Combining eco-efficiency and eco-effectiveness for continuous loop beverage packaging systems: learnings from the Carlsberg Circular Community

Eco-efficiency (i.e., increasing value while reducing resource use and pollution) can with advantage be combined with eco-effectiveness (i.e., maximizing the benefits to ecological and economical systems) to address the challenges posed by the circular economy in the design of circular industrial systems. We present a framework combining life cycle assessment (LCA) and the Cradle to Cradle® (C2C) certification program for the development of continuous loop packaging systems, which was conceived for aluminum cans in the context of the Carlsberg Circular Community. As a first step, the environmentally optimal beverage packaging life cycle scenario is identified, both in terms of defined use and reuse. Second, the limiting factors are identified for the continuous use of materials in multiple loops, meeting the two requirements in the C2C certification process that address the material level (i.e., “material health” and “material reutilization” criteria) and the “renewable energy” criterion. Then, alternative scenarios are built to meet C2C certification criteria, and LCA is used to quantify the environmental impacts of the resulting improvement strategies, for example, change in material composition, in order to guide the identification of the optimal scenario from an eco-efficiency point of view. Finally, the business perspective is addressed by assessing the potential for a green value network business model for a closed-loop supply. The outcome is a list of prioritized actions needed to implement the most efficient and effective “upcycling” strategy for the beverage packaging, both from an environmental and an economic point of view. In the case of the aluminum cans, the main recommendation from both the LCA and C2C perspective is to ensure a system that enables can-to-can recycling.
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