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PERSPECTIVE

Geography and Time: Two Underexplored Barriers to a Circular Economy

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Abstract

Circular economy researchers have catalogued barriers across technological, institutional, economic, and cultural dimensions, yet two structural dimensions remain systematically underexplored: geography and time. Drawing on two recent papers, one on spatial frictions in scaling circular systems and one on time as a structural barrier, in this perspective it is argued that both dimensions introduce compounding constraints. The spatial structure of circular systems shapes whether material recovery is economically viable and institutionally coherent. The temporal structure determines when recovered materials re-enter the economy and how economic actors value delayed returns. Geography and time do not provide a complete account of why circular economy transitions stall, but they are two pieces of a larger and still partly unmapped puzzle. Identifying them more precisely should help researchers and policymakers see where conventional barrier frameworks fall short.

Keywords Circular Economy · Spatial Frictions · Geography · Material Lifespans · Intertemporal Dynamics · Time

JEL Q56 · R12 · O33 · Q20 · E61

1. Introduction

The circular economy (CE) has attracted growing policy attention and a substantial body of academic research. Barriers to CE adoption have been catalogued across technological, institutional, economic, and cultural dimensions (Kirchherr et al., 2018; Grafström and Aasma, 2021). Yet circularity rates in the European Union have remained largely flat across major material categories for more than a decade, even as recovery technologies have improved (Eurostat, 2025). Something might be missing from standard barrier analyses.

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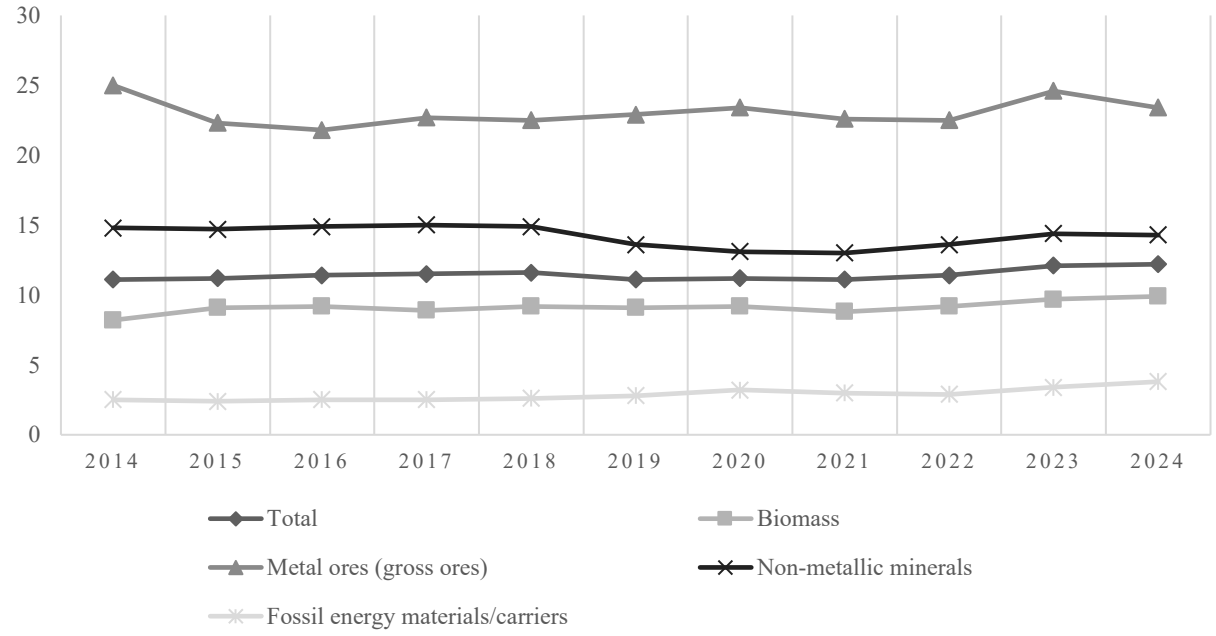

Figure 1. Circularity rate by material categories (%), EU, 2014-2024. Source: Eurostat, (2025).

In two recent papers, I identified time and geography as dimensions that have received insufficient attention as barriers for a circular economy. Geography shapes the performance of circular systems as they expand spatially (Grafström and Larsson, 2026). Time is an endogenous structural barrier (Grafström, 2026). The purpose of the present perspective is to draw out the shared logic of those two contributions and to place them within the broader debate on CE barriers.

It is worth being explicit about what the two papers do and do not claim. Geography and time are not offered as the full explanation for why circular transitions are slow. The barriers literature is large and well-developed, and dimensions such as regulation, culture, market structure, and technology all carry real explanatory weight (Kirchherr et al., 2018; Souza Piao et al., 2024). The argument is narrower: that geography and time have been treated as background conditions rather than as active structural forces, and that making them explicit improves both analysis and policy design.

2. Geography: Friction that grows with scale

Economic geography has long demonstrated that distance, institutional heterogeneity, and agglomeration shape economic outcomes (McCann, 2001; Duranton and Puga, 2004). In Grafström and Larsson (2026), I developed a framework that applies that logic to CE systems and used the plastics industry as an illustrative case. The core finding is that five categories of spatial friction accumulate as circular systems expand: regulatory diversity, logistical constraints, behavioral variation, economic disparity, and coordination difficulty.

