Regional industrial ecology: examples from regional economic systems of forest industry and energy supply in Finland

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Abstract

Industrial ecology (IE) promotes the development of industrial systems based on recycling of matter and cascading of energy through cooperation. In this paper, the local/regional industrial ecosystem approach is reflected in two examples from Finland. The local forest industry system is based on renewable resources, waste materials and energy utilisation between forestry companies, a saw-mill, a pulp mill, a paper mill and a forest industry power plant. Waste energy from electricity production is used for production of heat and process steam. Regional city energy supply systems in Finland are also to a large extent arranged around power plants that utilise waste energy. The potential of combining the forest industry system with the energy supply systems of cities is considered and the conditions for success in the Finnish case are discussed.

Keywords: industrial ecology, regional industrial ecosystem, local forest industry systems, regional energy supply of cities.

Introduction

This paper focuses on the emerging practice of industrial ecology (IE), a concept introduced in 1989 in a Scientific American article by Frosch and Gallopoulos (1989). IE is derived from industrial environmental management, and is based on a provocative ecosystem analogy of roundput or recycling systems. In ecosystems, waste equals food and energy is cascaded in the food chain, while the only input to the system is solar energy. Therefore, the purpose of IE is to consider the potential of facilitating the emergence of industrial systems, where the actors involved cooperate by using each other’s waste material and waste (residual) energy flows.

The few case studies that exist have been in a regional context. A local/regional network of companies can in theory provide the IE concept with a fruitful testing ground. Also public organisations and consumers could be studied as parts of such a network. The aim is to keep as much as possible of the product’s life cycle within regional boundaries, to reduce the consumption of energy and improve the capacity of the actors to monitor and manage it. In this paper, experiences from Finland are illustrated with case studies from forest industry and the household energy supply of a Finnish city. The paper concludes with a scenario for future development of IE and considers some conditions of success in the Finnish example, or the extent to which these examples can be considered successful.

Regional industrial ecosystems

The most frequently cited working model of an industrial ecosystem is in Kalundborg, Denmark (Ehrenfeld and Gertler, 1997), where, according to many researchers, the industrial actors have created an economic-environment win-win situation (for discussion on win-win, see Porter and van der...
Linse, 1996; Walley and Whitehead, 1996) by util-
ising each other’s waste material and energy flows.
The vision of the local/regional industrial ecosys-
tem analogy is presented in Figure 1. A group of
industrial actors are located in close physical prox-
imity to each other. Corresponding to a local ecosys-
tem, the system’s operation and sustainability is
based on waste material and waste energy util-
isation (recycling of matter, cascading of energy)
between the actors. When successful, the environ-
mental ‘win’ arises through reducing the system’s
material and energy input as well as the waste and
emission output. In theory, recycling can reduce
both. The economic ‘win’ arises from reduction of
raw material and energy costs, or costs that result
from the implementation of measures required by
environmental legislation. The ‘image costs’ and
waste management costs can also be reduced and
the potential for green marketing can also be
realised in this scenario.

The regional industrial ecosystem thesis is still
in its initial stages and the definitions vary. Accord-
ing to Ayres and Ayres (1996), ‘The industrial
analog of an ecosystem is an industrial park (or
some larger region) which captures and recy-
cles all physical materials internally, consuming
only energy from outside the system, and pro-
ducing only non-material services for sale to con-
sumers. This vision is highly idealised, of course.’
A regional industrial ecosystem can be defined as
an eco-industrial park. Cote (1998) describes an
eco-industrial park as a ‘community of manufac-
turing and service companies seeking enhanced
environmental and economic performance through
collaboration in managing environmental and
resource issues including energy, water, and
materials… Through collaboration, this commu-
nity of companies becomes an industrial ecosystem’
(Research Triangle Institute and Indigo Develop-
ment, 1996; Cote, 1998:9–11; Baas, 1998). The
United States President’s Council on Sustainable
Development considered an eco-industrial park
to be ‘an industrial system of planned materi-
als and energy exchanges that seeks to minimise
energy and raw materials use, minimise waste, and
build sustainable economic, ecological and social
relationships.’ (President’s Council on Sustainable

The local/regional context suits the ecosystem
analogy. Here the actors involved may have the
necessary motivation for cooperation. Mutual and
common interests may emerge regarding the eco-
nomic and environmental issues of the region.
As noted above, in an ideal situation, regional
industrial ecology can benefit the local economy.
Reduction of transportation, the benefits of co-
operation and the exchange of information, tacit
knowledge and the opportunities for innovation in
regional systems where firms are situated close to
one another are issues that have been frequently
discussed in the literature on regional economics.
Cooperation may be easier in a regional or local

Figure 1. The basic local/regional industrial ecosystem analogy. Industrial systems are encouraged to move towards
an interactive local system based on the system model of ecosystems, i.e. a roundput system. Through co-operative
waste material and waste energy utilization between the local industrial actors A, B, C and D, the virgin material and
energy input as well as the waste and emission output of the system are reduced (virgin resources are substituted with
wastes derived from within the system). By reducing the waste management costs, raw material and energy costs, costs
resulting from environmental legislation and by improving the environmental image as well as the green markets potential
of the system, economic gains are possible. The benefits of successful regional IE may also include new economic
opportunities that arise through increasing cooperation that this approach can create.
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