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SUPPLY CHAIN OPTIMIZATION FOR SUSTAINABILITY AND PROFITABILITY BY THE P-GRAPH FRAMEWORK

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The proposed methodology is an outcome of the collaboration between the Office of Research and Development (ORD) of the U.S. EPA and the research group led by the founders of the P-graph framework. U.S. EPA/ORD has substantial creditable experience with the development of indicators and metrics for sustainability, while the P-graph framework is deemed to be highly effective for algorithmic design of process networks including supply chains. The integration of supply chain design and sustainability is the main focus of the collaboration.

The P-graph framework provides a mathematically rigorous procedure for synthesizing optimal and alternative suboptimal networks subject to multiple objectives and constraints, which include profitability and sustainability in the proposed methodology. Specifically, to evaluate the sustainability of a given process under construction including its supply chain, sustainability metrics are incorporated into the design procedure.

The proposed methodology is demonstrated with the optimal design of a supply chain for the infrastructure providing heat and electric power to an agricultural region with relatively limited area where agricultural wastes can potentially be recovered as renewable resources. The objective functions for optimization comprise the profit, ecological footprint, exergy dissipation, green net regional product, and ratio between renewable and total emergies.

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