Regulatory friction grows with every additional jurisdiction. A producer designing a nationwide recycling scheme must navigate hundreds of interfaces that would not exist in a locally organized system. Logistical friction compounds the problem. Recycled plastics cannot be sourced from centralized global markets in the way virgin materials can. Their cost and quality depend on local collection efficiency and contamination levels (Barford and Åhman, 2021). Nordic countries illustrate the tension: large territories and dispersed populations push transport and handling costs above market returns for many material categories (Milios et al., 2018). The microfoundations of agglomeration, namely sharing, matching, and learning, explain why CE performance is stronger in urban cores than in peripheral regions (Duranton and Puga, 2004).

That said, geography is not destiny. Agglomeration can also work in favor of circularity: dense urban systems generate the material volumes and actor density that circular models require. The point is that spatial structure needs to be designed for rather than ignored.

3. Time: The barrier built into every product

The second paper, Grafström, (2026), treats time. The starting observation is simple, but its implications run deep: circularity at any moment reflects decisions made in the past. A food container may be returned for recycling within weeks. A vehicle returns after roughly twenty years. A building locks materials into stock for forty to a hundred years (Held et al., 2021; Fahlstedt et al., 2024). Recovery flows are always lagged outflows from earlier inflows, not responses to present policy or technology.

Recovery supply, in the construction industry, enters the market according to demolition and disassembly schedules that are largely independent of current demand. When reclaimed materials arrive before a project needs them, they require storage at cost (and waste storage permission). When they arrive after demand has been filled by virgin inputs, they go unused.

The circularity ratio, recovered inputs divided by total material use, stagnates when long-lived goods dominate stocks. The argument concerns metric sensitivity, not the desirability of longevity as a strategy: long-lived goods are among the stronger circular interventions precisely because they reduce material throughput, yet the benefit is largely invisible to flow-based indicators on policy-relevant timescales. Improvements in recovery efficiency for packaging and textiles appear quickly in system indicators and benefits from long-lived circular strategies arrive thirty to fifty years in the future. Under a social discount rate of, for example, three percent, a benefit realized forty years hence is worth less than one third of the same benefit realized today.

Again, time is not an insuperable obstacle. Short-lived goods demonstrate that rapid turnover allows technology and policy to translate quickly into measurable outcomes, making them useful proof-of-concept cases for the indicator framework, not preferable from a CE standpoint. The challenge is that most material stock, by volume, consists of long-lived assets, and long-lived assets are precisely where CE ambition should be highest, even if their outcomes are the hardest to measure. Designing policy around short-loop successes when the bulk of embedded material follows a much slower clock is a recipe for persistent indicator stagnation.

4. Discussion

Geography and time are conceptually distinct but to some extent practically intertwined. Spatially dispersed systems face longer transport distances, which raise the cost of synchronizing supply and demand. Jurisdictional fragmentation extends the time required to establish contractual arrangements for material exchange. Aligning procurement calendars, demolition schedules, and processing capacity across multiple jurisdictions takes time, and misalignment generates costs on both dimensions simultaneously. Time is money as so commonly said.

A "big-small paradox" runs through both papers (Grafström, 2026; Grafström and Larsson, 2026). For CE systems to generate substantial environmental and economic gains, they must operate at sufficient scale to encompass meaningful material volumes and diverse capabilities. Yet the larger the system, the harder coordination becomes: more jurisdictions, more actors, more temporal mismatches. Scale is simultaneously necessary and costly. No purely technical solution resolves that tension.

The broader implication for research is that CE barrier frameworks should be extended rather than replaced. Kirchherr et al. (2018) and Grafström and Aasma (2021) provide foundations that can accommodate spatial and temporal dimensions without abandoning the insights already accumulated. The next step is empirical: quantifying how frictions scale with distance and institutional diversity, measuring lifespan distributions across sectors, and testing whether the nonlinear cost dynamics identified in the stylized models hold in specific real-world contexts.

5. Implications for policy and research

For policy, short-term targets measured over five-year horizons will systematically understate progress in sectors dominated by long-lived goods and overstate it where short-lived packaging dominates. Indicators that credit expected future substitution from assets already in service would better align political horizons with material horizons. At the spatial level, place-sensitive policy design matters more than uniform national targets.

Regional clearinghouses or digital platforms that standardize contracts, reporting, and certification could lower transaction costs across jurisdictions.

For research, the spatial and temporal dimensions of circularity point toward methods and data sources that are underused in CE studies: economic geography tools for measuring agglomeration and transaction costs, stock-flow models calibrated to sectoral lifespan distributions, and dynamic investment models that take discounting seriously. Neither geography nor time will yield fully to qualitative barrier mapping. Both require formal modelling alongside empirical grounding.

Geography and time will not be the last underexplored dimensions in CE analysis. The barrier landscape is large, and the two papers discussed here illuminate corners of it rather than the whole. What they share is a commitment to treating structural constraints as endogenous to the system rather than as external conditions to be wished away. That commitment seems like a productive orientation for the field to sustain.

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Data availability No data was used.

Declarations

Competing Interests The authors declare no competing interests.

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