



Pergamon

Technovation 22 (2002) 471–484

technovation

www.elsevier.com/locate/technovation

Eco-industrial parks: stimulating sustainable development in mixed industrial parks

A.J.D. Lambert ^{a,*}, F.A. Boons ^b

^a Faculty of Technology Management, Technische Universiteit Eindhoven, TM/AW Pav. H.03, P.O. Box 513, 5600 MB Eindhoven, The Netherlands

^b Studiecentrum voor Milieukunde, Erasmus Universiteit, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands

Received 20 February 2001; accepted 17 March 2001

Abstract

In several industrialised countries, there have occurred initiatives to establish eco-industrial parks. Originally, these were mainly based upon the exchange of resources between heavy industries in industrial complexes. These initiatives are generally referred to with the concepts of industrial symbiosis and eco-industrial parks. Since then, the concept of eco-industrial parks has been extended to another relevant type of industrial park, the so-called mixed industrial park, which consists of various small- and medium-sized enterprises (SMEs), sometimes complemented by a small number of larger industries. Because of the resulting growing ambiguity in the significance of eco-industrial park initiatives, a typology is desirable for entangling the confusion that is introduced. It is argued that mixed industrial parks are poorly investigated although they have a major environmental and spatial impact. Starting from a general consideration of eco-industrial park initiatives, this paper describes the societal and environmental problems that are related to the mixed industrial parks, proposes solutions and discusses the counteracting factors. While our argument relates strongly to the traditionally industrialised countries, it is also relevant to newly industrialised countries, as they are faced with similar problems, or will encounter them in the near future. © 2002 Elsevier Science Ltd. All rights reserved.

Keywords: Eco-industrial park; Industrial ecology; Environmental and country planning; Small- and medium-sized enterprises; Mixed industrial park

1. Introduction

In the Netherlands, as well as in the United States and Canada, the discussion on eco-industrial parks has explicitly started since about 1995. Many elements in this discussion are related to subjects that have been considered earlier separately, such as ageing, country planning, utility production, and waste handling. One of the roots of this discussion is in the concept of *industrial ecology*, which in turn was an attempt to face the problems that were related to resource consumption, waste production, and emission, by an integrated approach. In developing this concept, the challenge for *sustainable development* played a significant role. The need for unleashing the economic progress from the consumption of finite resources and from the discharge of waste is

crucial to sustainability. To obtain this, measures were advocated that combine economical and ecological advantages. Although the basic ideas of industrial ecology were already discussed in papers of the mid-1950s, which have been reviewed by Erkman (1997), the first paper that explicitly formulated the principles of such an approach and that brought these ideas to a broader audience was by Frosch and Gallopoulos (1989). Industrial ecology intends to transform the industrial system by learning from the functioning of the natural environment. In the natural system, all components are integrated and no waste is produced. It needs a systematic analysis of materials flows inside the so-called technosystem, which includes the human-controlled production and consumption processes and which is positioned against the ecosystem. The basic characteristics of industrial ecology are formulated as follows (Erkman, 1997):

1. It is a systematic, comprehensive, integrated view of all the components of the industrial economy and their relations with the biosphere.

* Corresponding author. Tel.: +31-40-247-4634; fax: +31-40-244-4602.

E-mail addresses: a.j.d.lambert@tm.tue.nl (A.J.D. Lambert), boons@fsw.eur.nl (F.A. Boons).

2. It emphasises the biological substratum of human activities, i.e. the complex patterns of material flows within and outside the industrial system, in contrast with current approaches, which mostly consider the economy in terms of abstract monetary units, or alternatively energy flows.
3. It considers technological dynamics, i.e. the long-term evolution (technological trajectories) of clusters of key technologies as a crucial (but not exclusive) element for the transition from the actual unsustainable industrial system to a viable industrial ecosystem.

This innovative approach has been frequently used by both investigators and industries for making inventories of material flows inside the technosystem and for optimising the material flows with respect to the environmental and economic performance of production processes and enterprises. It has also given theoretical background to the current tendency towards “closing the chain”. Although complete closing of the chain of materials flows in the technosystem is utopian, the waste reduction might be considerable and will result, e.g. in closure of landfills in Germany not later than the year 2020. However, the discharge of some dilute emissions such as carbon dioxide, and the creation of small amounts of high-risk wastes that have to be stored in a controlled way, are unavoidable for the time being. Regulation has resulted in bans and restrictions on waste disposal and the costs that are related to waste processing are increasing. This has been a strong incentive for the coming of age of a formerly somewhat obscure, but presently a well-established and innovative branch of industrial activity: the recycling industry.

Based on the framework of industrial ecology, the concept of industrial symbiosis emerged. This concept was introduced by Lowe and Evans (1995), based on studies on spontaneously emerged industrial complexes in which the different industries exchanged material flows on a large scale: Houston Ship Channel in Texas, and Kalundborg in Denmark. In the USA, a prestigious project was initiated by the Environmental Protection Agency of the Federal Government. This was called the eco-industrial park project. In this project under responsibility of the President’s Council on Sustainable Development (PCSD), experiences should be gathered by co-operating universities, consultants, project developers, local authorities, etc. and dispersed on interested parties for establishing eco-industrial parks. In a 1996 workshop, information was exchanged on 15 sites in the USA and Canada (PCSD, 1997). In this workshop, the definition for the term eco-industrial park was established. Two definitions were selected, the one focusing on societal performance, the other on technical performance:

1. A community of businesses that collaborate with each other and with the local community to efficiently share resources (information, materials, water, energy, infrastructure and natural habitat), leading to economic gains, gains in environmental quality, and equitable enhancement of human resources for the business and local community.
2. An industrial system of planned materials and energy exchanges that seeks to minimise energy and raw materials use, minimise waste, and build sustainable economic, ecological and social relationships.

Although these definitions largely coincide, there are differences, as the second one has an explicit emphasis on physical flows (materials and energy), while the first definition focuses on organisational and societal processes.

In this paper, we will explain that this distinction is not accidental, but rather reflects the different problems that arise in different kinds of industrial parks. The focus on materials and energy exchange has its roots in the chemical industries. This principally refers to “classical” *industrial complexes* that consist of concentrations of materials and energy intensive, so-called heavy industries which intrinsically are mutually interrelated. These complexes can be situated close to each other, but they are often in a zone, for instance alongside a waterway or close to an ore deposit. The other approach is principally inspired by the problems related to *mixed industrial parks*, which usually house a variety of small- and medium-sized enterprises (SMEs). The challenges there are indeed far more diverse and not confined to the exchange of the many relatively small and diverse flows of materials and energy.

Additionally, we will discuss examples of both approaches, and we will stress that the appropriate planning and management of mixed industrial parks will become an urgent problem in the near future. Although many examples are taken from the Netherlands, which is indeed a densely populated and highly industrialised country, the associated problems are characteristic to the industrialised world and are emerging in newly industrialised countries as well.

2. Typology of eco-industrial parks incentives

We have already mentioned the distinction between industrial complexes and mixed industrial parks that will be further discussed in the remainder of this paper. Apart from this, a third approach is often studied in the literature. This involves the regional approach, which is frequently advocated in, e.g. Germany and Austria (Schwarz and Steiniger, 1997). Here, recycling networks are stimulated, based on industries that are not located on the same site, but that are present in a particular

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات