

Circular public space as a sociocultural indicator: An exploratory case study situated in the city of Porto

Jeff Anderson

Faculty of Engineering, University of Porto, Portugal
contatOMICROtopia@gmail.com

The transition towards circular cities and regions requires monitoring approaches that extend beyond sectoral and material-flow-based metrics. Existing frameworks for assessing urban circularity remain fragmented and predominantly quantitative, often overlooking sociocultural and territorial dimensions. This article addresses this gap by conceptualizing circular public space as a transversal sociocultural indicator of urban circularity. The study adopts a qualitative comparative research design and examines two initiatives within the urban food system of Porto, Portugal: Good Food Hubs (local organic markets) and Community Composting Islands (community biowaste valorisation). The analysis is structured around the space-flows-actors framework and supported by participant observation, structured surveys, material-flow data, and documentary sources. The findings reveal convergent socio-spatial patterns across the analysed cases, including territorially anchored circular flows, citizen participation, multi-actor cooperation, and the collective appropriation of public space for regenerative purposes. These patterns support the identification of circular public space as an emergent socio-spatial configuration through which circularity becomes visible in everyday urban life. Rather than directly measuring circularity, circular public space operates as an indirect sociocultural indicator that complements conventional monitoring frameworks and offers municipalities, urban planners, and researchers a means of assessing how circularity is socially produced and territorially embedded.

Keywords: circular cities, circular regions, circular economy, food system, indicators, circular public space

Copyright: author. Protected under CC BY 4.0. ISSN 2468-0648.

Please cite as: Anderson, J. (2026). Circular public space as a sociocultural indicator: An exploratory case study situated in the city of Porto. *plaNNext – Next Generation Planning*. Online first (16 August 2026). <https://doi.org/10.24306/plnxt/129>

Open Access Journal

Introduction

The growing unsustainability of the linear model of production and consumption—often summarized by the extract-produce-discard cycle—has intensified the search for alternatives capable of reconciling ecological limits, social justice, and economic viability. In this context, the Circular Economy (CE) has been promoted as a transition paradigm that seeks to reconfigure urban metabolism by reducing waste, retaining value, and reconnecting material and energy flows to the planet's biophysical limits. From this perspective, circular cities and regions (CCRs) emerge not merely as localized applications of CE principles, but as frameworks requiring territorial and institutional transformations, including the reorientation of value chains, the reconfiguration of infrastructures, and the reinterpretation of the role of urban space in supporting circular economy transitions.

Despite the proliferation of circular initiatives across different sectors—from waste management to food systems—a critical challenge remains: the lack of robust monitoring instruments capable of assessing circularity at the urban and regional scale in an integrated manner. A large proportion of existing indicators remain sector-specific, fragmenting evaluation processes and limiting a systemic understanding of cities' circular performance, with direct implications for the formulation of more effective public policies.

This limitation highlights the need for transversal indicators (Paoli et al., 2022). In the context of this study, the term “transversal” refers to indicators that cut across sectors and analytical domains (e.g., waste, food, governance, and inclusion), capturing dimensions that cannot be reduced to isolated material quantities but instead manifest in territorial, institutional, and sociocultural dynamics. In line with recent debates on circular cities, sustainability transitions, and socio-spatial approaches to circular economy, circularity is not merely a techno-economic regime; it also encompasses ecological, social, and cultural dimensions. Consequently, its assessment requires the articulation of material metrics with qualitative approaches capable of capturing citizen participation, multi-actor engagement, and transformations in the use of public space.

It is precisely at this intersection that the present study situates its contribution. Within the context of community-based circular initiatives, a socio-spatial configuration can be observed across the cases analyzed: territorially anchored circular practices embedded in public space that simultaneously activate material flows (e.g., food, biowaste), networks of cooperation (e.g., volunteers, local producers, municipal services), and collective forms of territorial appropriation. This article designates this configuration as circular public space and proposes it not as a metric, but as a transversal sociocultural indicator of urban and regional circularity—that is, an observable sign of how circularity materializes in everyday urban life through social relations, spatial uses, and coordination among actors.

Based on these premises, the article pursues the following general objective: to conceptualize circular public space and assess its potential as a transversal sociocultural indicator for monitoring circularity in urban and regional contexts. From this objective derives the research question guiding the study: Under what conditions can public spaces that host circular practices be conceptualized as “circular public spaces” and employed as a sociocultural indicator of urban and regional circularity?

