, *coordinators* and *Eco-innovation park*.

Perspectives

If the cleaning up of the site is now achieved, by the end of 2011 park developers were still waiting for approval by authorities before implementing further development. In the meantime, EDA will continue to study "responsible and viable development projects that are well-suited for the currently complex restrictions and allowable uses for this site".

Park no. 167: Silver Bay Eco-Industrial Park

USA

Geography	USA, Minnesota, Silver Bay	
Type of park	Industrial	
Size of park	44 ha	135 jobs (planned)
	N/A companies	N/A inhabitants
Eco-criteria	Renewable energy ~~Energy efficiency~~ Waste management Water management ~~Biodiversity~~ Material flow	Cultural, social, health ~~benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ ~~Noise prevention~~ ~~Environmental Mgmt System~~
Status	Under construction	
Project leader	PPP	
References	(ISIE, 2010b); (ISIE, 2011e); (ISIE, 2011a) Internet links www.silverbay.com/buspark.htm www.silverbay.com/MPCA%20Grant%20Project%20Summary.pdf www.silverbay.com/Eco-Industrial%20Business%20Park%20Presentation.pdf www.wtip.org/drupal/content/silver-bay-moving-forward-eco-industrial-business-park	

Origin

This project originated in 2008, when stakeholders implied in the development of the Silver Bay Business Park -including the City of Silver Bay, Minnesota Pollution Control Agency and private actors- discussed how to transform it into and eco-industrial park. As a result, they decided to assess the potential for renewable energies development and to achieve “zero waste-zero emissions” through the application of industrial ecology principles. Their main motivations are to improve resource productivity and eliminate pollution while expanding markets and create new employment opportunities.

Objectives

One of the park developers’ key objectives is to build exchange networks among the tenants to foster waste and by-product recovery. They also want to develop a self-sufficient park with its own power supply facilities using renewable energies (wind, biomass, and biodiesel). Onsite greenhouses will produce organic vegetables, fish and algae for biodiesel, using reclaimed rainwater from rooftops as well as nutrients fish production and Silver Bays Water treatment facility. But the anchor of the park will be the biomass combined heat and power (CHP) plant, owned by the City of Silver Bay.

Success factors

In 2011, the Silver Bay Eco-Industrial Park project had already received several grants totalling USD 600 000 to reach its objectives. These grants financed feasibility studies, land use planning and zoning schemes, construction of infrastructures and also the creation of guidelines for businesses that wish to develop sustainable activities, as well as a communication program to promote the park new development among educators, tourists, and officials. Key success factors are therefore *incentive* and *coordinators* and *Eco-innovation park*.

Perspectives

The Silver Bay Eco-Industrial Park is in its first phase of redevelopment, and most of the eco-innovations are still to be implemented.

Park no. 168: TwelvelWest

USA

Geography	USA, Oregon, Portland	
Type of park	Urban	
Size of park	5.13 ha	N/A jobs
	N/A companies	273 apartments
Eco-criteria	Renewable energy Energy efficiency ~~Waste management~~ Water management ~~Biodiversity~~ ~~Material flow~~	~~Cultural, social, health benefits~~ ~~Mobility, transport~~ ~~Land use optimization~~ ~~Air pollution prevention~~ Noise prevention ~~Environmental Mgmt System~~
Status	In use	
Project leader	Private	
References	Internet links www.designbuild-network.com/projects/twelvewestportlandor www.metropolismag.com/February-2010/Twelve-West/ www.greensource.construction.com/green_building_projects/2010/1007_twelve-west.asp www.indigo12west.com/	

Origin

The Twelve|West tower, designed by Zimmer Gunsul Frasca (ZGF) Architects, is a mixed use 23-storey (81m) building with offices, retail space, and apartments. Opened since July 2009, it achieved two LEED Platinum certifications for base building new construction (NC) and commercial interiors (CI) ratings system.

Objectives

Sustainable materials and equipment are used for the apartments, e.g. bamboo veneer casework, recycled content carpets, zero-VOC paint, low-flow plumbing fixtures, PVC-free window coverings, Energy Star appliances, etc. The tower is also designed to maximize natural light and ventilation. On the roof a 126 m² solar thermal array produces about 24% of the tower domestic hot water needs and 4 wind turbines produce annually 9000 kW/h (about 15 times less than the solar array). Besides, a rainwater reclamation system provides 90% of the office’s toilet-flushing needs (Oregon health codes didn’t allow for use of reclaimed water in the apartments). Stored rainwater also irrigates vegetated areas on the roof. Overall, savings could reach 50% in both energy and water use.

