

# Stimulating Sustainable Development in Mixed Eco-Industrial Parks

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*Abstract:* Since the world summit on sustainable development in Johannesburg, discussion on eco-industrial parks has started in several industrialised countries and many initiatives occurred to establish eco-industrial parks or to transform existing industrial parks. Originally, eco-industrial parks were mainly based upon the exchange of resources among industrial complexes. These initiatives are generally referred to with the concepts of industrial symbiosis. After this initial period, the concept of eco-industrial parks has been extended to another type of industrial park, the so-called mixed industrial park, which consists of various small and medium-sized enterprises some times complemented by a small number of larger industries. The significance of eco-industrial park initiatives needs a typology for clarifying the confusion. It is argued that mixed industrial parks are poorly investigated although they have a major environmental and spatial impact. Starting from a case study of a mixed eco-industrial park initiative, this paper describes the related societal and environmental problems and proposes solutions for the first stage of the transformation.

*Key-words:* Eco-industrial park, Sustainable development, Landscape reclamation, Planning.

## 1 Introduction

According to the United Nations commission concerning Development and the Environment [1], sustainable development is defined as one that caters to the present needs while not compromising the possibility for future generations in meeting their own necessities.

The Political Declaration of 2002 during the World Summit on Sustainable Development in Johannesburg [2] affirms that a sustainable development is built upon “three interdependent and mutually sustaining pillars.”

- Economic Development
- Social development
- Environmental protection

Eco-Industrial Parks are an ordered layout of various production and business facilities within the same geographical area whose aim is in maintaining sustainable development through a symbiotic relationship between its various parts in adherence with ecological concerns [3]. We are dealing in effect with a highly autonomous location, capable of providing the necessary means towards its industrial

and economic aspects by use of service equipment, cultural and recreation facilities and social spaces among others [4].

Aside from the habitual preoccupation with the economic viability of the park, the Administration gives special emphasis in facilitating the implantation of companies whilst presenting various initiatives that foster in providing a cohesive and synergistic dynamic between the various entities within an eco-friendly framework.

Each industry functions within and concerns itself with ecological matters when possible, such as the using or reusing of by-products and substances which may be considered industrial waste or their reprocessing into less volatile and eco friendly ones [5].

The development of Eco-Industrial Parks is strongly backed by European governments, both politically and financially. In 1997, the Ministry of Regional Planning expressed the preoccupation in balancing economic growth without causing too great an impact in detriment to the environment and provide an outline of 16 essential guidelines for the

cooperation between the public and private sectors [6, 7, 8, 9].

In 1961 the construction of a new Oil Refinery in the Danish town of Statoil gave rise to the The Kalundborg Park. Despite the lack of any initial planning, Kalundborg evolved into an Eco-Industrial Park of high repute, cited frequently as the best example of a practical and functional model for an Industrial ecosystem [10, 11].

This study aims in identifying several aspects of the SAPEC Bay Industrial Park that are not compatible with the landscape or ecology of the region with the objective of presenting several proposals that will overall contribute towards a more economically viable and eco-friendly usage of the area.

## 2 The SAPEC Bay Industrial Park

The SAPEC Bay Industrial Park is located in a highly industrialized region in the County of Setúbal, including 46 ha of the Natural Reserve of the Sado Estuary (NRSE). The nearest populated city is the Praia do Sado, 1,5km away (Figure 1).



Fig. 1 –Location of the Industrial Park SAPEC bay.

The peripheral area of the SAPEC Bay Park is characterized essentially by the presence of various industrialized zones and support facilities, such as ports and docks, various train lines (The Sado Line, SAPEC/Portucel), the national road EN 10-4, several wooded areas as well as social facilities built on a small scale.

The SAPEC Bay Industrial Park encompasses a total Area of 365 ha, with an industrial makeup of various types that range from the fabrication of chemical products for agricultural use, cement production and non toxic residue treatment and logistics among others.

### 2.1. Proposals for landscape interventions.

It has been identified a highly erodible slope that resulted from the construction of a road in the southern part of the park which requires bioengineering slope stabilization. The benefits of this stabilization are evident both from an ecological and aesthetic perspective, mainly the reduction of soil erosion caused by rainfall and winds as well improved cohesiveness within the surrounding landscape (Figure 2). Also it is proposed a hydro seeded implantation for this slope. At the planned widening of the national road EN 10-4 it is proposed various landscaping interventions along the park using drought resistant species (Figure 3).



Fig. 2 –Landscape intervention at the perimeter of the Park.



Fig. 3 –Road enlargement and landscape intervention.

South of the Administrative Complex there too arises the need for better landscape planning, being an area that is easily visible from the EN 10-4, such an intervention would confer upon the area a nicer aesthetic instead of the present state from which one infers a sense of abandonment and lack of care The intervention proposed would stabilize the soil by the use of stone slabs, ornamental plants and hydro

seeded bushes of different dimensions with the aim of creating an asymmetrical arrangement (Figure 4).

The main entrance to the Park is unordered resulting from excess usage of informative signs which confuse the visitor and does not encompass what could be defined as the space that serves as a calling card for the park. In our opinion the main should reflect the spirit of the place (*Genius loci*), “the character of the park”.



Fig. 4 –Landscape intervention at the south of the Administrative Complex.

