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## From potential to reality: Advocating for an evidence-based circularity assessment framework

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### ABSTRACT

Circularity is often treated as a design principle or strategic ambition to improve resource efficiency, but in practice, many of its claims remain unverified and untraceable. Existing assessment methods typically focus on intended design strategies or modelled impacts, rather than demonstrating real-world outcomes. This paper introduces the concept of evidence-based circularity assessment as an alternative approach for shifting from intention to actionable outcome. Drawing on an analogy of two contrasting ‘circular’ coffee pod systems, it illustrates how the credibility of circularity claims depends on the presence of verifiable evidence, coordinated infrastructure, and traceable processes. Building on these insights, the paper proposes a conceptual framework for assessing circularity, structured around three interdependent elements: proof, process, and persuasion. Finally, the paper explores how these principles can be applied in the built environment, where supporting systems are needed to track, evaluate, and realize circular material flows. The approach aspires to support more transparent, accountable, and adaptive forms of circularity assessment in complex real-world settings.

### INTRODUCTION

In the early years of the 2020s, one global coffee company was fined with more than one million dollars for misleading consumers and investors about the recyclability of its plastic coffee pods. The company claimed that its pods are “100% recyclable” and that extensive testing has shown that they “can be effectively recycled”. In response, the recycling operators explicitly told the company that processing the pods was not commercially feasible. The design of the pods and the material choices were viewed as too costly and impractical to process, which was expected to result in significant amounts of waste to landfills. This wide gap from the coffee pod case questions the discrepancies between claimed recyclability and actual recycling outcomes: to what extent claimed recyclability guarantees recycling? Does this mean that recyclability could be treated as a reliable proxy for circular performance? In essence, it leads to the sanity check of what is really meant when circularity-related claims like materials, products or assets being (fully) recyclable or reusable are made.

The circular economy is based on a regenerative and restorative approach to production and consumption systems. It promotes waste management strategies such as reuse, repair, remanufacturing, and recycling, which are often referred to as the R-strategies (Morseletto & Haas, 2023). Within this paradigm, circularity is commonly described as the degree to which a product, material, or system remains in use, regenerates value, or avoids waste over time (EU Action Plan for the Circular Economy, 2020). But despite its appeal, circularity remains

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a contested and often vaguely defined concept (Dominko et al., 2023; Nikolaou et al., 2021). This ambiguity becomes especially problematic when circularity is treated as something that can be simply claimed, rather than something that must be demonstrated. When circularity becomes just an unsubstantiated claim, the consequences may be profound. For example, it can lead to misguided investments, poorly informed policies, and false consumer confidence (Kurnaz, 2021; Pölkki, 2024). Circularity is not simply a feature of what something is made of, instead, it is about what happens to it and can be proven to happen to it. This probes deeper question for the underlying circular reality, as to how can circularity be assessed not for its desired outcome (e.g., intended reuse after end-of-life) but proven outcome, beyond a reasonable doubt?

The gap between circularity as intention and circularity as outcome calls for a reassessment of how such claims are evaluated. Existing assessment methods in the built environment operate across different levels, ranging from products and materials to assets and broader systems, and address various aspects of the circularity landscape, including design strategies, policy frameworks, and operational practices (Feizollahbeigi et al., 2025; Khadim et al., 2022; Peng & Cao, 2025). Examples include Level(s) (Dodd et al., 2017, 2020a, 2020b, 2021; Donatello et al., 2021), Material Circularity Indicator (MCI) (Ellen MacArthur Foundation & Granta Design, 2019), Building Circularity Indicator (BCI) (Verberne, 2016), Material Flow Analysis (MFA) (Tanzer & Rechberger, 2019), and Life Cycle Assessment (LCA) (Lei et al., 2021). They provide valuable insights into circular potential or modeled environmental impacts. However, these methods often focus on intended design strategies or predicted performance rather than on demonstrating whether circular outcomes are actually achieved in practice. As a result, they may lack transparency, traceability, and clear mechanisms to verify the real-world realization of circularity claims.

In this article, we argue that circularity claims, much like public declarations in legal settings, should be treated as assertions that carry a burden of proof (Stein & Allen, 2013). When a stakeholder, whether a developer, designer or contractor, makes a circularity claim, such as “this product is 100% recyclable” or “this building is 100% designed for disassembly”, they are, in effect, making a public assertion that should be answerable to others. Drawing inspiration from principles of legal accountability, they bear the responsibility to substantiate such claims with credible and verifiable evidence (Stein & Allen, 2013). Methodologically, this paper adopts a conceptual approach, using narrative review to explore how evidentiary logic can be adapted for circular construction in the built environment. The review process involved identifying and synthesizing insights from literature on circularity assessment, evidence-based practices, and legal reasoning, in order to trace gaps in current methods and inform the development of a new conceptual framework. The result is a set of conceptual building blocks that form the basis of an evidence-based assessment framework. These include the foundational elements of proof, process, and persuasion, which together offer an alternative lens for evaluating circular performance, not as a promise, but as a demonstrable reality.

