

Integrating Circularity into Life Cycle Assessment and Product Category Rules Processes for Enhanced Performance of Luminaires, Power Supplies, and the Mechanical and Electrical Industry

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Primary Topic

Design for Remanufacturing & Recycling for the Circular Economy

Secondary Topic

Methods & Metrics

Abstract

Over the past few decades there has been a significant change in consumers interests towards more sustainable and efficient products. As such, industries and manufacturers are interested in integrating the principals of circularity into their production lines. The transition to a circular facing economy is especially critical within the mechanical and electrical (M&E) industry where products can extend lifetimes and improve maintenance by embracing new business opportunities such as product modularity, refurbishment, remanufacturing, and recycling. These circularity best practices can foster economic growth and job creation. However, there remains a critical need for methods to measure and reward circular and modular practices within Life Cycle Assessments (LCA) and Product Category Rules (PCR).

To address this critical need for circularity measures within LCAs and PCRs, the team at Pacific Northwest National Laboratory (PNNL) has been endeavoring to aid in the transition towards circular economies and product lifetime extension in the M&E industry. Recent work includes the development of luminaire LCAs and model-linked life cycle inventory (LCI) templates, through which the team researched pathways for manufacturers to track modularity and circularity of components. Modular design practices can facilitate the repair, reuse, and recycling of individual components and promote a closed-loop system that aligns with circular economy principles. These circularity best practices enhance the longevity and efficiency of luminaires and preliminary LCA research shows they can reduce the environmental footprint associated with their production and disposal. PNNL has identified a critical need for the inclusion of circularity and replacement metrics in LCAs and PCRs to track and incentivize these improvements especially within the M&E industry. We propose detailed methodologies for integrating tracking of circularity within PCRs and LCI templates, which include specific approaches for evaluating the modularity, and replaceability of components. This paper explores innovative approaches to embedding elements of circularity, specifically focusing on the lifecycles of luminaires and their associated power supplies, alongside other M&E components. Using these approaches for enhanced tracking of environmental footprint, manufacturers can show how products that adhere to circularity best practices can achieve higher levels of resource efficiency and reduced waste benefits within the building supply chain, procurers, and their consumers. The adoption of these methodologies supports the creation of more sustainable products and aligns with the broader goals of a more resilient, circular building services economy.

Keywords

Circular Economy, Life Cycle Assessment (LCA), Product Category Rules (PCR), Luminaires, Modularity, Sustainability, Resource Efficiency, Mechanical and Electrical (M&E) Industry