To address this question, the article analyzes two initiatives within the urban food system of the city of Porto (Northern Portugal): Good Food Hubs and Community Composting Islands. These cases represent distinct modalities of circularity—proximity markets and community composting—implemented across different typologies of public space. It is important to emphasize that the proposed typology of circular public space is not assumed a priori; rather,

Open Access Journal

it is treated as an analytical outcome derived from cross-case comparison, that is, as an emergent category grounded in the identification of recurring socio-spatial patterns emerging from the integrated analytical framework adopted in this study.

Methodologically, the study adopts a qualitative comparative approach centred on the space–flows–actors framework (Verga & Khan, 2022). The comparison draws on participant observation, structured surveys, documentary sources, and material-flow data to examine how circular practices become spatially embedded, socially enacted, and connected to localized material flows. These complementary sources provide the empirical basis for identifying recurring socio-spatial patterns across the two cases, while the methodological procedures and analytical framework are detailed below.

Literature review

This chapter reviews the main theoretical debates informing the study. It first discusses the emergence of circular cities and regions and the challenges associated with monitoring urban circularity. It then examines the growing recognition of sociocultural dimensions within circular economy research and the role of public space in enabling circular practices. Finally, it identifies a conceptual gap in the literature and introduces the contribution developed in this article.

Circular economy and circular cities and regions: Conceptual framework and territorial turn

The global climate crisis, extensively documented in the most recent IPCC (2023) reports, has reinforced the role of cities and regions as key scales for ecological transition. In this context, the Circular Economy (CE) has been promoted as an alternative paradigm to the linear model of production and consumption, advocating the reduction of resource extraction, the minimization of waste, and the retention of value throughout material life cycles (Ellen MacArthur Foundation, 2015; Bourguignon, 2016).

The application of these principles to urban and regional contexts has given rise to the concept of circular cities and regions (CCRs), understood not merely as the localized application of CE principles, but as a strategic framework articulating urban metabolism, territorial planning, and multilevel governance (Marin & De Meulder, 2018; Prendeville, 2018; Williams, 2021; Dąbrowski et al., 2024). The literature notes that CCRs hold significant transformative potential insofar as they enable the alignment of urban systems with ecological limits while simultaneously fostering resilience, social innovation, and territorial justice (Marin & De Meulder, 2018; Ellen MacArthur Foundation, 2019; Paiho et al., 2020).

However, despite this potential, several authors acknowledge that the implementation of CCRs remains at an early and experimental stage, characterized by pilot projects, sector-specific initiatives, and strong dependence on public funding (Ellen MacArthur Foundation, 2017; Dąbrowski & Wandl, 2024; Circle Economy Foundation, 2024). This condition reinforces the need for conceptual and analytical instruments capable of understanding, monitoring, and guiding circular transition processes in urban and regional contexts, particularly for local governments, urban planners, policymakers, and researchers engaged in circular economy transitions.

Monitoring urban circularity: Limitations of existing indicators

One of the main challenges identified in the literature concerns the monitoring of circularity. Although the assessment of CE has been widely discussed, there is no consensus regarding

Open Access Journal

which dimensions should be prioritized or which indicators are most appropriate for capturing circularity at the urban or regional scale (Paoli et al., 2022; Williams, 2024; Dąbrowski & Wandl, 2024). Recent studies identify more than 295 indicators proposed in academic literature and hundreds of metrics employed by cities and regions, revealing a fragmented and methodologically heterogeneous landscape (OECD, 2020; Paoli et al., 2022). The absence of systematized monitoring structures—particularly those adapted to urban and regional realities—hampers an integrated understanding of circular performance and compromises the formulation of effective public policies (Ferreira & Fuso-Nerini, 2019; OECD, 2020; Government of Amsterdam, 2020; PBL, 2023; Government of Flanders, 2023; European Commission, 2023).