Success factors

For the rainwater reclamation system, the municipality offered a 30% reduction in systems development charges based on the anticipated reduction in storm water runoff, which sometimes leads to the overflow of Portland sewer system. In addition to its LEED certifications, Twelve|West has won in 2010 a place in the American Institute of Architects Committee on the Environment Top Ten Green Projects. Key success factors are therefore *incentive* and *coordinators* (communication & marketing).

Perspectives

Even if the energy production is marginal, the rooftop wind turbines installation was the first of its kind in the US. Its designers faced many challenges to conceive a first compact all-inclusive personal wind generator (Skystream 3.7). They gave special attention to noise and vibrations reduction to avoid their transmission to the building structure. This pilot project will serve as a testing ground for future installations.

> Annexes

A1 The specific case of energy distribution systems

The following cases are examples of innovative experiences in terms of efficient energy production and distribution systems. They are not included in the study as detailed case studies as they focus on a single eco-innovation aspect and do not involve various entities working together in a given spatial area. A brief description of the most prominent cases is given below. Most of them are based on co-generation systems or combined heat and power (CHP) plants, which are much more efficient than conventional power plants focusing only on one type of energy, and produce energy for collocated industries, urban areas, or both.

In Austria, Bioenergie Mureck involves three companies that supply the entire Mureck region with electricity, heat and fuel. Five energy cycles are interconnected with rapeseed, used cooking oil, heat, biogas and electricity. The initiative has won several prizes and plans to make the city use 100% renewable energy (today 75%) (SEEG 2013).

The Avedøreværket CHP Plant in Denmark is known as one of the world's most efficient of its kind. The plant consists of two units: the older one (1990) is coal- and oil-fired while the second unit (2001) can feed on natural gas and oil as well as on biomass (i.e. wood pellets and straw). Their overall energy efficiency is 91% and 93%, respectively, and they supply approximately 200 000 households with heat and 1.3 million households with power (Dong Energy 2013; Renewable Energy Information 2008).

In the city of Jyväskylä, Finland, a highly efficient system for energy supply is organized around a public-owned cogeneration plant (Rauhalahti). The main fuel for the CHP plant is peat followed by waste wood provided mainly from nearby paper mills. It supplies heat and power to industry and households in the area and an energy cascading system provides connected companies with recovered heat (Chertow 2007; Korhonen 2001a; Saikku 2006).

In the city of Södertälje, Sweden, the Igelsta CHP plant produces most of the district heating. It has a capacity of 200 MW for heat and 85 MW for electricity, enough to provide heat for 50 000 houses and electricity for 100 000 households. Its new boiler feeds mainly on renewable and recovered materials (instead of coal) such as residues from forestry and paper industries, crops (willow salix and reed canary grass), urban waste wood pellets (Söderenergi 2010).

In Switzerland, Axpo Tegra AG, a private biomass based energy provider, takes woodwaste from local companies and produces electrical power as well as district heat and process steam, which are used by other industries in the same industrial park. The company produces around 125 000 MWh of CO_2-neutral electricity and 220 000 MWh of thermal energy annually (Axpo 2013).

Besides CHP plants, other noteworthy experiences are heating and cooling networks.

In Helsinki, the world's largest heat pump uses heat from wastewater and seawater to provide district heating (90 MW) and cooling (60 MW) (Helsingin Energia 2013; Shields et al. 2009). In Switzerland, the Geneva-Lake-Nations project and the Zurich hydrothermal networks were both initiated in 2002. These air-conditioning systems use water from the nearby lakes to provide heat and cold to various public and private buildings (Chertow 2007; Geneve Cooperation Internationale 2013; Hawkins 2009). In Geneva, the water rejected by the network is reused to irrigate public gardens.

Also in Switzerland, the public-private partnership CADCIME has been initiated in 1993 and put into operation in 1997. It has developed an energy network system that recovers heat from a cement plant owned by Holcim to provide district heating to nearby communities. The current system has an overall capacity of 20 MW and allows for yearly economies of approximately 1.6 million liters of fossil fuel for heating purposes. This approach has been successfully developed for 15 years by Holcim, which is implementing it in a growing number of cement factories around the world in collaboration with public authorities.

In the United Kingdom, Milton Keyes has a reputation as a pioneer in energy conservation through architectural and urban design. The city is part of the on-going Concerto Initiative, a European Union initiative to foster energy efficiency. 650 dwellings (nearly 3830 people) are included in this project which focuses on buildings energy efficiency (insulation, heat recovery systems) and renewable energy supply. Also intelligent management systems are being designed to optimize energy consumption (Concerto 2013).

In Switzerland, Energienetz GSG is a governmental and industry funded energy efficiency platform for urban and industrial areas. An on-going pre-study called "Masterplan Energie" includes 77 office and residential buildings, as well as 150 industrial buildings/companies on an area of 600 ha. Heat and process steam of every building/company are represented on a map as a basis for establishing an efficient energy network plan and developing synergies (Energienetz Gsg 2013).

A2 List of the detailed eco-innovation parks

Tab. 6 > List of detailed European eco-innovation parks

see also Map in Fig. 4.

Country	Name of case	Map number	Type of park	Project status
Austria	Aspern Vienna's Urban Lakeside	1	urban	under construction
Austria	Eco World Styria	2	industrial	in use
Austria	Ecopark Hartberg Steiermark	3	industrial	in use
Belgium	Créalys® Scientific Park	4	industrial	in use
Belgium	Ecolys® Park	5	industrial	under construction
Belgium	Evolis Business Park	6	combined	under construction
Belgium	Galaxia Industrial Park	7	industrial	in use
Belgium	Kaiserbaracke Industrial Park	8	industrial	in use
Belgium	Monceau-Fontaines Park	9	industrial	in use
Belgium	Tenneville Industrial Park	10	industrial	under construction
Bulgaria	Business Park Sofia	11	industrial	in use
Denmark	Aarhus Eco-city	12	urban	in use
Denmark	Herning-Ikast Industrial Park	13	combined	Planned
Denmark	Kalundborg – sustainable city – waste makes resource	14	combined	in use
Finland	Harjavalta Industrial Eco-Park	15	industrial	in use
Finland	Kymi Eco-Industrial Park	16	industrial	in use
Finland	MABU (Material Business) Project	17	industrial	in use
Finland	Rantasalmi Eco-industrial park	18	industrial	in use
Finland	Uimaharju Industrial Area	19	industrial	in use
France	Chemical Valley Industrial Area	20	industrial	in use
France	Croix-Fort Artisanal Park	21	industrial	under construction
France	Deux Synthe Industrial Park	22	industrial	in use
France	Grand Troyes Park	23	industrial	in use
France	Havre Industrial-Harbour Park	24	industrial	in use
France	Lagny-sur-Marne and La Courtilière Industrial Parks	25	industrial	in use
France	Les Sohettes Bio-refinery	26	industrial	in use
France	Lille City	27	urban	in use
France	Nogent Industrial Basin	28	industrial	planned
France	Plaine de l'Ain Industrial Park	29	industrial	in use
France	Port-Jérôme Industrial Park	30	industrial	in use
France	Roche en Brénil Wood Ecopole	31	industrial	in use
France	Technopôle de Métropole Savoie	32	industrial	in use
France	Torvilliers Industrial Park	33	industrial	in use
Germany	BASF Verbund site Ludwigshafen	34	industrial	in use
Germany	Bayer Industrial Park Brunsbüttel	35	industrial	in use
Germany	Camp CO2-Zero	36	industrial	under construction
Germany	Chemical industrial Park Knapsack	37	industrial	in use
Germany	Chemie- und Industriepark Zeitz	38	industrial	in use

Country	Name of case	Map number	Type of park	Project status
Germany	ChemiePark Bitterfeld Wolfen	39	industrial	in use
Germany	Chempark Dormagen	40	industrial	in use
Germany	Chempark Krefeld-Uerdingen	41	industrial	in use
Germany	Chempark Leverkusen	42	industrial	in use
Germany	Dow Value Park	43	industrial	in use
Germany	Felsenpark	44	industrial	stopped
Germany	Gertshofen Industriepark	45	industrial	in use
Germany	Gewerbenetzwerk Pfaffengrund	46	industrial	in use
Germany	Honeywell Seelze	47	industrial	in use
Germany	Industriepark Höchst	48	industrial	in use
Germany	Industriepark Kalle Albert	49	industrial	in use
Germany	Infraleuna, Leuna	50	industrial	in use
Germany	Marl Chemical Park	51	industrial	in use
Germany	Neue Bahnstadt, Opladen	52	combined	under construction
Germany	Oberbruch Industry Park	53	industrial	in use
Germany	Pharma- und Chemiepark Wuppertal	54	industrial	in use
Germany	Schwedt Industrial Park	55	industrial	in use
Germany	Zero Emission Park Bottrop	56	industrial	in use
Germany	Zero Emission Park Bremen	57	industrial	in use
Germany	Zero Emission Park Kaiserslautern	58	industrial	in use
Italy	Amaro Industrial Park (Area Industriale di Amaro)	59	industrial	in use
Italy	Cairo Montenotte Industrial Park (Area Industriale di Cairo Montenotte)	60	industrial	in use
Italy	Envipark (Parco Scientifico Tecnologico per l'Ambiente)	61	industrial	in use
Italy	Lucento Industrial Area (Area Industriale Lucento)	62	combined	in use
Italy	Navicelli di Pisa Park (Area Navicelli di Pisa)	63	industrial	in use
Italy	Padova Industrial Park (Zona Industriale di Padova, ZIP)	64	industrial	in use
Italy	Ponte Rizzoli Industrial Park (Area Industriale di Ponte Rizzoli)	65	industrial	in use
Italy	Prato 1st Industrial Macrolotto (1° Marcolotto Industriale di Prato)	66	industrial	in use
Italy	San Daniele s.c.a.r.l Agrifood Park (Parco-Agro-Alimentare di San Daniele s.c.a.r.l.)	67	combined	in use
Luxembourg	Ecopark Windhof	68	combined	in use
Luxembourg	Organic City – Diddeleng Neischmelz	69	urban	planned
Netherlands	Biopark Terneuzen	70	industrial	in use
Netherlands	Chemiepark Delfzijl	71	industrial	in use
Netherlands	Emmtec industry & business park	72	industrial	in use
Netherlands	Moerdijk	73	industrial	in use
Netherlands	Rietvelden – De Vutter (RiVu)	74	industrial	in use
Netherlands	Rotterdam Harbor INES project	75	industrial	in use
Netherlands	South Groningen business park	76	industrial	in use
Poland	Boruta Zgierz Industrial Park	77	industrial	in use
Poland	Business Garden Warsaw	78	combined	under construction

Country	Name of case	Map number	Type of park	Project status
Poland	Police Industrial Park	79	industrial	in use
Poland	Pulawy Production Park	80	industrial	in use
Poland	Wroclaw Industrial Park	81	industrial	in use
Portugal	Relvão Eco-Industrial Park	82	industrial	in use
Portugal	ResiSt Project	83	combined	under construction
Slovenia	EKO-PARK d.o.o. Lendava	84	industrial	under construction
Spain	22@Barcelona	85	combined	in use
Spain	Cicle Pell	86	industrial	planned
Spain	Els Pedregals	87	industrial	planned
Spain	Parc de l'Alba	88	combined	in use
Spain	Parque tecnológico de Valencia	89	industrial	in use
Spain	Parque Tecnológico Galicia Tecnópole	90	industrial	in use
Spain	Parque tecnológico y logístico de Vigo	91	industrial	in use
Spain	Polígono As Gándaras	92	industrial	in use
Spain	Polígono industrial de Alfacar	93	industrial	in use
Spain	Polígono Industrial El Congost	94	industrial	in use
Spain	Polígono O Ceao	95	industrial	in use
Spain	Santa Perpètua de Mogoda industrial area	96	combined	planned
Sweden	Hammarby Sjöstad	97	urban	in use
Sweden	Händelö Island	98	industrial	in use
Sweden	Jämtland County	99	combined	in use
Sweden	Landskrona Industrial Symbiosis	100	combined	stopped
Sweden	Malmö Cleantech City	101	combined	in use
Sweden	Norrköping and Linköping	102	combined	in use
Sweden	Södra Cell – Mönsterås Network	103	combined	in use
Switzerland	Basel Industrial Area	104	industrial	in use
Switzerland	Bulle industrial park	105	industrial	in use
Switzerland	Chablais eco-industrial region	106	industrial	planned
Switzerland	Cimo – Monthey Chemical Park	107	industrial	in use
Switzerland	Daval Eco-industrial Park	108	industrial	stopped
Switzerland	Ecosite workgroup	109	combined	in use
Switzerland	Infrapark Basselland	110	industrial	in use
Turkey	Eco-Efficiency (Cleaner Production) Programme	111	industrial	in use
United Kingdom	Dyfi Eco Park	112	combined	in use
United Kingdom	Green Park	113	industrial	in use
United Kingdom	Humber Industrial Symbiosis Programme	114	industrial	in use
United Kingdom	Ince park	115	industrial	planned
United Kingdom	London Sustainable Industries Park	116	industrial	under construction

