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Implementing industrial ecology? Planning for eco-industrial parks in the USA

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Abstract

Despite the widespread incorporation of sustainable development into policy discourses, actually achieving the 'win–win–win' scenario of economic, environmental and social development continues to be problematic. Advocates of industrial ecology suggest that by shifting the basis of industrial production from a linear to a closed loop system, these gains can be achieved. In recent years, concepts drawn from industrial ecology have been used to plan and develop eco-industrial parks (EIPs) that seek to increase business competitiveness, reduce waste and pollution, create jobs and improve working conditions. Despite a growing interest in EIPs, there have been few empirically informed studies that seek to explore the potential contribution such EIPs may make to sustainable development. This paper contributes to a developing sympathetic critique of industrial ecology by focusing on the key problems and dilemmas that arise in the course of developing eco-industrial parks, drawing upon empirical work conducted in the USA. The paper draws upon both an extensive survey of EIPs and in-depth interviews conducted with a range of stakeholders at ten US sites. As the paper reveals, EIPs in the USA are in their early stages and likewise their contribution to both economic development and environmental policy, let alone social policies, is complicated and inchoate. The empirical material reveals that key features of industrial ecology such as inter-firm networking and collaboration in the form of materials interchange and energy cascading are either absent or in the early planning stages. In each of the ten cases what is emerging is a form of EIP partly determined by the geographic setting and broader economic realities of the locality. While collaborative behaviour between firms is central to EIP development if the potential benefits of industrial ecology are to be realised, it is important to realise that such behaviour is difficult to develop from scratch through policy intervention. In conclusion, the paper suggests that expectations must be realistic for the community and location in question. As part of that realism, EIP projects must be designed to allow for a gradual approach, and each phase needs to be financially viable.

Keywords: Industrial ecology; Eco-industrial park; Sustainable development; USA

1. Introduction

Despite the outpouring of academic and policy literature on the topic since the Earth Summit of 1992, the actual implementation of sustainable development on the ground has continued to prove elusive (Milani, 2000; Roberts and Colwell, 2001; Gibbs, 2002). One attempt to counter this seeming impasse impeding the 'win–win–win' scenarios (economic–environmental–social) proposed in the sustainable development literature has been to argue that implementing concepts drawn from industrial ecology form a partial solution. Advocates of industrial ecology suggest that by shifting the basis of industrial production from a linear to a closed loop system, both economic and environmental gains can be achieved (see Erkman, 1997 for an historical

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overview). These arguments have been taken up by a number of academics and practitioners who have sought to encourage industrial ecology developments, particularly in the form of eco-industrial parks. In the USA the Clinton administration's President's Council on Sustainable Development (PCSD) encouraged the establishment of demonstration sites and in 2001 the National Center for Eco-Industrial Development was established as a research and information centre at the University of Southern California, funded by the US Department of Commerce's Economic Development Administration, the National Oceanic and Atmospheric Administration and the Environmental Protection Agency. [1] Eco-industrial parks (EIPs) seek to increase business competitiveness, reduce waste and pollution, create jobs and improve working conditions. They therefore aim to deliver all three economic, environmental and social benefits (Côté and Cohen-Rosenthal, 1998).

Although industrial ecology has been described as the "science of sustainability" (IEEE in Allenby, 1999, p. 40) the field is still very much in its early stages. Some of the early literature was almost evangelical in its optimism for what could be achieved, suggesting that EIPs represented the embodiment of industrial ecology (see for example, Hawken, 1993). More recently a critique (albeit sympathetic) has developed suggesting that the incremental adoption of industrial ecology principles and/or a regional approach may be more viable than a purely park-based approach (see for example, O'Rourke et al., 1996; Andrews, 2001; Thomas et al., 2003; Chertow, 2003). This paper is intended to contribute to this critique by focusing on the key problems and dilemmas that arise in the course of developing eco-industrial parks, drawing upon empirical work conducted in the USA. As the paper reveals, EIPs in the USA are in their early stages and likewise their contribution to both economic development and environmental policy, let alone social policies, is complicated and inchoate. The structure of the paper is as follows. In the following section we outline the concept of industrial ecology. Following this, we examine how attempts have been made to implement the concept in the form of eco-industrial parks. We then turn to examining the many problematic issues that have arisen in planning and developing eco-industrial parks through an examination of empirical evidence from an interview survey and from a range of secondary materials of the operations of ten eco-industrial park developments in the USA. A concluding section discusses the potential future for planning eco-industrial park development.

2. Industrial ecology

Industrial ecology (IE) attempts to understand the potential for environmental improvement in industry using an analogy of industrial systems to natural ecological systems (see Frosch and Gallopoulos (1989) for the seminal statement on industrial ecosystems). Industrial ecology has numerous aspects including pollution prevention, product life cycles, design for environment and green accounting (Chertow, 2000). A key concept is that processes and industries are seen as interacting systems rather than comprising isolated components in a system of linear flows. This provides a basis for thinking about ways to connect different waste-producing processes, plants, or industries into an operating web that minimises the total amount of industrial material that goes to disposal sinks or is lost in intermediate processes. The focus changes from minimising waste from a particular process or facility (i.e. pollution prevention), to minimising waste produced by the larger system as a whole, as well as reducing materials inflow (Richards et al., 1994; Brand and de Bruijn, 1999).

Industrial ecology essentially represents a development that moves forward from dealing with localised environmental impacts. Rather than focusing upon concepts such as cleaner production and eco-efficiency, which are concerned with reducing materials inputs and reducing wastes *at the level of the firm* (OECD, 1998; Lovins et al., 1999), it is contended that industrial ecology offers an holistic conceptual framework for the kind of "significant, systemic industrial change" needed to eliminate environmental damage (Tibbs, 1992, p. 1). The impacts at the level of the individual firm or process are still considered important, but need to be connected to the wider industrial ecosystem. In industrial ecology studies, these firm or process impacts are dealt with through the parallel concept of industrial metabolism, which is concerned with the efficiency of the metabolic processes within firms or processes (Ayres, 1989). Improved industrial metabolism across the whole spectrum of industrial processes would, it is argued, make the creation of industrial ecosystems easier (Tibbs, 1992). Thus "a better understanding of material flows is a first step to increasing the eco-efficiency of society's metabolism by closing material flows into loops of recycling and reuse" (den Hond, 2000, p. 61).

In an industrial ecosystem, effluents and wastes from one process serve as the input materials for other processes or are recycled for further production, mimicking food webs in natural systems (Dunn and Steinemann, 1998). In another ecological parallel, it is proposed that 'niche species' will emerge to fulfil particular functions,

[1] The PCSD was subsequently disbanded by the incoming Bush administration. A small number of individuals formed the driving force behind developing the EIP concept—Ernest Lowe at Indigo Development, Ed Cohen-Rosenthal at Cornell University and Raymond Côté at Dalhousie University. The Centre at USC received limited funding and concentrated upon research and dissemination of research results.