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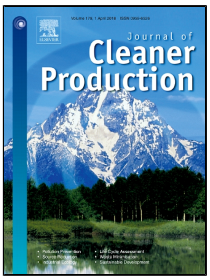

Extending Industrial Symbiosis to Residential Buildings: A Mathematical Model and Case Study

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Extending Industrial Symbiosis to Residential Buildings: A Mathematical Model and Case Study

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Highlights:

- Challenges and opportunities for industrial-residential energy symbiosis are discussed.
- A mathematical model to optimize a heat exchange network is developed.
- The effect of uncertainties on the optimal symbiosis network is investigated.
- It is found that symbiosis provides considerable economic and environmental benefits.

Abstract

Industrial symbiosis is a cost-effective and environmentally-friendly solution for industries. It reduces the consumption of energy and virgin material by extracting value from waste, lost heat and by-products. Energy symbiosis could fulfill a portion of industrial and non-industrial energy needs. This study discusses the opportunities and challenges of energy symbioses for non-industrial purposes, and develops a multi-objective mixed integer linear programming model for that purpose. The model minimizes the total cost and the environmental impact among energy suppliers and users. It includes the costs of implementing and operating an energy sharing network. The model is used to determine the optimal energy partners in an industrial area and residential neighborhoods in a western European industrial park. The proposed model also helps in studying the effects of uncertainties that may arise when establishing the energy network. The contribution of this paper is twofold. First, it proposes using industrial symbioses to identify the challenges and to find solutions to meet the increasing demand for energy in urban and rural areas. Second, it develops a method to access affordable sources of energy for non-industrial purposes under uncertainties. The results show that involving residential customers in the symbioses would increase the environmental and economic benefits for all stakeholders in an