Tools such as Material Flow Analysis (MFA), Life Cycle Assessment (LCA), the Butterfly Diagram (Ellen MacArthur Foundation, 2021), and the RESOLVE framework (Ellen MacArthur Foundation, 2015) were primarily developed for products, firms, or national policies and therefore present limitations when applied to complex urban systems (Circle Economy Foundation, 2024; Dąbrowski et al., 2024). In particular, they tend to privilege quantitative and sectoral dimensions—such as waste, energy, or water—at the expense of social, institutional, and spatial processes.

Moreover, many municipalities lack territorially disaggregated primary data and the institutional capacity to systematically apply complex indicators, thereby limiting comparability across urban contexts (Paoli et al., 2022; Circular Cities Declaration, 2024). This scenario has generated growing calls for transversal indicators capable of cutting across sectors and capturing circularity as a systemic and territorial phenomenon.

The sociocultural dimension of circularity and the role of space

Recent literature increasingly recognizes that the Circular Economy (CE) cannot be reduced to a purely techno-economic model, as it also encompasses ecological, social, and cultural dimensions (Paoli et al., 2022; Bono et al., 2024). Consequently, many of the defining characteristics of circular cities and regions are not measurable in strictly quantitative terms and therefore require complementary indicators capable of capturing subjective, relational, and qualitative dimensions of circularity (Paoli et al., 2022).

This perspective is reinforced by approaches emphasizing the territorial nature of circularity. Dąbrowski et al. (2024) and van den Berghe and Dąbrowski (2024) argue that CE materializes through localized practices mediated by institutions, infrastructures, and specific sociopolitical contexts. Similarly, Verga and Khan (2022) propose analyzing urban circularity through the interaction between space, flows, and actors, highlighting that circular practices are simultaneously material and relational.

In this context, several authors advocate for the incorporation of sociocultural indicators into the monitoring of urban circularity. According to Bryman (2016), an indicator can be understood as an indirect measure of a complex concept. In the context of this study, the complex concept under investigation is what this article conceptualizes as circular public space. As an emergent socio-spatial phenomenon, circular public space cannot be directly measured through a single variable or metric. Instead, it must be approached through observable manifestations of circularity within public space, including spatial practices, forms of participation, collective action, and the territorial expression of circular activities.

A sociocultural indicator, therefore, constitutes an indirect measure that renders observable the human dimensions of urban circularity that escape strictly metabolic or economic measurement. Unlike the metrics most commonly used to evaluate urban circularity—such as

Open Access Journal

resource volumes, recycling rates, or metabolic efficiency—sociocultural indicators point to citizen participation, multi-actor cooperation, social inclusion and cohesion, collective learning, collaborative governance, activation of local social networks, territorialization, and regenerative uses of space. They function primarily as qualitative signals of the incorporation of circularity into urban life. In doing so, they reveal how circularity is socially embedded, appropriated, and enacted in everyday urban contexts—by whom, through which practices, in which spaces, with what degree of institutional support, and under which cultural and territorial conditions.

Within this framework, public space emerges as a particularly relevant analytical dimension. Traditionally understood as the substrate of urban life (Lefebvre, 1974), public space is increasingly recognized as a site where circular practices become visible, where networks of cooperation are constructed, and where new forms of governance and collective territorial appropriation are experimented with (Loorbach et al., 2017; Williams, 2021). Public space not only accommodates circular practices but also provides the social and territorial conditions through which they can become embedded in everyday urban life.

However, despite this growing recognition—and although dispersed references to circular practices in community and urban contexts exist—the literature still lacks a systematic conceptualization capable of articulating public space, circularity, and the monitoring of urban circularity. This gap is particularly significant because many circular practices are inherently place-based and socially mediated, yet existing monitoring frameworks remain predominantly focused on material flows, resource efficiency, and environmental performance. Addressing this gap requires conceptual and analytical approaches capable of making visible the sociocultural dimensions through which circularity is enacted, experienced, and sustained within urban territories.

Circular public space: Conceptual gap and contribution of the study

The present study proposes circular public space as a conceptual lens through which the relationship between circular practices, public space, and urban circularity can be examined. Rather than assuming its defining characteristics a priori, the study explores whether recurring socio-spatial patterns emerge across different circular initiatives and whether these patterns support the conceptualization of circular public space as a sociocultural indicator of urban circularity.

Rather than directly quantifying circularity, this indicator enables the indirect and qualitative identification of how circularity manifests within the territory through social practices, spatial appropriations, and forms of collective coordination. By proposing circular public space as a transversal cross-sectoral sociocultural indicator of urban circularity, this article addresses the gap identified in the literature regarding the monitoring of CCRs (Paoli et al., 2022).

Methods and materials

Research design and analytical approach

This study adopts a qualitative-comparative research design oriented towards the in-depth analysis of territorially anchored circular practices embedded in public space. The methodological objective is neither to test causal hypotheses nor to generate statistically representative findings, but rather to conceptualize and explore circular public space as a transversal sociocultural indicator of urban circularity, grounded in the empirical observation of concrete practices.

Open Access Journal

The research follows an exploratory and inductive analytical logic, in which the concept of circular public space emerges from cross-case comparison rather than being imposed a priori. This approach is consistent with contemporary research on sustainability transitions and urban circular economy, which acknowledges the contextual, territorial, and relational nature of circularity (Loorbach et al., 2017; Williams, 2021; Dąbrowski et al., 2024).

To structure the analysis, the study mobilizes a combination of complementary methodological instruments, deliberately selected to capture both material and sociocultural dimensions of circularity: (i) the space-flows-actors approach proposed by Verga and Khan (2022), serving as the primary analytical framework; (ii) the Sector-Wide Circularity Assessment (SCA) method developed within the CityLoops project (CityLoops – Metabolism of Cities, 2020), to contextualize material flows; (iii) participant observation (Lakatos & Marconi, 2003), to capture social dynamics and everyday practices; and (iv) structured surveys, to collect perceptions, motivations, and barriers related to citizen participation.

The combination of these instruments responds to the need identified in the literature for hybrid methodological approaches capable of capturing the socio-territorial complexity of urban circularity (Dąbrowski et al., 2024; van den Berghe & Dąbrowski, 2024). The methodological logic adopted in this study is summarized in Figure 1.

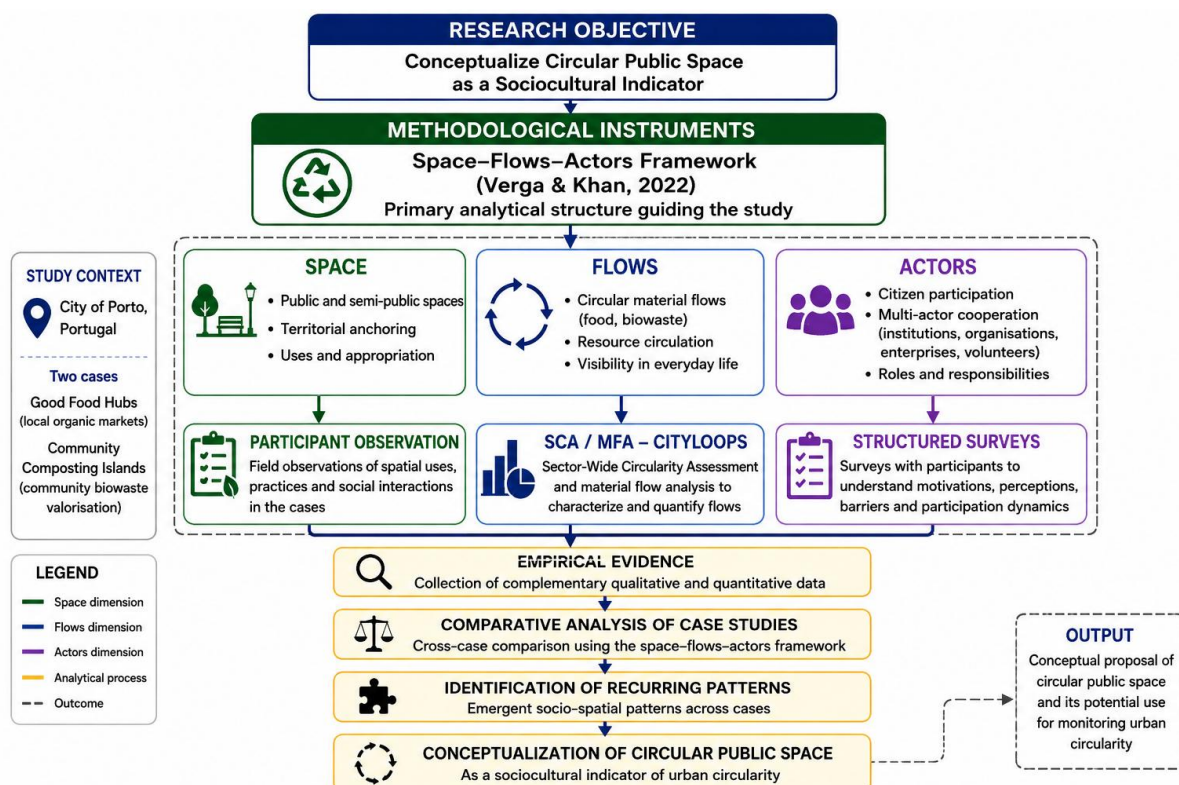


Figure 1. Integrated analytical framework combining the space-flows-actors approach with the empirical methods applied in the study. Source: author

The space-flows-actors framework functions as the primary analytical structure guiding data collection and interpretation. Within this framework, participant observation was used to capture spatial practices and social interactions, the SCA method provided contextual information regarding material flows, and structured surveys generated evidence concerning motivations, perceptions, barriers, and participation dynamics. The integration of these

Open Access Journal

complementary sources enabled the comparative identification of recurring socio-spatial patterns that underpin the conceptualization of circular public space.

Case selection and study context

According to PORDATA (2025), the municipality of Porto has 273,476 inhabitants and forms part of the Porto Metropolitan Area, which has a total population of 1,736,228 inhabitants. Porto constitutes a particularly relevant example for the study of urban circularity due to its involvement in European initiatives such as the CityLoops project and its adherence to the European Circular Cities Declaration (Circular Cities Declaration, 2024), as well as the adoption of a Roadmap for the Circular Economy 2030 (Câmara Municipal do Porto, 2017).

Within this context, two case studies were selected, all embedded in the urban food system and based on the following inclusion criteria: the development of explicit circular economy practices; the direct use of public space or public infrastructures; the involvement of multiple actors (institutions, citizens, organizations); diversity of circular practice typologies, enabling comparative analysis.

The selected cases were: Good Food Hubs (established in 2022) – pop-up markets for organic and regional products; Community Composting Islands (established in 2021) – community-based composting of biowaste.

Table 1. Analyzed documents

Characteristic	Good Food Hubs	Community Composting Islands
Initiative type	Local organic food markets	Community biowaste composting
Location	ISEP and FEUP, Asprela, Porto	Praça do Cávado and Parque Infantil do Amial, Porto
Year established	2022	2021
Circular practice	Short food supply chains and local food distribution	Local treatment and valorisation of biowaste
Main material flow	Organic and regional food products	Organic waste and compost
Public space typology	Semi-public institutional spaces	Public urban green spaces
Main actors	Producers, consumers, universities, project organizers	Residents, municipal environmental services (Porto Ambiente)
Data collection period	2022–2023	2021–2023
Participant observation	Yes	Yes
Survey respondents	55	45
Documents	Yes	Yes

The two cases were deliberately selected because they represent different forms of circularity within the urban food system. While Good Food Hubs focus on the circulation and consumption of organic food products through temporary market structures, Community Composting Islands address the recovery and valorisation of biowaste through permanent

Open Access Journal

neighbourhood-based infrastructures. This contrast enables the exploration of whether similar socio-spatial patterns emerge across distinct circular practices. The selection of two distinct cases allows for the exploration of variations in how public space is appropriated for circular practices, thereby strengthening the analytical robustness of the emergent concept of circular public space.

Data collection

Data collection took place between 2021 and 2023, varying according to the case study, and involved multiple techniques, as summarized below.

Participant observation

Participant observation was adopted following Lakatos and Marconi (2003), who define it as the systematic observation of social phenomena through the direct presence of the researcher within the context being studied. This approach enables the identification of behaviors, interactions, and everyday practices that may not be fully captured through surveys or documentary sources. In this study, participant observation focused on the use of public space, interactions among actors, and the functioning of infrastructures.

Structured surveys

Structured surveys were administered to both users and non-users of the initiatives, with the objective of collecting qualitative data on: motivations for participation; perceptions of benefits and limitations; barriers to access and inclusion; the relationship between circular practices and public space. A total of 55 participants completed the structured survey associated with the Good Food Hubs case study. