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Qualification of Key Actors in the Building Energy Efficiency Sector (KABEE)

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1 Definitions

1.1 Green Growth, Green Economy, Eco-Industrial Development, Sustainable Development, Eco-Industrial Parks, Sustainable Industrial Areas – What is it all About?

When talking about “Greening the Economy” or “Achieving Sustainability” there are many key word in use (e.g. Green Growth, Green Economy, Green Recovery, Eco-Industrial Development, Eco-Innovation, Sustainability, etc.), which may have different understandings related to the geographical location, political system or development strategy. Therefore, there is a need to find a common understanding to harmonize the effort for sustainable industrial development.

The following definitions are promoted by international organizations:

- Green Growth

Economic development and growth is regarded to be necessary (although insufficient) for reducing poverty and improving overall living conditions. Green Growth and as such new, socially and ecologically and climate-friendly development paths are needed. Green Growth is defined as:

**Definition OECD:** Green Growth is a strategy fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies.

**Definition BMZ:** Economic growth strategy, which organizes the economy in an ecological manner thus creating new job and income with a minimum of negative impact on the environment.

- Green Economy

The concept of Green Economy calls for improvements in three dimensions: the economic, environmental and social dimension. In its simplest expression or at the operational level, a Green Economy (GE) is low-carbon, resource efficient and socially inclusive. It is defined as:

**Definition UNEP:** Green Economy is one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities.

**Definition BMZ:** Type of economic behavior that considers the interrelation between economy, society and environment.

- Sustainability

Sustainability is achieved if social, environmental and economic issues are equally considered (see following figure).
Green Economy in this respect is the part of economy, which takes economic, environmental and social aspects into consideration (Definition BMZ).

- Eco-Industrial Development

In order to create "Green Economy" industrial development strategies have to be based on ecological and social consideration as well, thus creating an "Eco-Industrial Development".

This systematic approach consists of the following principles:
Industrial Ecology: maximum utilization of resources through the greatest possible cycling of material and energy – capitalization on synergies

Networked Manufacturing: enterprises work together towards market and cost advantages and the minimization of waste

Joint Services: enterprises benefit from the use of common services

High Performance: inclusive and productive workplaces, highest cost efficiency, above average return on investments

Community Ownership: strong connections to local institutions and society that promote ownership and support.

- Eco-Industrial Parks (EIP)/Sustainable Industrial Areas (SIA)

Industrialization is an important driver for development and many developing countries and emerging economies have witnessed a boom in the construction of industrial areas – such as industrial estates, industrial parks, special economic zones and investment zones – as parts of significant economic development strategies.

The establishment of industrial areas is perceived as a promising strategy in developing industries and attracting international investment by accelerating the often lengthy process of obtaining permits and licenses. Furthermore, such areas provide access to infrastructure such as road systems, water, waste disposal, electricity, and telecommunication lines. The number of industrial areas has especially been increasing in emerging economies, enabling companies to take advantage of public infrastructure, to economize on construction and common facilities and to benefit from the closer proximity of other businesses.

However, apart from the advantages for industrial development, the fast and all too often uncontrolled spread of industrial estates in developing and transition countries has resulted in significant environmental degradation. A focus on proper planning and development of industrial areas could greatly contribute to the goal of sustainable development.

The concept of eco-industrial parks (EIP) has been first described at the UNCED. The now commonly accepted international definition is based on the one initially created by an Indigo Development Team in 1992 and then expanded for the U.S. Environmental Protection Agency in 1995. It was refined in 2001 by Ernest Lowe in an Eco Industrial Handbook published by the Asian Development Bank. There “Eco-Industrial Areas” are defined as

“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 individual benefits each company would realize if it optimized its individual performance only”

While the concept of “Eco-Industrial Parks” tries to consider in particular the ecological demands of industrial development, “Sustainable Industrial Areas” (SIA) have a broader approach in emphasizing also the social aspects of development.
Eco-Innovation

Definition UNEP: Eco-innovation is the development and application of a business model, shaped by a new business strategy that incorporates sustainability throughout all business operations based on life cycle thinking and in cooperation with partners across the value chain. It entails a coordinated set of modifications or novel solutions to products (goods / services), processes, market approach and organizational structure, which leads to an enhanced performance and competitiveness of the company.

Conclusion:

To achieve “Sustainability” as the overall goal of industrial development, “Green Growth” acts as development strategy. One important element of “Green Growth” is “Green Economy” which bases among others on “Eco-Industrial Development”. “Sustainable Industrial Areas” as sheltered and managed structures are most favorable for introducing mechanisms of “Sustainability” and “Eco-Industrial Development” such as “Viable Production”, “Resource Conservation”, “Environmental Protection”, Social Responsibility” and others. On company level, “Eco-Innovation” is the new business model.

Figure 3 The three dimension of “Green Economy” applied to Sustainable Industrial Areas (SIA)

- Economic Dimension
  - Economic production method
  - Maintaining high quality
  - Minimizing costs through synergies/circular economy, energy networks, etc.

- Environmental Dimension
  - Maintaining energy and resource efficiency
  - Low pollution, waste/wastewater management
  - High environmental standards
  - Regular monitoring and transparent reporting, etc.

- Social Dimension
  - Labor friendly production methods
  - Income generating, maintaining social security
  - Consious regarding neighbourhood, maintaining transparency
  - Considering gender issues, etc.

Figure 4 “Sustainable Industrial Areas”, important elements for “Sustainable Development”
1.2 Industrial Parks – Motor of Industrial Development

In emerging countries like China, India, Indonesia, Brazil and others, industrial development zones or industrial parks play a significant role. While some of them, for example in China, are designed from scratch in only few years others have been developed gradually over many years, often without any special planning as encountered in many parts of India.

The China Example

In China, starting in 1984, special economic and technological development areas were introduced to achieve the following goals:

- Attraction of foreign capital and modern technology

Foreign capital was welcomed to ease the financing bottlenecks e.g. for establishing the required infrastructure in the modernization process, whereas the related technology transfer was required to upgrade old production facilities, to improve production capacities and to promote the transition from labor intensive to technology intensive production.

- Increase of foreign trade and export

The share of export-oriented production in development zones was requested to be equal to approx. 70% of the total production in order to settle the trade deficit caused by capital imports. Production for import substitution in the zones was limited and only allowed for modern high quality products

- Linkage effects (cumulative effects of industrialization)

Two types of linkage effects were expected: 1) backward linkage, whereby the investments are made in anterior provinces to procure the input of the zone production, i.e. natural resources or products of domestic suppliers, which flow into the zones, and 2) forward linkage whereby the output of zone production flows to outside commercial customers for further processing. The success of these linkage effects was decisive for whether a zone functions as an isolated enclave or became a promoter of regional economic development.

- Learning effects (production related educational effects)

"Learning by doing" was expected to increase the production and management knowhow of the employees thus supporting the upgrading of processes, the improvement of product quality and the establishment of more efficient organizational structures. Industrial zones should increase the knowledge of domestic employees, which then later act as middle managers able to perform educational functions themselves.

- Economic experimental and demonstration effects

For the Chinese Government industrial zones functioned as laboratories for testing the principles of a market economy. The encountered beneficial aspects of China's modernization process were adopted and gradually spread throughout the country. For the outside world, these zones functioned as showcases of China's reform process.

There are different types of industrial development zone in China:

- National Economic Development Zones
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- National Economic and Technological Development Zone
- National High-tech Industrial Development Zone
- National Bonded Zones and Other Special Customs Supervision Zones
- National Border Economic Cooperation Zone
- Other National Economic Development Zone (such as Tourism Resort Zone), etc.

- Provincial Economic Development Zone.

The Indian Example

In the Indian context, an "Industrial Park" means a project in which plots of developed space or built up space or a combination, with common facilities and quality infrastructure facilities, is developed and made available for the purposes of industrial activities or commercial activities. The Department of Industrial Policy and Promotion (DIPP) of the Ministry of Commerce and Industry (MoCI) of Government of India (GoI), states following objectives to be fulfilled by a project to be considered as an Industrial Park:

- An Industrial Model Town: development of industrial infrastructure for carrying out integrated manufacturing activities including research and development by providing plots or sheds and common facilities within its precincts.

- An Industrial Park: development of infrastructural facilities or built-up space with common facilities in any area allotted or earmarked for the purposes of industrial use.

- A Growth Centre under the Growth Centre Scheme of the Government of India: scheme which is implemented by an undertaking and distinctly developed as a separate profit center.

The different types of industrial parks existing in India are summarized below.

- Industrial Estate/ Park

The term "industrial estate" is often used interchangeably with industrial district, industrial park, industrial zone, special economic zone, eco-zone etc. An Industrial Estate (IE) is a self-contained geographical area with high quality infrastructure facilities, which house businesses of an industrial nature. An industrial estate is administered by a single authority that has a defined jurisdiction with respect to tenant companies. The authority makes provisions for operation and management: enforcing restrictions on tenants and planning with respect to lot sizes, access and utilities.

- Specialized/Theme Based Parks (Science & Technology Parks, Biotechnology Parks, Leather Parks, Hardware Parks etc.)

Specialized Industrial Infrastructure has for example been developed by Maharashtra State agencies for various sectors, including information technology, leather, chemicals, textiles and food processing zones.

- Export Oriented Zones (Special Economic Zones, Export Processing Zones, Free Trade Zones, and Free Zones)

EOU & SEZ Schemes are one among the series of export promotional schemes devised by 'Export Promotion Council for EOUS and SEZs' of Government of India, which provides an internationally competitive duty free environment coupled with better infrastructural facilities for export production. According to 'Department of Commerce' under 'Ministry of Commerce and Industry' of the
Government of India, the main objectives enlisted are generation of additional economic activities, promotion of exports of goods & services and investment from domestic & foreign sources, creation of employment opportunities, and development of infrastructure facilities.

Figure 5 Different types of industrial parks in India

- Clustering & Aggregation

The Department of Industrial Policy and Promotion defines ‘Industrial Cluster’ under the National Manufacturing Policy as ‘a concentration of manufacturing industry units located within a clearly demarcated geographical area with the land use notified as such by the state government’. According to the Report of the Working Group on Clustering and Aggregation for the 12th 5-Year Plan, industrial clusters are defined by the relationships between industries providing similar and related goods or services:

- Specialized suppliers of goods, services, and financial capital (backward linkages)
- Distributors and local customers (forward linkages)
- Companies with complementary products (lateral linkages)
- Companies employing related skills or technologies or common inputs (lateral linkages)
- Related research, education, and training institutions such as universities, community colleges, and workforce training programs
- Cluster support organizations such as trade and professional associations, business councils, and standards setting organizations.

The Indonesian Example

In the past, there have been two phases for the creation and operation of industrial estates. The first phase started in the 1970s where industrial estates were created and operated by local and provincial governments. Since 1989 industrial estate are developed by the private sectors and supervised by the government. A third phase of industrial estates shall be introduced, which has the objective to introduce standards guiding the industrial estates towards sustainability.
The following table gives additional information on Indonesian Industrial Estates of the various generations.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Generations of Indonesian industrial estate development</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; Generation of industrial estates (1970-1989)</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Generation of industrial estates (1989-2013)</td>
</tr>
<tr>
<td><strong>Product</strong></td>
<td>Diverse, not focused</td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td>No support facilities integrated</td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td>No proper waste and wastewater (environmental) management</td>
</tr>
<tr>
<td><strong>Development target</strong></td>
<td>Growth of the estate</td>
</tr>
<tr>
<td><strong>R&amp;D</strong></td>
<td>no R&amp;D centres in the estate</td>
</tr>
<tr>
<td><strong>Regulation</strong></td>
<td>Separate regulations</td>
</tr>
</tbody>
</table>

The legal basis for an industrial estate guideline gives “Regulation No. 35/2010 on Technical Guidelines for Industrial Estate”. The regulation incorporates a basic concept for development, planning and management of industrial estates. According to the HKI (Industrial Estate Association), the total industrial land in Indonesia reached 27,320.6 ha in June 2012. In future the demand for industrial land area will be around 1000 ha/year<sup>1</sup>, which emphasize the necessity to work on standards for industrial estate.

Presently, problems also exist at the administration level due to decentralization. Since 2004, local governments have the authority for certain areas. This means, that each province, city, and region have his or her own local regulation being specific and adapted to the regional context. The central government only sets the general context while the local authorities adapt it adequately to their situation. This makes it difficult to establish a common standard.

Finally, Indonesia is still lacking a central industrial estate authority since the 1990s due to political reasons. In 2009, a “National Team for Industrial Estates” was formed under the supervision of the Ministry of Industry. This team has the main task to assist in policy development and management of industrial estates.

1.3 Defining EIP/SIA and GIZ Proposed Criteria

The importance of industrial parks and development zones and their influence on resources consumption and the environment have encouraged many countries to develop criteria for sustainability and environmental protection for industrial areas. These criteria are sometimes related

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<sup>1</sup> Business Indonesia, 2012
GIZ with is fast experience in assisting industrial areas around the world proposes the following set of standards and respective indicators for industrial parks, areas or development zones trying to become "Sustainable Industrial Areas".

These (draft) standards are focused on the management level of the park and intend to guide the parks as a whole to become sustainable, and are less dealing with the individual companies. The environmental friendliness or performance of companies in the park is assumed to be guided by the respective sector or company related standards. Nevertheless, a sustainable framework on park level of course will initiate and promote positive changes on company level as well.

The (draft) standard is organized as follows:

There are **three focuses**:
- Management
- Infrastructure
- Society.

### Table 2 Focus and principles of standards

<table>
<thead>
<tr>
<th>Focus</th>
<th>Principle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Management</strong></td>
<td>1.1. Sustainable operation</td>
</tr>
<tr>
<td></td>
<td>1.2. Service orientation</td>
</tr>
<tr>
<td></td>
<td>1.3. Networking</td>
</tr>
<tr>
<td></td>
<td>1.4. Environmental orientation</td>
</tr>
<tr>
<td><strong>2. Infrastructure</strong></td>
<td>2.1. High Efficiency</td>
</tr>
<tr>
<td></td>
<td>2.2. Joint utilities provision</td>
</tr>
<tr>
<td></td>
<td>3.2. Acceptable working conditions</td>
</tr>
<tr>
<td></td>
<td>3.3. Transparency</td>
</tr>
</tbody>
</table>

For each focus, several principles and criteria are proposed. The achievements required to fulfil each criterion are described by **three levels of indicators**:
- Minimum level
- Certification level
- Superior level.

### Table 3 Example of principle, criterion and respective indicators
The **minimum level** indicates that the required information of the status quo and respective needs for improvement are known and first most pressing measures have already been implemented.

The **certification level** indicates that key requirements are met, but in their majority as singular or individual achievements.

The **superior level** indicates that all measures taken are part of a comprehensive concept governing the entire park in this field.

A quantification of the indicators is not included. This would need to be adapted to suit local circumstances.
2 International and German Practice of EIP/SIA

2.1 An Overview

An excellent overview of eco-(innovation) parks of the world was gained by a study carried out by Guillaume Massard et al. from SOFIES, Switzerland on behalf of the European Research Area Network on Eco-innovation (ERA-NET ECO-INNOVERA) and the Swiss Federal Office for the Environment (Bundesamt für Umwelt) in 2013/14.

In this study, Massard et al. defined eco-innovation parks as follows:

"... the term eco-innovation park is used to define both, eco-industrial parks and eco-innovative areas combining residential and industrial activities, such as eco-cities 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).

The following table gives the Eco-criteria used in the study.

<table>
<thead>
<tr>
<th>Eco-criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy efficiency</td>
<td>Optimization or reduction of energy use, including energy needed for buildings and other infrastructure as well as for industrial production</td>
</tr>
<tr>
<td>Renewable energy sources</td>
<td>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</td>
</tr>
<tr>
<td>Waste management</td>
<td>Onsite collection, transport, onsite or external processing and recycling or disposal of waste</td>
</tr>
<tr>
<td>Water management</td>
<td>Onsite wastewater treatment, reduction/optimization of water use for infrastructure and production</td>
</tr>
<tr>
<td>Material/chemical flow</td>
<td>Synergies, exchange of materials (chemicals, waste, etc) among companies, inter-firm collaborations. Input-output scheme as theoretically defined by industrial symbiosis</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Biodiversity conservation or revitalization of ecosystems in the industrial/urban and surrounding area</td>
</tr>
<tr>
<td>Mobility, transportation</td>
<td>Efficient viable transport of goods or person with low environmental impact (e.g., public transport, electric vehicles, plug-in hybrids, carpooling systems)</td>
</tr>
<tr>
<td>Land use</td>
<td>Optimization/reduction of land use for industrial/urban infrastructure, revitalization of derelict land</td>
</tr>
<tr>
<td>Air pollution prevention</td>
<td>Reduction in pollutant emissions through cleaner production processes or implementation of end-of-pipe technologies</td>
</tr>
<tr>
<td>Noise prevention</td>
<td>Reduction in noise emissions through cleaner production processes or implementation of end-of-pipe technologies</td>
</tr>
<tr>
<td>Environmental management systems</td>
<td>Certification and labels with environmental standards at the park scale such as ISO 14000 or EMAS</td>
</tr>
<tr>
<td>Cultural, social, health and safety</td>
<td>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</td>
</tr>
</tbody>
</table>

In total, the study identifies 302 parks, which showed at least some criteria of eco-innovation. From this total number 168 parks were evaluated and described as case studies in detail.

Figure 6  Case Studies of Eco-Innovation Parks in Europe (Massard et al.)

Figure 7  Case Studies of Eco-innovation Parks outside of Europe (Massard et al.)

The following figure shows the type of eco-criteria addressed in the investigated parks.
As shown, waste management, energy efficiency, water management and optimized material flow are the most often addressed eco-criteria in the investigated parks. It is obvious, that not all eco-criteria were addressed in each park. The following figure give the distribution of eco-criteria addressed in the investigated parks.

The figure shows that approx. 35% of the parks applies only 2–3 eco-critical, while another 42% of the parks applies 4–5 eco-criteria. Only some 23% of the parks apply 6 and more eco-criteria according to the study of Massard et.al.

2.2 Kalundborg Industrial Area – the classic example of an EIP
Kalundborg industrial area and municipality (as described by Massard et al.) is the world’s most well-known and documented example of Industrial Symbiosis (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 them 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) and a waste treatment company (Kara/Novoren).

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-1990s is also consider as a success factor.

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.

2.3 Chinese EIP Development
Tackling the economic and environmental conflicts on an industrial park level, the predecessor of the Ministry of Environmental Protection, the State Environmental Protection Administration (SEPA), began in the late 1990-ies to promote the development of Eco-industrial Parks (EIP). SEPA regarded the promotion of the EIP-concept as a win-win approach, because the prevailing end-of-pipe pollution control approach was both costly and ineffective. Originally, SEPA was created to solve the issue of industrial development zones as pollution havens and enhance the environmental management of industrial parks.

As the first National Trial EIP, the Guangxi Guigang Sugar–making Complex was approved in August 2001 (Zhu et al. 2007). The lack of formal, transparent procedures for application, appraisal and designation of EIPs resulted in a low interest among Chinese park management in applying to this voluntary program. Until 2003, only two parks were listed as Trial EIPs. As a result, SEPA published two key policies in December 2003:

1. Provisional Method on the Application, Designation and Management of National Demonstration Eco-Industrial Parks

This first set of regulations was based upon the nine priorities of "China’s Agenda 21", the Chinese implementation of the "Conference of Environment and Development" (UNCED) 1992 in Rio de Janeiro. It was published by "The Administrative Centre for China’s Agenda 21": (ACCA, 1994).

Table 5: The nine priorities of China’s Agenda 21

<table>
<thead>
<tr>
<th>Natural ecosystem principle</th>
<th>Eco-efficiency principle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capacity-building for Sustainable Development</strong></td>
<td><strong>Environmental Pollution Control</strong></td>
</tr>
<tr>
<td><strong>Sustainable Agriculture</strong></td>
<td><strong>Combating Poverty and Regional Development</strong></td>
</tr>
<tr>
<td><strong>Cleaner Production and Environment Industry</strong></td>
<td><strong>Population, Health and Human Settlements</strong></td>
</tr>
<tr>
<td><strong>Clean Energy and Transportation</strong></td>
<td><strong>Global Change and Biodiversity Conservation</strong></td>
</tr>
<tr>
<td><strong>Conservation and Sustainable Utilization</strong></td>
<td></td>
</tr>
</tbody>
</table>

In this guideline, SEPA defined EIPs as:

"a new type of industrial park designed according to the requirements of cleaner production, the concept of circular economy and ecological industry principles. By means of material and energy recycling, it connects different types of plants and enterprises into a symbiotic association in which resources are shared and by-products are interchanged. The waste or by-products of one plant may become raw materials or energy resource of another. Trying to simulate the natural ecological system and to establish "producer-consumer-decomposer" circulation mechanism, this system seeks to obtain closed material circulation, multi-level utilization and a minimum output of waste”

This definition resulted in the following principles, which had to be fulfilled by industrial parks to be recognized as EIP:

Table 6: Chinese SEPA's principles for eco-industrial parks

| Natural ecosystem principle | *Integrate with the regional natural ecosystem to maintain its eco-functions* |
| Eco-efficiency principle | *Cleaner production on EIPs design, operation,* |
To evaluate the progress of the program, practical quantitative standards were developed, which were also used to provide a more consistent and objective accreditation of EIPs. In September 2006, SEPA released three provisional standards concerning single industry, multi-industrial and venous (resource recovery) industry-based EIPs.

In April 2007, a joint venture between SEPA, the Ministry of Commerce and the Ministry of Science and Technology started, aiming at the creation of procedures and criteria for EIP planning and management in China. In 2009, a policy decree called “Notice on Promoting the Development of a Low Carbon Economy in National Demonstration Eco-industrial Parks” was released.

As of November 2011, the three ministries have jointly assessed and approved a total of 60 National Trial EIPs. Among them, 48 are mixed industrial parks and 11 are sectorial industrial parks, such as sugar-making, metallurgical, mining, coal-based chemical and petrochemical industries. Only one National Trial EIP is a resource recovery park.

Furthermore, 15 National Trial EIPs were granted the „National Demonstration EIP”-title by a thorough assessment of the implementation progress of the stated standards.

• China’s National EIP Standard

The comprehensive guidance developed by SEPA in 2006 describes the concept of EIP as well as criteria and indicators for successful EIP projects. It was the first national standard to guide EIPs in the world.

SEPA’s program general objective is to encourage, manage, and monitor EIP projects by setting up criteria and indicators. According to its definition, the difference between an EIP and a traditional industrial park is the emphasis on establishing a park-wide network of industrial symbiosis composed of varied industries, such as by-products exchange, water and energy cascading, and information sharing among firms. This is supposed to promote the principles of cleaner production, industrial ecology and the circular economy. To accommodate the various types of Chinese industrial parks, three different groups which slightly different criteria and indicators were defined.

- Sector-integrated group (parks with multiple industrial sectors)
- Sector-specific group (parks with primarily one main sector or anchor tenant)
- Venous industrial park group (resource recovery parks).

Requirements for application to the approval process are:

- Effective enforcement of all national environmental laws and regional regulations.
- No pollution accidents or dramatic events related to ecosystem damage in the preceding three years.
Local environmental quality must meet national environmental standards. No tenant company may exceed pollution permit individually, the overall emission should be below the control target set up by SEPA. The industrial park managers’ EIP plan must be evaluated and passed by SEPA and finally approved by the local government or Local People’s Congress.

The motivation for taking part in this program is not driven directly by financial benefits, as there is no such support to the parks by the program. However, a designation can improve the „green“ image of a park which might result in an increased attraction of industry and investment, given the strong competition among all industrial parks.

- Chinese EIP Indicators

The different park groups do not necessarily result in a different set of indicators. All indicators are categorized into four groups. There are indicators for:

- Economic development
- Material reduction and recycling (venous group: resource recycling and reuse)
- Pollution control
- Evaluation of park management

However, there are some minor differences in a second category of indicators, which do not have a big influence on the overall evaluation of the park. For an industrial park of the sector-integrated group, the following table shows the 21 main indicators.

Table 7: Main indicators for a sector-integrated park according to Chinese SEPA

<table>
<thead>
<tr>
<th>Category</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic development</td>
<td>• Added industrial value per capita</td>
</tr>
<tr>
<td></td>
<td>• Growth rate of added industrial value</td>
</tr>
<tr>
<td>Material reduction and recycling</td>
<td>• Energy consumption per added industrial value</td>
</tr>
<tr>
<td></td>
<td>• Fresh water consumption per added industrial value</td>
</tr>
<tr>
<td></td>
<td>• Industrial wastewater generation per added industrial value</td>
</tr>
<tr>
<td></td>
<td>• Solid waste generation per added industrial value</td>
</tr>
<tr>
<td></td>
<td>• Industrial water reuse ratio</td>
</tr>
<tr>
<td></td>
<td>• Solid waste reuse ratio</td>
</tr>
<tr>
<td></td>
<td>• Middle water reuse ratio</td>
</tr>
<tr>
<td>Pollution control</td>
<td>• COD loading per added industrial value</td>
</tr>
<tr>
<td></td>
<td>• ( \text{SO}_2 ) emission per added industrial value</td>
</tr>
<tr>
<td></td>
<td>• Disposal rate of dangerous solid waste</td>
</tr>
<tr>
<td></td>
<td>• Centrally provided treatment rate of domestic wastewater</td>
</tr>
<tr>
<td></td>
<td>• Safe treatment rate of domestic rubbish</td>
</tr>
<tr>
<td></td>
<td>• Waste collection system</td>
</tr>
<tr>
<td></td>
<td>• Centrally provided facilities for waste treatment and disposal</td>
</tr>
<tr>
<td></td>
<td>• Environmental management systems</td>
</tr>
<tr>
<td>Administration and management</td>
<td>• Extent of establishment of information platform</td>
</tr>
<tr>
<td></td>
<td>• Environmental report release</td>
</tr>
<tr>
<td></td>
<td>• Extent of public satisfaction with local environmental quality</td>
</tr>
<tr>
<td></td>
<td>• Extent of public awareness degree with eco-industrial development</td>
</tr>
</tbody>
</table>
The application of the indicators is described thoroughly in this regulation. The methods of data collection are similar to those adopted for preparing the urban development statistical almanac and the environmental protection statistical almanac. To ensure data quality and reliability, SEPA has suggested that reference data should come from the local statistical agency and environmental protection agency. To enable park managers to assess their own performances, standards and their calculation formulas were defined.

2.4 EIP Development in Germany

In Germany, industrial areas and parks are also a common instrument for economic development. There is a distinction between municipal industrial areas and industrial parks. For municipal industrial areas, the municipality provides the required infrastructure and utilities to attract the investment of individual companies. Industrial parks may have also been initiated by local government, but are meant from the beginning to be interlinked industrial complexes organized and managed mostly by a private legal entity. The majority of industrial areas were established in the 1990s.

The following table summarizes the driving forces for establishing (eco-)industrial parks.