This article questions the current ways in which circularity is assessed in both practice and academic work. It highlights that drawing on the principle of legal accountability can help to arrive at a different approach that treats circularity not as an assumption or a claim, but as something that must be demonstrated through proof, process and persuasion. In this way, stakeholders that wish to pride initiatives with a circularity claim would benefit from following a court-like synonym through which they carry the burden of persuasion to convince a jury or judge (e.g., regulators, clients or the public) that the evidence provided is strong enough to warrant belief and action. This adds to credibility of the actual circularity

that is desperately needed in our built environment. Just like a legal judgement is not made on possibility but on proof, circularity assessment must move beyond potential to documented reality with circularity claims being substantiated to demonstrate how circularity plays out over time. Without such a shift, circularity risks becoming a rhetorical gesture which sounds convincing but cannot be verified or trusted.

### **EVIDENCE-BASED CIRCULARITY: AN ANALOGY**

The notion of “evidence-based” is not new. It originates from medicine, where it emerged as a corrective to expert-driven decisions that lacked systematic justification (Sackett et al., 1996). It quickly spread to policy, education and management, where it was seen as a way to improve transparency, accountability, and the quality of decision-making (Baba & HakemZadeh, 2012; Head, 2016). Over time, scholars have questioned the neutrality of evidence, emphasizing that what counts as valid evidence is shaped by social, political and institutional contexts (Greenhalgh & Russell, 2009; Reay et al., 2009). In such contexts, to act in an evidence-based way means that action must be guided by transparent, reproducible, and verifiable knowledge, not intuition or intent (Baba & HakemZadeh, 2012). Transposed to the context of circularity, the term marks a similar shift: from promises to proof, from intent to traceable result. Evidence-based circularity, in our view, could refer to the assessment of circularity claims based on verifiable outcomes, supported by credible documentation and transparent processes, not just design intentions or material properties. It asks not whether a product could be circular, but whether circular strategies, such as reuse, repurpose and recycling, actually occur and can be shown to occur.

To help ground this abstraction, let us return to a more relatable example. While the aforementioned coffee company failed to substantiate its recyclability claim, another coffee company operating in the same market took a more systematic and transparent approach. This company uses aluminum for its coffee pods, a material with a feature of indefinite recyclability (Bulei et al., 2018). However, this company also realized that technical recyclability was only part of the equation. To support its claim, it implemented a comprehensive take-back system by providing consumers with prepaid return bags, establishing thousands of collection points, and building dedicated facilities where used pods could be sorted, processed, and reintegrated into material cycles. The company also communicated openly about the outcomes, publishing what percentage of pods were actually returned and how the recovered materials were reprocessed. As we can see here, the circularity of the pods was not just implied by its material, instead, it was enacted by a network of commitments: consumer instructions, reverse logistics, processing infrastructure, and communication with stakeholders. This analogy offers a simple but crucial insight for how evidence-based circularity could be: the material itself is not the sole determinant of circular outcomes; what matters equally is the system that surrounds it, e.g., the network of responsibilities, actions, and follow-up mechanisms that allow circularity to occur and to be seen to occur.

### **EVIDENCE-BASED CIRCULARITY ASSESSMENT: A LEGAL ACCOUNTABILITY**

The example of coffee pods systems is relatively contained because of a single-use product with a short lifecycle and a centralized actor responsible for closing the loop. The built environment, by contrast, is a vastly more complex ecosystem, where circularity claims, such as reuse potential, recyclability, or disassemblability, span decades, involve multiple phases and dozens of actors, and unfold across shifting regulatory, economic, and spatial conditions (Geldermans, 2016; Guo et al., 2024; Ofori, 2015). Claims made at the design stage can often disappear into the noise of execution.

At present, many circularity claims in the built environment remain more aspirational than operational. As Kanters (2018) observes, despite the presence of deconstruction principles and design-for-disassembly principles, less than 1% of buildings are actually constructed to be fully demountable. Similarly, although several modular systems claim to be relocatable and reusable, only a limited number of buildings have been successfully disassembled, relocated, and reinstalled in real-world conditions (Ling, 2023). Design for disassembly do not guarantee effortless disassembly and subsequent reuse. Yang et al. (2025) further emphasize that critical factors such as client ownership, digital material tracking, and the retention of component value play pivotal roles in enabling actual building reuse. The absence of these enabling conditions often results in circularity remaining a theoretical design ambition, rather than a realized outcome. This is not simply a technical shortfall but it reflects a deeper systemic accountability gap. Even when advanced tools such as Building Information Modelling (BIM) or material passports are used, they often serve as one-time records rather than evolving and verifiable sources of truth (Markou et al., 2025; Munaro & Tavares, 2021). These tools frequently fall short of functioning as instruments of accountability. They document what could happen, but they do not confirm what did happen. They may capture intended recyclability or reusability but not realized ones. Without institutional arrangements to update, audit, and enforce these records, the tools become static, like testimony without cross-examination. In such an environment, circularity claims lack both traceability and consequence. They can be made with ease but rarely carry the burden of proof or the expectation of follow-up. This is where an evidence-based circularity assessment, anchored in accountability, becomes not just preferable but necessary.