Tab. 7 > List of detailed non-European eco-innovation parks

see also Map in Fig. 5.

Country	Name of case	Map number	Type of park	Project status
Australia	Hunter Industrial Ecology Park	117	industrial	planned
Australia	Kwinana industrial park	118	industrial	in use
Australia	Port Melbourne Industrial Area	119	industrial	under construction
Australia	Synergy industrial park	120	industrial	in use
China	Beijiang Power Plant Complex	121	industrial	in use
China	Caofeidian Eco-City	122	combined	under construction
China	Dalian Development Area (DDA)	123	combined	in use
China	Dezhou Solar Valley	124	combined	in use
China	Ecopark Hong Kong	125	industrial	in use
China	Guitang Group	126	industrial	in use
China	Lubei National Eco-Industrial Demonstration Park	127	industrial	in use
China	Qingdao New World Eco-Industrial Park	128	industrial	in use
China	Shenyang Tiexi New District EIP Initiative	129	industrial	in use
China	Suzhou Industrial Park	130	combined	in use
China	Tianjin Eco-City	131	combined	under construction
China	Tianjin Economic & Technical Development Area (TEDA)	132	combined	in use
China	Yixing Economic Development Zone (YEDZ)	133	industrial	in use
India	Andhra Pradesh Special Economic Zone	134	industrial	in use
India	Nanjangud Industrial Area	135	industrial	in use
India	Narela Industrial Estate	136	industrial	in use
India	Naroda by-product exchange	137	industrial	in use
India	Taloja Industrial Estate	138	industrial	in use
India	Vatva Industrial Park	139	industrial	in use
Israel	Matam Park	140	industrial	in use
Japan	Eco-Town Aichi	141	industrial	in use
Japan	Eco-Town Akita	142	industrial	in use
Japan	Eco-Town Kawasaki	143	industrial	in use
Japan	Eco-Town Kitakuyushu	144	industrial	in use
Japan	Eco-Town Minamata	145	industrial	in use
Japan	Eco-Town Naoshima	146	industrial	in use
Japan	Fujisawa Eco-Industrial Park	147	industrial	planned
Japan	Kokubo Eco-Industrial Park	148	industrial	in use
South Korea	Banwol and Shiwha EIP	149	industrial	in use
South Korea	Chengju eco-industrial park	150	industrial	in use
South Korea	Gwangju Green City	151	urban	in use
South Korea	Macheon-Chilseo-Sangpyeong eco-industrial park Network	152	industrial	in use
South Korea	Mipo & Onsan eco-industrial parks (Ulsan EIP Project)	153	industrial	in use
South Korea	Pohang eco-industrial park	154	industrial	in use
South Korea	Yeousu eco-industrial park	155	industrial	in use

Country	Name of case	Map number	Type of park	Project status
United Arab Emirates	Al Naseem	156	urban	under construction
United Arab Emirates	Masdar City	157	urban	under construction
United States of America	By-Product Synergy Central Gulf Coast Project	158	industrial	in use
United States of America	Camden Eco Industrial Park	159	combined	under construction
United States of America	Devens planned community	160	combined	in use
United States of America	Guayama Industrial Symbioses (Puerto Rico)	161	industrial	in use
United States of America	Intervale Food Center	162	industrial	in use
United States of America	Keystone Industrial Port Complex	163	industrial	in use
United States of America	Londonderry Eco-industrial Park	164	industrial	in use
United States of America	Red Hills Ecoplex	165	industrial	in use
United States of America	Royal Phoenix Redevelopment Project	166	combined	under construction
United States of America	Silver Bay Eco-industrial Park	167	industrial	in use
United States of America	Twelve|West	168	urban	in use

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> Abbreviations, figures and tables

Figures

Tables