<table>
<thead>
<tr>
<th>Table 8 Objectives for establishing industrial parks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regional economic objectives</strong></td>
</tr>
<tr>
<td>• Attraction of investment</td>
</tr>
<tr>
<td>• Job generation</td>
</tr>
<tr>
<td>• Generation of tax revenues</td>
</tr>
<tr>
<td><strong>Company objectives</strong></td>
</tr>
<tr>
<td>• Strategic concentration of industries</td>
</tr>
<tr>
<td>• Easy access to up and down stream supply chain</td>
</tr>
<tr>
<td>• Reduction of costs through synergies and shared services</td>
</tr>
<tr>
<td>• Increased flexibility through production in networks</td>
</tr>
<tr>
<td>• Increased profit margins</td>
</tr>
<tr>
<td><strong>Environmental objective</strong></td>
</tr>
<tr>
<td>• Utilization of synergies</td>
</tr>
<tr>
<td>• Increased energy and resource efficiency</td>
</tr>
<tr>
<td>• Joint waste and waste water treatment facilities</td>
</tr>
<tr>
<td>• Reduction of emission and wastes (solids, wastewater, heat)</td>
</tr>
</tbody>
</table>

Although implementation, development and management of (eco-)industrial parks is primarily industry driven - there is no national/regional EIP strategy or planning as such - government takes influence on the development of eco-industrial parks in setting respective framework conditions. These framework conditions in form of laws, regulations and guidelines on one side and incentives on the other are valid for the entire industry sector, not only for industrial areas.

The following policy instruments intend to support eco-industrial development in general and as such also EIPs:

- Environmental policy (minimizing negative impacts, saving of resources, protection of climate, etc.)
- Economic policy (for strengthening the compatibility and regional development)
- Innovation policy (advanced technologies and processes, eco-innovation, etc.).

As part of the environmental policy, the following instruments were utilized:

- Market mechanism (e.g. emission trading)
- Financing instruments (e.g. for energy efficient industry settings, innovative technologies)
- Enforced reduction of energy utilization in buildings and application of renewable energies to a given minimum percentage
Beyond the environmental policy

- Instruments to increase sustainability (e.g., transition of tax on labor towards a tax on resource and energy consumption)
- Funds for regional structural development/cluster development
- Energy efficiency action plans (EU)
- etc.

were introduced to promote an eco-friendly industrial production.

In general, government instruments to support or control eco-industrial park development are classified into:

- Supply-oriented instruments:
  - Grants/loans (for energy efficiency measures, modernization of production technologies, etc.)
  - R&D programs (energy and resource efficient new materials, environmental technologies, R&D Program “Zero Emission Park”, etc.)
  - Education and training programs (environmental monitoring and auditing, climate mitigation and adaptation, etc.)
  - Support of networks and cooperation (on regional, national or European level)
  - Provision of knowhow and information (internet platforms, data banks, etc.)
  - Provision of infrastructure and utilities (communal wastewater treatment, waste disposal, etc.).

- Demand-oriented instruments:
  - Laws, rules and regulations (EIA, BAT, energy efficiency standards, etc.)
  - Financial incentive systems (compensation for energy fed into the grid, etc.)
  - Market mechanism (access to cheap energy/raw material, tax reduction, etc.)
  - Technology transfer (access to new technologies, R&D programs, etc.).

![Diagagram]

**Figure 11 Rationales of EIP government support**

Another instrument is based on the corporate responsibility commitment by the industry sectors: In *voluntary self-commitments* the industry sectors communicate their mid and long term objectives in emission reduction or substitution of ecological non-friendly products. This in turn contributes to future legislation.
As shown, the development of EIPs in Germany is not guided by a specific EIP government strategy, it is more the industry who

- has to comply with given laws and regulations (e.g. environmental legislation)
- wants to maximize its profit (through energy and resource efficiency, industrial symbiosis, etc.), and who
- wants to draw advantage from available incentives.

In summary, the parks intend to optimize themselves thus fulfilling most of the EIP criteria automatically.

Two excellent example of such highly optimized parks are the Industriepark Höchst, operated by Infraserv and the ChemPark of Bayer, operated by Currenta as management companies.

![Industriepark Höchst managed by Infraserv](image)

**Figure 12 Industriepark Höchst managed by Infraserv**

Infraserv as managing company of the Industriepark Höchst fulfills the following tasks:

- Site management including development and governance
- Site marketing and investors support
- Site operation
  - Site infrastructure and services
  - Energy management – generation (fossil, RE, waste-to-energy), energy/heat recycling and distribution of energy
  - Water management – provision and treatment
  - Logistics and material transport systems
  - Waste and wastewater management
  - Environmental monitoring and reporting, protection of water body
  - Security (fire, site protection, disaster prevention and response)
  - Labor force (1,900 employees).

The annual turnover of Infraserv in 2012 was 1,073 Mio. €, and the total investment of Infraserv into the parks infrastructure and services was 36 Mio. €.
Sino-German Cooperation Project
Qualification of Key Actors in the Building Energy Efficiency Sector (KABEE)
Training Textbook

German Experiences to obtain Energy Efficiency Gains in Cities through Eco-Industrial Park (EIP) Development

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**Figure 13** Service philosophy of Infraserv

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**Figure 14** Chempark Leverkusen managed by Currenta

---

As the manager and operator of CHEMPARK, CURRENTA offers a customized service portfolio.

<table>
<thead>
<tr>
<th>Services at a glance 服务项目</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Services 环境服务</td>
</tr>
<tr>
<td>Utilities 公用事业</td>
</tr>
<tr>
<td>Safety / Security 安全/ 保安</td>
</tr>
<tr>
<td>Infrastructure 基础设施</td>
</tr>
<tr>
<td>Logistics (CHEMION) 物流</td>
</tr>
<tr>
<td>Maintenance (TECTRIDE) 维修</td>
</tr>
</tbody>
</table>

---

**Figure 15** Service portfolio of Currenta
For both park managers governance tasks are an important part of park management. They both feel the responsibility to steer and to develop the community of the industry implanted on-site the park in a sustainable manner and have developed suitable governance tools.

To provide the best possible environment for the companies on-site and to foster the sustainable development both park managers perform an ongoing corporate change management. Any changes in legislation or other boundary conditions and changes of customer demands prompt the park managers Infraserv and Currenta to customize their service portfolio and governance tools.

Currenta has created a chemical innovation cluster “New Materials” within the chemical cluster ChemCologne and as an incubator has developed the innovation objectives and the required cluster structure. Currenta assumed the cluster-management for several years to initiate the cooperation of the cluster partners, to support the innovation processes and to foster the transformation of ChemPark and its environment into an eco-industrial area.
THE COLOGNE CHEMICAL CLUSTER – ONE OF THE LARGEST IN THE WORLD

科隆化工产业带—全世界最大的产业带之一

Figure 18 Regional integration of chemical parks
3 Methodology to Introduce Energy and Resource Efficiency in Industrial Areas

3.1 Factor of Success – The Multilevel Approach

In order to introduce energy and resource efficiency in industrial areas a multilevel approach is required.

On **macro level**, it is the duty of the park management to create favorable frameworks conditions to facilitate energy and resource efficiency in the park.

On **meso level**, cooperation among companies and networks are a key factor for circular production and business structures, which make optimal use of energy and resources possible.

On **micro level**, companies need to implement energy and resource saving measure to optimize their production and services.

3.2 Changing Park Management towards Sustainability

In China, most of the industrial parks and development zones are managed by administration committees, which are part of the local government authorities. Only few parks have public or even private management companies.

The result are administrative management structures, which set the legal framework conditions, provide space for investment, infrastructure and necessary utilities, and monitor the compliance of the companies in the park with given rules and regulations while the companies of the park operate within this framework independently according to their own priorities.

To introduce energy and resource efficiency and, in particular, to change the park into an eco-industrial park or sustainable industrial area, the park management mode has to change. The management has to become initiative, customer oriented and pro-active. It has to develop mechanism, which will encourage companies in the park to cooperate among each other and to implement energy and resource efficiency measures. This needs market orientation and a new type of stakeholder management; it needs a complete change of the management’s attitude.

3.2.1 Changing the Management’s Attitude

For the success of the eco-industrial park, it is necessary that all stakeholders have a good relationship with each other and solve common problems together. This applies in particular to environmental and ecologic issues, for which first of all awareness and a common understanding must be created. Joint activities can only be encouraged, when the parties understand each other and know what the needs of the others are. The management is required to change its relationship to the companies on-site and maintain a partnership-based dialog.

Managing an eco-industrial park is inseparable from having a respective business concept for the park and vice versa. Developing and managing an industrial zone without a **clear and detailed business concept** based on reliable figures may lead to administrative problems and failure of the entire zone.

It is also necessary that administration regards itself as **service provider** with corporate alignment and treats the companies on-site as customers. Prerequisite is that the management takes the
Another objective of the management should also be to develop favorable conditions for the companies on-site and to initiate and coordinate joint activities. It is required that the management takes over governance functions to ensure that the companies on-site take responsibility for their actions.

In the eco-industrial parks, complex management tasks are required:

**Table 9  Management functions in EIPs**

- Coordination and surveillance of common life in the park
- Execution of governance functions
- Implementation of regulations, their enforcement and sanctioning of non-compliance.
- Consistent mediation promoting the ideas of sustainability
- Providing services and ensuring their availability and quality on-site
- Stakeholder management in and outside of park
- Creation of favorable framework condition for networking in the park
- Promotion of communication with neighborhood and general public
- Maintaining and marketing of positive eco-industrial park image
- Responding to investors and site marketing

Of course, the observance of existing laws, regulations and limits is also a governance task. The management - in the function of a mediator - ensures the companies compliance with the prevailing regulations.