To address this accountability gap and explore how evidence-based circularity assessment could work in the built environment, we turn to the logic of legal proceedings. When a claim is made in court, the party making the claim carries the burden of proof. It is not enough to state something, instead, verifiable evidence that holds up under examination should be provided. The burden of persuasion is meanwhile equally important. Even if one has evidence, it must be presented in a form that jury or judge (i.e., regulators, client, the public) can evaluate and trust (Schauer, 2006). This means that circularity assessment must be not only accurate but also legible and verifiable. A material passport that lists components as “recyclable” means little unless it is kept up-to-date and linked to measurable outcomes after use (Markou et al., 2025). As with a testimony, clarity, transparency and traceability matter. The aim is not to penalize ambition but to reward accountability to support circularity claims that can be substantiated through documented processes and demonstrable results. To move toward an evidence-based framework, we propose an assessment structure inspired by courtroom reasoning. Rather than assuming that circularity happens because it was intended, we ask whether it can be demonstrated across the three interdependent dimensions of proof, process, and persuasion.

The first dimension, *Proof*, addresses the question of whether a circularity claim can be substantiated with verifiable evidence that circular outcomes have actually occurred. This can include audits, tagging systems, verified material transfers, or post-demolition tracking. Proof mirrors the burden of proof in legal reasoning, whether party making the claim must produce evidence that supports their assertion. In the context of circularity, proof corresponds to verifiable documentation that circular strategies were executed, not merely designed or intended.

The second dimension, *Process*, focusses on whether there is a functioning system in place that enables circularity to occur. This involves the availability of supporting infrastructures, regulatory mechanisms, and coordinated procedures that allow reuse, recycling, or other

circular strategies to be executed effectively. This relates to the concept of due process or procedural justice in legal systems, where how something is done is as important as what is done. In circularity assessment, it is not enough to declare that a material is recyclable, instead there needs to be a system that makes recycling actually happen.

The third dimension, *Persuasion*, concerns whether the presented information can convincingly support the circularity claim to those who must act on it, whether they are clients, regulators, or procurement officials. This dimension involves transparency, traceability, and the capacity to transform data into actionable knowledge. It mirrors the burden of persuasion in legal contexts, whether even with evidence, the claimant must present it in a compelling way to convince the decision-makers. In circularity assessment, persuasion is about whether evidence is traceable, clear, and credible enough for stakeholders to trust and act upon.

In the built environment, these three dimensions can be directly translated into practice. Proof relates to tracking materials and verifying that reuse, recycling, or recovery actually occurred. Process concerns whether infrastructures like material passports, deconstruction protocols, and recovery systems are in place to enable circular strategies. Persuasion involves providing traceable and transparent information that not only documents past actions but also clearly indicates the material's readiness for a next life cycle, which gives stakeholders a concrete basis for future decisions.

This conceptual framework with three dimensions shifts circularity assessment from speculative aspiration to accountable practice. It moves the emphasis from what could happen to what has happened, and how we know it. In this way, evidence-based circularity could become not just a concept, but a commitment to traceability, verification, and trust.

## **CONCLUSION AND OUTLOOK**

This paper has introduced an evidence-based concept for circularity assessment, informed by principles of legal evidentiary reasoning and structured around the dimensions of proof, process and persuasion. Circularity, especially in the built environment, should not be judged on material potential or design alone, but on demonstrable outcomes achieved through credible evidence and supportive systems. The proposed evidence-based circularity assessment framework with three dimensions shifts the focus of circularity assessment from making claims to cases whether claims that must be substantiated, contextualized, and legible to others. In doing so, circularity moves from idealism toward institutional accountability.

Nonetheless, challenges remain. Current tools, such as LCA and circularity indicators, often focus on potential or modeled outcomes rather than observable results. Data on material reuse or recycling in construction projects is often fragmented or unavailable. Institutional incentives may reward declarations rather than verification. These challenges point to a need for further development in both research and practice.

Our next steps will be focusing on constructing and operationalizing this approach. There is also a need to better understand how evidence-based assessment interacts with certification schemes, procurement criteria, and policy instruments, many of which currently prioritize intentions over implementation. Future research will also explore how these systems can evolve to support more verifiable claims and facilitate adaptive learning across projects.

In conclusion, circularity assessment must evolve in both method and mindset. The move toward evidence-based circularity is not about perfection, but about progress that can be

demonstrated and improved upon. It asks not only whether something is circular in principle, but whether it is circular in practice and whether we have the evidence to show why, how, and to what extent.

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