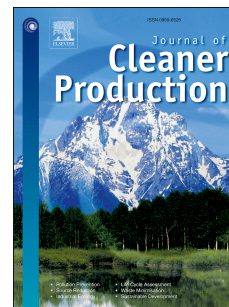


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## A Resilience Indicator for Eco-Industrial Parks

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### Abstract

An Eco-Industrial Park (EIP) is a community of businesses that seeks to reduce the global impact by sharing material. The connections among the industrial participants within this park improve the environmental performance of the industrial network. However, the connectivity also propagates failures. This risk is an important point of criticism and a barrier to industrial plants when evaluate their integration to an EIP. This paper proposes an indicator to follow the resilience of an EIP so as to improve the security of the whole system, considering the dynamic of the participants to endure a disruptive event. This metric could be used by decision-makers in order to include the resilience in the design phase of an EIP. Solving these security problems would expand the set of experiences of cleaner production, facilitating the integration of industrial processes. The proposed resilience indicator is based on two main characteristics of an industrial network: the number of connections among participants, and the capacity of each flow to change its magnitude when a participant suddenly stops sharing flows within the park. A network is separated in independent layers to quantify its flexibility when substituting flows. Each layer includes a single shared material. The resilience of a multi-layer park is then calculated as a weighted summation. This indicator is applied over two illustrative cases to study: Kalundborg, in Denmark; and Ulsan, in South Korea. These applications show consistent results when compared with reality. Although the proposed resilience indicator has been developed for material networks, it can be adapted to heat integration networks. In this case, special attention should be payed to physical constraints as minimal temperature gradients.

*Keywords:* Indicator, Resilience, Eco-Industrial Park, Network

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