The organization of the EIP management body might be set in a divisional structure to support workflows and decision-making processes.
3.2.2 Adopting Management Skills

For EIPs, new management skills are required. This comes with the increasing demands, which are expressed by the companies and those, which are set by the administration itself trying to fulfil the extended governance tasks and the new orientation of a service company.

The required skills vary according to the tasks that are assigned due to the industrial focus of the eco-industrial park. However, whatever type of setting is envisaged indispensable are very good knowledge and experience in management skills, project management and customer relationship management. With the concept of eco-industrial parks, old paths in the management of industrial zones needs to be left, requiring specific management methods and a participatory approach to problem solution. A better mutual understanding among all stakeholders is achieved through intensive contacts, joint discussions and common projects.

SWOT analysis, stakeholder management and investor response are concrete management tools for developing eco-industrial parks.

- SWOT Analysis

The park’s vision of a community of companies that work together requires a targeted selection of those new companies trying to enter the park. In order to market the park the specific advantages being an eco-industrial park have to be analyzed and advertised.

For this purpose, a systematic SWOT analysis of the park in respect to the envisaged target group is required. In this process the park evaluates, in particular, its

- Strengths
- Weaknesses
- Opportunities
- Threats.
Experience has shown that it is wise to structure the SWOT-Analysis with regard to the horizon of the individual aspects to facilitate the compilation of arguments and to identify levers for improvements:

- Related to the site of the EIP
- Related to the close environment and the neighboring residential area
- Related to state level
- Related to national level
- Related to international level.

After this analysis, the SWOT aspects must be mirrored in respect to the site selection criteria of a possible investor to understand the investor’s rationales. The compilation of all advantages provides a list of attractive characteristics of the park and thus the arguments for a positioning the eco-industrial park in the market.

**SWOT analysis Example Agreb / Tunisia – site level (highly aggregated)**

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Existing industries are already export-oriented</td>
<td>1. The zone has been created in an anarchical way, not based on any site mastering planning</td>
</tr>
<tr>
<td>2. Proximity to the motorway</td>
<td>2. Lack of paved roads and drainage systems</td>
</tr>
<tr>
<td>3. Proximity to the industrial city (21 km)</td>
<td>3. Very close to the National Park</td>
</tr>
<tr>
<td>4. Detailed information available about the zone</td>
<td>4. Zone’s perimeter is not clearly limited</td>
</tr>
<tr>
<td>5. The zone’s management is operational and active</td>
<td>5. Grave disrespect of basic environmental regulation without legal consequences</td>
</tr>
<tr>
<td>6. High land utilisation (70% of the lots occupied)</td>
<td>6. No consideration of / no information about (the polluted) wastewater and waste</td>
</tr>
<tr>
<td>7. Diversified activities in the zone</td>
<td>7. Raw materials and waste are stored in huge quantities outside the companies lots</td>
</tr>
<tr>
<td>8. Proximity of qualified workforce</td>
<td>8. Regional waste site depot very close to the zone</td>
</tr>
<tr>
<td>9. Proximity to the airport</td>
<td>9. No connection to wastewater grid / -treatment nearby</td>
</tr>
<tr>
<td>10. Important infrastructure already existing and nearby (natural gas, electricity, waste disposal site)</td>
<td>10. No street-lightening, disaster control, public transport, security measures</td>
</tr>
<tr>
<td></td>
<td>11. No cooperation with the university</td>
</tr>
<tr>
<td></td>
<td>12. Settlements in direct proximity to the zone</td>
</tr>
</tbody>
</table>

**SWOT analysis Example Agreb / Tunisia – site level (highly aggregated)**

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The future waste disposal site</td>
<td>1. (Anarchic) industrial activities outside the zone’s perimeter</td>
</tr>
<tr>
<td>2. Growing interest in sustainability among the companies</td>
<td>2. Soil pollution and its transfer to the surrounding area by rainfall and illegal waste dumps</td>
</tr>
<tr>
<td>3. Trigger-down effects from regional development around the city</td>
<td>3. Non-compliance with basic rules and regulations (companies)</td>
</tr>
<tr>
<td>4. Future Motorway</td>
<td>4. No climate of collaboration among companies in the zone</td>
</tr>
<tr>
<td>5. New technologies / possibilities for waste recycling</td>
<td>5. Heavy nuisance of neighboring companies due to emissions, waste and odours</td>
</tr>
<tr>
<td>6. Room for future expansions</td>
<td>6. Social unrest due to continuous pollution that could lead to the close-down of several companies</td>
</tr>
<tr>
<td>7. Stakeholders are very active and committed (Municipality, Companies in the zone)</td>
<td>7. Destruction of agriculture soil, the flora and fauna in a wide radius around the zone</td>
</tr>
<tr>
<td>8. The retrofitting will make the zone more attractive and the chances that new companies will settle there are high</td>
<td>8. Social instability</td>
</tr>
<tr>
<td>9. The zone will be officially integrated in the land use planning</td>
<td>9. Postponed investments</td>
</tr>
<tr>
<td></td>
<td>10. Lack of financial means for technical studies</td>
</tr>
<tr>
<td></td>
<td>11. Critical economic situation in the companies due to recurring strikes</td>
</tr>
</tbody>
</table>

Main conclusions:
- Environmental impact has to be assessed
- Companies have to be encouraged to cooperate with one another but also with the municipality and the regional government
- Measures to limit the pollution and to protect the environment (especially the national park) have to be taken
- Decontamination measures have to be taken
- Define industries to target
- Governance in the zone has to be assured
- The zone has to be connected to a wastewater treatment utility

Figure 20 Example of site related SWOT-Analysis
Stakeholder Management

It is always possible that conflicts occur between individual companies or with the park. In particular, in eco-industrial parks, these conflicts may more often because networking and cooperation of companies is vital to the park concept. Most important is therefore to build up management capacities for the tasks of moderation and mediation. Appropriate methods in this respect are active listening and stakeholder management.

An eco-industrial park can create competitive advantages by having a stronger network than other industrial parks. This might give the edge over competitors by expanding the value chain, by strengthening the company on-site and the new companies implanted. With the tool of a stakeholder analysis, the management can get a clear view of supporters and opponents of envisaged or pending projects. Core objective is the removal of barriers and the motivation of supporters.

Stakeholder Management - General procedure-

<table>
<thead>
<tr>
<th>Step 1: Identification of stakeholders</th>
<th>Step 2: Description of relationship</th>
<th>Step 3: Evaluation and analysis</th>
<th>Step 4: Deriving of measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who is involved in the project?</td>
<td>Describe the stakeholders and their relationship to the project:</td>
<td>Comparison of expectations and interests of the individual stakeholders</td>
<td>Findings from the analysis and possibilities of cooperation</td>
</tr>
<tr>
<td>Who is interested in or is affected by the project?</td>
<td>Internal and external stakeholders</td>
<td>Expectations of the project</td>
<td></td>
</tr>
<tr>
<td>Which processes and procedures are influenced?</td>
<td>Intensity of the relationship</td>
<td>Characterization</td>
<td>Estimation of risks, threats and opportunities</td>
</tr>
<tr>
<td></td>
<td>Importance of the stakeholders</td>
<td>Objectives and interests of the stakeholders</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stake of commitment</td>
<td>Elaboration of an implementation strategy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Influence, power and approach to the project – positive/ negative</td>
<td>Setting of a road map of measures and ways of communication</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Participation in the project</td>
</tr>
</tbody>
</table>

Figure 21 General procedure in stakeholder management

The participatory approach "Make sufferers participating" is the guiding principle for an active stakeholder management. Stakeholders may be identified in industry, politics and neighborhood, and classified in supporters, skeptics and opponents. The systematic approach for a stakeholder management consists of four steps:

- Identification of stakeholders
- Exploration of relationships
- Interpretation and Analysis
- Deriving measures.

Stakeholder management is one of the most important tasks of the management of eco-industrial parks. External and internal information platforms have to be installed such as round tables and IT databases serving for an exchange with the authorities, neighborhood and the open public. It encourage the companies on-site to support the sustainable development of the eco-industrial park actively and to have them join common projects.
Stakeholder management puts also a particular focus on projects for the implantation of new companies into the park.

- Investor Response

As the park wants to develop further and knowing that there is an intensive competition between industrial zones, the response to possible investors creates high demands on the park management. To address an investor in the right way, special management skills are needed to understand which criteria are important for the investor's site selection decision, and to be able to respond correspondingly.

On the side of the administration, there should be a clear vision of the future of the industrial zone and of the minimum criteria to be met by the investor to fit into the overall concept of the industrial park. In an eco-industrial park, these criteria are often dictated by the Ministry of Environment as well. To attract targeted companies an innovation-oriented co-operation, efforts to extend local value chains and the creation of innovation clusters are appropriate tools.

A dedicated risk management on the investor's application will keep the development of the industrial zone in the hands of the management. In particular, environmental aspects should be screened intensively in the implantation process. Any investor's growth forecasts are to be challenged and cross-checked. It is important that the park itself gets to know which industries and technologies have a potential for further growth and can be expected to create innovative industries in the park.

3.2.3 Introducing Governance

Governance describes the management task, which set the framework for the interaction of all stakeholders in the park. In order to develop the strengths and address the vulnerabilities of the park and its companies, the interests of all stakeholders should be taken into account and platforms for the exchange of information should be coordinated and managed by the park management. This comprises for example of

- Face to face discussions regarding the misconduct and joint search for solutions and the subsequent monitoring of the change process
- Discussion on contract provisions and the expected behaviors in accordance with the internal regulations and the CSR-Charter of the companies and the park
- Involvement of the authorities in case of violation of applicable laws or other regulations
- The way of exercising pressure on companies for compliance.

To guide all companies in the park it is necessary to develop a concept and a common understanding of the rules in the park, which also gives advice how to monitor and resolve any conflicts with applicable laws - but also how to combat misconduct.

- Common Corporate Social Responsibility (CSR) Charter

The adoption of a CSR-Charter is a widely spread action taken by companies and industry associations to express their commitment to sustainability openly. The companies of the park recognize the idea of "corporate responsibility" with this Corporate Social Responsibility (CSR)-Charter and adhere to it transparently. In an eco-industrial park, the companies take active...
precautions to respect the basic principles of sustainable development and to apply this to concrete actions.

<table>
<thead>
<tr>
<th>Charter of Companies On-site</th>
<th>- Corporate Social Responsibility -</th>
</tr>
</thead>
<tbody>
<tr>
<td>Companies on-site agree on guidelines for responsible actions such as:</td>
<td></td>
</tr>
<tr>
<td>o Social market economy needs sustainable business success</td>
<td></td>
</tr>
<tr>
<td>o Sustainability requires a sensible balance between economy, ecology and social</td>
<td></td>
</tr>
<tr>
<td>o Good work needs respect, fairness, trust and responsibility</td>
<td></td>
</tr>
<tr>
<td>o Economy needs fairness</td>
<td></td>
</tr>
<tr>
<td>o Sustainable success requires skills and commitment</td>
<td></td>
</tr>
</tbody>
</table>

Figure 22 Principles of a CSR Charter

- Internal Regulation

Based on the CSR-Charter and the vision of an eco-industrial park, applicable rules are set in "internal regulations for the eco-industrial park". There, the principles of coexistence in the park are laid down which should be valid for the first implanted company already. The aim of these rules is to minimize the risks and to protect companies and people inside/outside of the park and the environment against hazards, and provide to all users a favorable working environment.

All enterprises implanted in the park and their employees are invited to observe the statutory provisions and regulatory requirements applicable to their facilities. The industrial park regulation shall be binding for all the enterprises on-site.

The main aspects to be laid down in the internal rules and regulations are as follows:

- All companies take care that their employees contribute through their behavior to a working atmosphere, which respects given laws and regulations, the environment and the dignity of others.
- All companies are obliged to maintain order and cleanliness not only at their own premises but also on public areas, and take all required measures to protect each person individually and the environment in general.
- On internal roads the general highway code is applied, as well as certain rules of conduct specially adopted to eco-industrial parks.

Usually the internal regulations cover a wide range of topics, which are comprised of the following list.
The role of the park management is to act as a facilitator and mediator to help that the companies comply with the given laws and regulations. It should be empowered to stop non-compliant activities, to correct them and to sanction misconduct if necessary.

Thus, the internal rules and regulations are necessary to maintain security and order within the eco-industrial park and a good relationship with the surrounding neighborhood.

- Surveillance and Control

Living together in a coherent eco-industrial park requires compliance with the given rules. The administration/management as the ambassador of the park has as its most important task to ensure a positive image. Therefore, in terms of governance, the park management takes over the responsibility to survey the compliance of all stakeholders with all applicable regulations.

This includes in any case, the controlling of the environmental behavior. In addition, monitoring equipment for emissions and waste disposal, as well as the involvement of analytical laboratories are required. In addition to visits to companies, plant inspections and stationary measuring systems mobile environmental measuring devices are successfully used in several EIP.

The following tools may be applied to encourage companies or individuals to comply with rules and regulations:

- Call to order/warning by the management
- Publication of on-going misconduct
- Influence via responsible committees
- Information to the general public
- Termination of services in park
- Exclusion from the bodies of the park
- Cessation of lease contracts
- Appeal to the courts.
3.2.4 Competence Center

In order to ensure that the management skills and developed procedures and regulations remain in the administration even after personnel changes, a competence center is needed, which manages the entire knowledge, procedures and rules of the park. Examples of such procedures and task managed by a competence center are:

- Development of overall governance rules, regulations and a joint CSR-Charter
- Site master planning and infrastructure development
- Communication with stakeholders and site marketing
- Standardization of services across companies
- Workforce development and continuing education
- Coordination of park activities and transfer of knowledge to the companies
- Knowledge base for all relevant laws and regulations – environmental and work safety regulations in particular
- Coordination between the authorities and the companies
- Development of the industrial zone – for example by means of innovation clusters.

Figure 24 Organization of a competence center

3.2.5 Provision of Services

To large extent the attractiveness of parks and as such, eco-industrial parks is manifested by the services, the park is able to offers to the individual companies. These services are offered to all companies on-site at competitive prices and with sufficient quality due to the economy of scale. The services offered must be aligned with the needs of the companies, coordinated and of course provided within the objectives of the eco-industrial park. The management exerts direct influence to ensure the availability, reliability and quality of services to customer satisfaction.

The classic services, which are provided in the majority of parks depending on customer needs – defined by means of customer surveys, interviews or other tools –, are as follows:

- Site services, infrastructure and logistic
  - Transport system – roads, rail, buses, pathways, pipelines, conveyors, etc.
  - Utilities supply and distribution – water, power, gas, steam, cooling media
• Joint facilities
  o Central workshops
  o Logistic hub
  o Harbor facilities
  o Incubation center
  o Laboratories
  o Environmental monitoring system
  o Meeting rooms, conference centers
  o Support facilities and services for investors
  o Internet marketing and knowledge exchange platforms

• Social facilities
  o Canteens, restaurants, hotels, supermarket, coffee-shops
  o Training facilities, schools, universities
  o Housing and recreation areas

• Security
  o Gate service/fencing
  o Fire brigade, emergency planning and response
  o Ambulance, polyclinics

While these services are common for many industrial parks, eco-industrial parks offer further services, in particular, to foster networking among the companies, circular economy and the promotion of resource and energy efficiency. As an example, integrated energy, water, heat, wastewater waste management systems are important services offered by eco-industrial parks. To increase energy and resource efficiency the park management can promote energy efficiency networks and networks for industrial symbiosis.

For service provision, it is not necessary that the park management company or administration carry out all of these services themselves. Depending on the management concept, some or all services can be contracted to service providers, which are monitored by the park management.

3.3 Introducing Networking for Energy and Resource Efficiency

To increase energy and resource efficiency industry has to avoid "end-of-pipe"-solutions and linear production chains as best as possible. Taking natures as an example, production, consumption, re-use and recycling have to form circular strings or symbiotic networks, in which the waste or by-product of one industry is the resource of another.

Industrial areas and parks offer favorable frame conditions to form such symbiotic organism, since

  o the companies in the park are located closely together
  o there are already commonly used infrastructure elements and services
  o near-by space is available to integrate companies for closing supply chains or utilizing waste and by-products
  o the park management is able to take over the role of a coordinator and facilitator (overview of flow of energy and resources, trustful relation to companies, knowledge about laws and regulations).
Due to these factors, economic benefits from networking and circular economy are easier to achieve and demonstrate in the sheltered environment of parks than in regions with a scattered industrial structure.

As mentioned before the companies in a park in the majority of the cases do not from network structures automatically. It often needs an initiator or catalyst to start the networking process. This is in particular the role of the park administration or management company.

To increase energy and resource efficiency two types of networks proved to be very successful:

- Energy Efficiency Networks (EEN)
- Networks for Industrial symbiosis.

Although they are not restricted to industrial parks, but due to the reasons mentioned above they both find favorable framework conditions in parks.

### 3.3.1 Energy Efficiency Networks

- **History**

  The first EEN was form already in 1987 in Zürich, Switzerland, while the first EEN in Germany started in 2002 (by Frauenhofer ISI). Until 2008 the EEN management system was further developed as part of a “30 pilot networks”-project (funded by BMU). In 2009 the Lernende EnergieEffizienz-Netzwerke (LEEN) GmbH was form, which trained and certified until 2010 over 80 consulting engineers and moderators in the methodology. This led to an implementation of some 50 EEN in Germany until 2011.

  In China, the German company ARQUM in cooperation with the GIZ Energy Policy and Energy Efficiency (EPEE) Program (2009-2013) and State Grid Corporation of China (who introduced EEN as a new instrument for Demand Side Management in 2011) implemented EEN in recent years very successfully. Until Dec. 2013, SGCC set up 576 EEN, carried out 4378 workshops, helped the customers to save energy of 960 GWh, and achieved a load reduction of 689 MW in the last two years.

  Also as part of the EPEE-Program the first EEN in Chinese industrial areas were implemented (Chengdu Economic and Technical Development Zone, Kunshan Economic and Technological Development Zone).

  The objectives of an implementation of EEN are not only to increase the energy efficiency in the participating companies and thus to reduce the regional CO\(_2\)-emissions but also to develop the capacity of the stakeholders involved to form and operate industrial networks.

- **Fundamentals of Energy Efficiency Networks**

  Many companies who want to start energy saving measures are challenged by the following thoughts:

  - Energy saving is not our core business
  - Energy saving touches a big variety of topics
  - To solve each topic professionally, a multitude of expertise is necessary
  - Developing regulated expertise is for ourselves difficult.
Figure 25 Areas to be addressed when saving energy

To overcome these challenges, ENN offer a number of advantages:

- Better knowledge on energy and resource consumption (where and how much)
- Highlight the priority of energy efficiency for decision makers
- Gain a broad range of expertise through the exchange of experience and external experts
- Successful measures increase reputation of network and members
- Networks have an impact on surrounding companies as well as on the supply chain

- Networks create shared value through:
  - reduction of investigation and decision making costs
  - support of the responsible person for energy efficiency in the companies through the knowledge and the backing of the network
  - decision making based on proven long-term profitability of investment.
For forming an EEN the German LEEN system recommends:

- Local companies, in a distance of less than 100 km
- In total 8 to 15 companies
- Comparable in size, e.g. with annual energy cost of a minimum of 150,000 EUR
- No market competition.

These companies may form:

- Sector specific EEN (e.g. metal industry, food processing, etc.)
- Mixed sector EEN with similar cross-sectional technologies (cooling, process heat, etc.) or similar energy management systems.

To operate an ENN 4 different functions and positions have to be provided:

- Network manager (coordinates and manages the network)
- Moderator (neutral moderator facilitating the communication and decision making process)
- Consultant engineer (offering technical advice on energy efficiency measures)
- Auditor (independent monitoring of achievements).

In small networks, one person each can fulfill the functions of the network manager and moderator as well as the consulting engineer and the auditor.
The implementation of an EEN is carried out in three steps:

1. Step: Kick-off phase
2. Step: Initial start-up phase
3. Step: Continuous improvement and monitoring phase

The results of the first EEN in Germany (Modell Hohenlohe) showed an average reduction of energy consumption of 3.5% while in the average energy reduction of the industry in the same period was approx. 1% per annum.
Experiences with EEN in Chinese Industrial Areas

In 2012/2013 the EPEE-Program in cooperation with the Chinese Association of Development Zones (CADC) implemented the first two EEN in Chinese industrial parks – in the Chengdu Economic and Technical Development Zone and the Kunshan Economic and Technological Development Zone.

Experiences of Chengdu Economic and Technical Development Zone (1st EEN in Chinese industrial parks):

Stakeholders of the networks were:

- Eleven companies of the park
- ARQUM Germany as technical advisor
- Sichuan Electric power conservation Services Company as auditor
- Park administration as facilitator and moderator.

The activities:
The results:

Two plants have changed electricity fee payment mode: 1,200,000 RMB/a be saved

Four plants are part of a research and transformation project: more than 3 million RMB/a and 4 million kWh/a will be saved, 5000 t/a CO2 will be reduced

If 108 recommendations can be implemented:

108 corrective recommendations

15.68 million RMB/a will be saved, 33.06 million kWh will be saved, 28,930 t/a CO2 will be reduced!
With the same methodology, an EEN of 12 companies was formed in the Kunshan Economic and Technical Development Zone. The results of the initial audits of these companies showed the following energy saving potentials:

Table 10 Energy Saving potential of Kunshan Economic and Technical Development Zone

<table>
<thead>
<tr>
<th>Results (5 companies, approx. 30 energy efficiency measures)</th>
<th>~ 20,000 MWh/a</th>
<th>~ 13,000,000 RMB/a</th>
<th>~ 14,800 t/a</th>
<th>~ 19,000,000 RMB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Savings (Electricity, Heat)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy Cost Savings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO₂-Emission Reductions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Investment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Although significant gains in energy and cost savings can be achieved in both parks, a primary investments of almost 50 Mio. RMB is required to achieve the wanted effects. The following table gives an overview of investment and resulting payback periods.

Table 11 Investment and related payback periods

<table>
<thead>
<tr>
<th>Investment with a payback time of less than 1 year</th>
<th>5,186,500 RMB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment with a payback time of 1-3 years</td>
<td>19,092,100 RMB</td>
</tr>
<tr>
<td>Investment with a payback time of more than 3 years</td>
<td>25,631,000 RMB</td>
</tr>
<tr>
<td>Total</td>
<td>49,909,600 RMB</td>
</tr>
</tbody>
</table>

3.3.2 Networks for Industrial Symbiosis

- Fundamentals of industrial symbiosis

Industrial Symbiosis (IS) is the key element to move from a linear production and consumption model towards a circular system in which the different actors (companies) build up long-term symbiotic relationships for mutual benefit (win-win). The involved innovative resource management approach reduces the environmental impacts of production while securing the supply of resource and strengthening the economic competitiveness of the companies involved.
Industrial symbiosis improves and optimizes the management of natural resources used for economic activities. Through energy, material and knowledge exchanges as well as service or infrastructure sharing, economic actors can make an optimal use of available resources and create new value-added.

As the figure above shows, solutions offered by industrial symbiosis include:

- By-product exchanges: converting wastes into valuable productive resources
- Waste heat recovery: turning energy losses into new profits
- Joint supply through the development of shared infrastructures: water, energy and other utilities
- Joint waste management through the development of shared handling and sorting infrastructures or services and the promotion of innovative recycling value chains
- Shared services meeting the needs of businesses like security, training, catering, meeting rooms, etc.

The benefits for the involved partners, the society and the environment are numerous.
In particular, the following effects are achieved:

- **Strengthening economic competitiveness**
  - Create new value-added with by-products or wastes
  - Reduce costs thanks to infrastructure and service sharing
  - Stimulate innovative and efficient technologies.

- **Securing resources supply**
  - Develop an exhaustive knowledge of available material and energy flows
  - Anticipate future needs.

- **Minimizing environmental impacts**
  - Reduce natural resource consumption
  - Reduce waste production and polluting emissions
  - Anticipate the evolution of policies and regulations.

- **Enhancing companies integration and reputation**
  - Contribute to local sustainable economic development
  - Communicate on innovative and eco-friendly achievements
  - Improve of image.

- **Exchange of knowledge, human or technical resources.**

There are many areas where industrial symbiosis offer solutions and business opportunities.
Forming networks of industrial symbiosis

The formation of networks for industrial symbiosis require that companies meet. These meetings have to be initiated and organized. In industrial areas and parks, the facilitating institution is most probably the park administration or managing company.

During initial meetings or thematic workshops, participants express their "Have" and their "Want". The intension is that those companies, which have something to offer (e.g. by-product, waste, heat, etc.) come in contact to those companies who need a certain material or energy source, etc.

As example, the following figure shows the matches/pairs identified through such meetings organized by the National Industrial Symbiosis Program (NISP) in the UK.
Identifying symbiosis pairs or matches is of course only one step. At the end, these ideas have to lead to business opportunities. The following figure describe the steps of the entire IS-process.

**Procedure**

1. Preliminary analysis of the territory
2. Identifying successful experiences and establishing a social network
3. Thematic workshops
4. Interviews and audits
5. Identification of opportunities and feasibility study
6. Project management and support
7. Implementation and monitoring

The preliminary analysis of the territory (1) shall identify the needs related to the geographic location, economic structure, land use issues, environmental challenges, etc.

Identifying the potential stakeholder involved, existing social networks and already established good examples of cooperation and IS (2) shall generate a list of important economic players, private and
public partners and best practices which may be used to support awareness raising and attraction of other companies.

The following thematic workshop (3) with companies of the park shall raise the awareness for IS further and shall identify first potentials for industrial symbiosis.

Intensive audits (4) of companies and production lines will give detailed information on material and energy flows. The information is collected in a database, which the park (network) has to keep up-to-date all the time.

By analyzing the available data (5) opportunity for IS are identified and a following feasibility analysis will confirm potential symbioses.

In order to implement (6) the identified IS-projects a project management and implementing procedures on company level has to be established which might be supported by internal or external experts.

In order to make the gained expertise available to other companies and institutions IS-projects are monitored and recorded (7) giving the key performance and success indicators, the resource savings and economic benefits.

Although industrial symbiosis can take place only between two partners, IS-network offer additional benefits, such as:

- Build-up of mutual trust
- Knowledge transfer and learning from each other
- Maintaining a culture of circular economy and symbiotic business relations
- Mutual benefits exceed the capability of individual companies
- Creating showcases that attracts others.

For long-term management of the formed network a network manager, facilitator (SOFIES, Switzerland) or a practitioner (International Synergies, UK) is needed. The task of this person is as follows.

- Identify ‘IDEAS’ of symbiosis pairs
- Make introductions
- Facilitate negotiations
- Provide technical expertise
- Mine the network for answers and opportunity
- Use their industry expertise and knowledge
- Encourage and accelerate synergy progress.

International Synergies of the UK applies a 6-step process to form an IS-network.
Experiences with IS in Chinese Industrial Areas

Industrial symbiosis projects have been carried out in several economic and technical development zones in China.

Experiences of Chengdu Economic and Technical Development Zone (CETDZ)

In 2012/2013, within the GIZ EPEE-Program in cooperation with the China Association of Development Zones (CADZ) a network for industrial symbiosis was formed in the Chengdu Economic and Technical Development Zone.

The activities during implementation shows the following figure.
As results of these activities a number of potential symbioses have been identified.

**Tianjin Economic and Technical Development Zone (TEDA)**

Financed by the Switch–Asia Program of the EU and assisted by International Synergies from the UK, a network for industrial symbiosis was implemented by TEDA during the years 2010 to 2014.
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**Sino-German Cooperation Project**
Qualification of Key Actors in the Building Energy Efficiency Sector (KABEE)
Training Textbook

**German Experiences to obtain Energy Efficiency Gains in Cities through Eco-Industrial Park (EIP) Development**

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**Figure 45** TEDA working together for industrial symbiosis

**Figure 46** TEDA match making process

**Figure 47** Results of IS at TEDA

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- 81 inter firm relationships over 16 years
- 33 within the boundary of TEDA
- 48 involve partners outside boundary of TEDA (59%)

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Han Shi et al (2010)
3.4 Implementing Measures on Company Level

The aim of both – EEN and network for industrial symbiosis – is to implement identified projects on company or park level. Before a final decision can be made, the technical, environmental, social and economic feasibility of the investment measure has to be analyzed.

As the above figure points out, a well-designed comprehensive feasibility study should investigate various aspects like:

- Social, geographical and political context

- Technical feasibility
  - Description of the products or services
  - Details of the operations, raw materials, intermediates and by-products
  - Figures on utility demands
  - Layout and extensions for space requirements
  - Figures on logistics, traffic
  - Figures on labor demand

- Legal feasibility
• Economic feasibility
  o Summary of investment costs and credit demand
  o Operation costs
  o Cash flow analysis
  o Calculation of internal rate of return (IRR), net present value (NPV) and payback period
  o Economic sensitivity

• Organizational and management aspects
  o Management demand
  o Demand for monitoring

• Environmental feasibility
  o Environmental impact assessment (EIA)
  o Environmental sensitivity
  o Required mitigation measures and limits of operation

A feasibility study refers to the implementation of projects and its operation, and is of particular importance when risks may otherwise not be appreciated or the achievability is questioned. It aims to objectively and rationally uncover the strengths and weaknesses of a project. It must be conducted with an objective to obtain information upon which the investment decisions can be based. For investment projects in an EIP the achievability of sustainability has to be proven.

To analyze the environmental issue in particular, it is often required to carry out an Environmental Impact Assessment (EIA).

Usually environmental impact assessments are carried out according to country-specific legislation. In many countries, there are rules that govern the procedure for the preparation of environmental impact assessments. Environmental analyses are carried out for entire industrial parks as well as for individual investment projects.

The environmental impact assessment (EIA) is an instrument for planning, development and use of resources and territory with the aim of determining how environmental components are affected by the investment measure. The study includes the identification and mapping of natural and technological risks and points out recommendations and requirements to improve sustainability and eco-friendliness of the company and process. Though identifying the impact of the investment measure on the environment, recommendations are given to avoid overusing the resilience of the natural and social environment. Knowing the environmental profile of different scenario on the neighborhood relevant indicators for the implementation of a monitoring system are derived.

At first, the actual state of company or process is taken as baseline for the evaluation of changes caused by the new investment. The analysis could be performed by means of surveys, measurements and inquiries and presented in maps where appropriate. If entire new plants are going to be installed the following topics have to be analyzed to describe the untouched situation:

  o Environmental conditions – tectonics, climate, prevailing winds,
  o Flora and fauna, including temporary habitat for birds of passage and butterflies of passage
If smaller investments within an existing operation are analyzed aspects like:

- Working environment
- Present energy and resource consumption
- Noise level
- Emissions and waste/wastewater.

In a **second step**, the changes due to the investment have to be described by means of key indicators. Different scenarios have to be considered and their environmental impact described. Important key figures are occupational health, energy and resource consumption, noise, emissions and hazardous by-products or waste.

These key figures are evaluated first for normal framework conditions and standard operation where all prevailing laws and regulations and specified limits are assumed to be met. Then, as a particular priority, the risks that can be caused by incidents such as natural disasters, human or technological malfunction, fire or explosion are taken into consideration. Important aspects of the analysis are the exploitation of resources such as energy, water, raw materials air and the generation of climate gases.

The **third step** consists of the impact evaluation. What consequences are to be expected due to the investment or caused by conceivable incidents. For many aspects, simulation tools are available such as propagation of airborne emissions, underground water currents, and sound propagation. In other cases such as spread of fire, endangering of biodiversity or of individual species research studies may be required (in particular for entire new plants).

In case of entire new plants in a **fourth step** the environmental resilience has to be estimated in order to find out whether the new installation exceeds the absorption capacity of the environment.

Finally, the **fifth step** gives recommendation for limits of operation, technologies and processes to be used and measures taken to increase the disaster preparedness and the avoidance of unexpected incidence.
To summarize, environmental impact assessment is a powerful tool being normally part of any feasibility study of investment projects in general, and is of particular importance for those to be implanted in an EIP.

The EIA for investments in an EIP is a decision-making tool for both the company management as well as the EIP management.
4 Available Knowhow and Support

This document is only able to give an overview on energy and resource efficiency in industrial areas. In order to implement the highlighted aspects and measures further advice is required, which can be drawn from institutions, companies or consultants listed on the following pages.

4.1 Knowhow on Criteria for EIP and SIA

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Dag-Hammarskjöld-Weg 1-5, 65760 Eschborn, Germany
SIA TEAM – Katrin Gothmann
E-Mail: katrin.gothmann@giz.de
Phone: +49 6196 79-2035
Info: www.giz.de

Deutsche Gesellschaft für Nachhaltiges Bauen – DGNB e.V.
German Sustainable Building Council – GeSBC
Tübinger Straße 43, 70178 Stuttgart, Germany
E-Mail: info@dgnb.de
Phone: +49.711.72 23 22-0
Fax: +49.711.72 23 22-99
Info: www.dgnb.de

4.2 Knowhow on Park Management Aspects

Infraserv GmbH & Co. Höchst KG
65926 Frankfurt am Main, Germany
E-Mail: kundenservice@infraserv.com
Phone: +49 69 305-6767
Fax: +49 69 305-986767
Info: www.infraserv.com

CURRENTA GmbH & Co. OHG Chempark
51368 Leverkusen, Germany
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Weber Sites Consulting GmbH
Biggestr. 17, 50931 Köln, Germany
Dr. Michael Weber
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Phone: +49-1577-3195746
Phone: +86-185-8339-7993
4.3 Knowhow on Energy Efficiency Networks

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BMS-PUR-P&T-Technology, B211, 522
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Dr. Bastian Mahr
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Info: http://www.bayermaterialscience.com
4.4 Knowhow on Networks for Industrial Symbiosis

International Synergies Limited
44 Imperial Court, Kings Norton Business Centre, Pershore Road South, Birmingham, B30 3ES, UK
Peter Laybourn
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Phone: +44(0) 121 433 2660

Sofies SA
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Guillaume Massard
E-Mail: guillaume.massard@sofiesonline.com
Phone: +41 22 338 15 24
Mobile: +41 78 625 27 51
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4.5 Knowhow on Project Management and Energy

INTEGRATION Umwelt & Energie GmbH
INTEGRATION environment & energy
Bahnhofstrasse 9
91322 Gräfenberg, Germany
Ralph Pförtner
E-Mail: rpförtner@integration.org
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Fax: +49 9192 995910
Info: www.integration.org

TIME
Technologie–Institut für Metall & Engineering GmbH
Dr. Ralf Polzin
Koblenzer Str. 43, 57537 Wissen, Germany
E-Mail: Ralf.polzin@time-rlp.de
Info: www.time-rlp.de

4.6 Knowhow on Technical Processes or Hardware for Energy Efficiency

Green Building:

energydesign (Shanghai) Co. Ltd.
Phone: +86 21 6597 9141

Shanghai Sto Ltd.
Factory 288 Qingda Road Pudong 201201 Shanghai, China
Phone: +86 21 5887 2295.
**Sino-German Cooperation Project**
Qualification of Key Actors in the Building Energy Efficiency Sector (KABEE)

**Training Textbook**

**German Experiences to obtain Energy Efficiency Gains in Cities through Eco-Industrial Park (EIP) Development**

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**Green-It:**

IBM
No. 6 Changjiang Backstreet, Dongnan Uni. Techpark, Room 103
Nanjing, China

**Solar:**

Baysolar Office Shanghai
Room 1520 Floor 15th, No. 66, Hua Yuan Shi Qiao Road,
Pudong District, Shanghai, China
Phone: +86-21-2080 3128

**HVAC**

Trane Air Conditioning Systems (China) Co. Ltd.
No.88, Suzhou (E) Rd. Taicang, Jiangsu 215400, China
Phone: +86 512 5358 5200

Bosch Rexroth (Changzhou) Co., Ltd
No.16 East Renmin Road, Wujin District, Changzhou 213161, China
Phone: +86 519 8817 5000

**Compressor:**

Kaeser Kompressoren (Shanghai) Co., Ltd.
No. 3500 Jindu Rd. Xinzhuang Industry Zone,
MinHang District, Shanghai 201108, P.R. China

**Pumps:**

Grundfos Pumps (Suzhou) Ltd.
No.72 Qingiu Road. CN-215126 Suzhou, Jiangsu.
Phone: (+86) 512 62831800

**Lighting:**

OSRAM Asia Pacific Management Company. 28/F., Harbour Ring Plaza,
No.18 Xi Zang (M.) Road Shanghai, P.R. China
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Annex: Company Presentations