According to Bell [12], perception is the starting point for the aesthetic experience. For Schopenhauer [13], a great sense of beauty is to be obtained if the scene expresses what he calls the ‘idea’, the essence of the place or perhaps its spirit (*genius loci*). Order and diversity are the necessary ingredients for an impulsive response to beauty, but the key ingredient is the knowledge of the essence of the place [12]. In figure 5 can be seen the proposed interventions in order to better portray the eco-industrial “character of the park”:



Fig. 5 –The intervention in the main entrance to the park expressing the genius loci of the place.

- Covering part of the entrance grounds with the granite stone indigenous to the nearby region of Herdade das Praias which is used in the sulphuric acid production industry of the park.

- A sculptural arrangement using naturalistic looking Sunflowers and Cornstalks made from lasting materials that also reflect the bio-fuel industry of the park.

## 2.2. Intergating the Natural Reserve of the Sado Estuary (NRSE)

Presently, the 46 ha of the natural reserve area within the park are degraded and without any management plan requiring more attention from an ecological point of view:

- reclamation of the degraded wooded area of the NRSE through a sustained reforestation use that aim to preserve threatened species such as *Quercus suber*, *Quercus faginea*, *Quercus coccifera* e *Pinus pinea* in areas where they were already found.
- Eucalyptus plantation within the recognized areas of their existence in accordance with the national legislation requirements.
- Plantation of the indigenous species of *Populus alba* along the streamlines of the area and at riparian areas induced with salt water, it is suggested the well adapted *Tamarix*.
- Improving habitat conditions for waterfowl and other bird species of the reserve.
- Promoting public awareness of the ecological qualities of the NRSE by allowing public access.
- Promoting initiatives that seek to educate and inform the public about the ecological and heritage value of the NRSE.

In order to achieve the objectives stated above, it is proposed the following: The construction of an adjoining elevated walkway, built in wood, along the main train line for pedestrian use that would easily integrate with the Natural Reserve surroundings. In order to maximize the nesting potential of some bird species within the reserve, it is suggested the placement of bird houses within the reserve as well as informative panels regarding the various species that could signal areas of potential bird watching interest. Such a campaign should include local schools for its realization and could serve as a lesson in environmental education and awareness.

The elaboration of a bird-watch post, (Figure 6) in the most elevated part of the park will provide a better view for the appreciation of bird watchers as well as the uniquely beautiful and ecologically rare marshlands of the nearby natural reserve.

The SAPEC Group looks toward the development of a bio-fuel/bio-energy plant within

the Industrial Park. As a reflection of the current agenda for the production of clean and renewable energies by means of the appropriate use of sunflower and corn plantations as well as electricity production by wind powered turbines or windmills the large areas of the industrial park can be promoted. The use of these plantations could serve the bio-fuel industry and provide habitat for the various bird species and thereby contribute to the eco-sustainable qualities of the park.



Fig. 6 –Bird-watch post at the Natural Reserve of the Sado Estuary part of the Park.

### 2.3. Proposals for the Eco-Sustainability of the Industrial Park

The roads within the industrial zone should be planted with trees to improve visually the landscape, to retain dust and particles and to serve as a natural barrier for noise insulation generated by heavy equipment and transport vehicles. It is proposed planting trees next to industrialized lots as a method of obtaining a micro climate that strengthens biodiversity and increase energy efficiency from the buildings themselves.

Industrial waste and residue treatment should be undertaken by industries as a whole, to strengthen the synergistic potential in reuse or trading by-products of the various industries into the raw materials needed by others.

The potential for using solar powered cells for the energy production needs of the park should be analyzed. Energy production systems that involve heat such as thermal energy or the use of natural gas or biomass combustion should be contemplated. It should be also be studied the construction of a thermal-electrical production facility that would mainly employ the use of biomass residue from wooded areas. Aside from these, such a facility could potentially reutilize other biomass materials such as hay, cane, woodchips, leaves and even construction materials. The SAPEC Bay Group could in effect take advantage of its geographical

proximity to the Arrábida Mountain Range Natural Park with an area of 10,800ha as it's major supplier of biomass wherein establishing a provision with the Natural Park Authority to clean the forested areas whilst retaining the right to use such material for its own purposes.

The SAPEC Bay Industrial Park should take into account a mix of industries that in the long run would benefit in the reutilization of residues and materials. To strengthen this case, it is noted that the EPA (Environmental Protection Agency) in the United States has developed a guideline known as the Facility Synergy Tool (FaST) whereby the selection of one main industry can garner in the inclusion of other industry partners for whom certain industrial by products or residues can serve as a principal raw material [14, 15]. At the NRSE region of the industrial park, it is proposed the inclusion of a constructed wetland as Phyto-water treatment facility that can mitigate flooding problems and can reuse treated water to irrigate the gardens and tree plantations of the industrial park.

### 3 Conclusion

The present work intends to stimulate the growth and dissemination of ECO-Industrial Parks in Portugal and thereby provide the Administration of the SAPEC Bay Industrial Park a working philosophy that encompasses economic development, societal concerns and ecology values for the betterment of its own public image, both nationally and abroad, as well as to attract future financial investment.

To conclude, based on what has been presented in relation to the development of the SAPEC Bay Industrial Park, this study contains the necessary means and potential for introducing the changes and improvements to the present infrastructure through social, economic and environmental proposals that favour sustainable development and guide in the transformation of the SAPEC Bay Industrial Park into an Eco-Industrial Park of the future.

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