

Evaluating the circular economy: An inventory and comparison with the Circularity Assessment Protocol

Authors: Amy L Brooks¹, Erica Beigi¹, Rafaela Goncalves de Almeida¹, Jenna Jambeck², Melissa M Bilec^{1*}

Affiliations:

¹ University of Pittsburgh, Pittsburgh, Pennsylvania, USA

² University of Georgia, Athens, Georgia, USA

* Corresponding Author: Melissa M Bilec, University of Pittsburgh, mbilec@pitt.edu

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Abstract

Implementation of circular economy strategies requires accounting for the practicalities of local management of material flows, waste, and emissions, yet existing assessment tools often fail to capture the complexity of community-scale circular systems. The circular economy's potential to advance and strengthen community resilience across sectors requires the evaluation of approaches that match this complexity. With increasing interest in the adoption of circular strategies in cities, comprehensive evaluation tools are needed that bridge technical metrics, such as material recovery rates, waste diversion, and carbon footprint reductions with other considerations such as growth and urban planning, economic opportunities, and community development. Numerous circularity assessment approaches exist, and their accessibility, scope, and community engagement vary significantly. We will report on findings from an inventory of 33 circular economy and waste assessment frameworks focusing on building materials and plastics, characterizing the existing tools across key dimensions such as the scale of application, logistical and cost requirements, stakeholder outreach, and deliverables of each approach.

We found that just over half of the established tools explicitly focus on circular economy principles, with only a handful targeting city-scale implementation. Accessibility of tools varies widely, with only about half offering free access, several requiring specific training or certified assessors, and most engaging only professional, industry-based stakeholders. Critical gaps include limited integration on environmental emissions, particularly mismanaged and unaccounted for waste, and minimal community-based participatory frameworks. To address some of these gaps and as a part of the National Science Foundation Convergence Accelerator Track I project, we further developed and expanded the Circularity Assessment Protocol (CAP). The CAP addresses these limitations through its holistic approach that explores upstream product and material inputs, how materials are used and disposed of in communities, what materials are lost to the environment through litter and illegal dumping, and what stakeholder perceptions are across these considerations. Further, we showcase an interactive open-access

data portal in development for the CAP that provides insight for applications across more than 50 cities, and describe ongoing strategies for co-creation under development with local stakeholders in participating CAP cities, including an example of how the CAP addresses gaps with a case study city. Taken together, this inventory establishes CAP as a significant advancement in circular economy assessment, addressing critical gaps in community engagement, environmental impacts, and accessibility that is essential for circular economy implementation in both resource-rich and resource-burdened communities.