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## TOWARDS CIRCULAR FOOD SUPPLY CHAINS: INTEGRATED DESIGN OF FOOD PACKAGING AND WASTE MANAGEMENT INFRASTRUCTURES

Food supply chains play a fundamental role in society by ensuring the availability, safety, and accessibility of food products. Packaging plays a crucial role in food supply chains guaranteeing quality and food safety, extending the product's shelf-life while avoiding food waste, and facilitating food access. Nevertheless, most of the food packaging becomes waste after a single use contributing to multiple environmental impacts like water, land, and air pollution that threaten ecosystems, wildlife, and humans. Given the growing environmental, economic, and social concerns surrounding food supply chains, a redesign and a transition to more sustainable operations is needed. Circular Economy (CE) can provide targets for this transition. CE is an economy that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times. To achieve such an economic model for the food industry, packaging recycling is vital.

To identify the optimal waste management infrastructure for food packaging, a complete analysis that includes existing waste management technologies and the potential implementation of new facilities and technologies is required. We present the foundations of a systems engineering framework and quantitative decision-making tools for the analysis and trade-off optimization for food packaging supply chains, including waste management pathways. A multi-objective optimization strategy is followed for the analysis of the trade-offs empowered by the introduction of composite metrics for CE that include waste, energy and resource use minimization, as means to facilitate decision-making and compare alternative production processes, packaging designs, and waste management processes. A hierarchical optimization model is proposed to simulate the interactions between policymakers and the food and waste management industries. The versatility, potential, and applicability of the proposed framework will be demonstrated through a case study on coffee packaging.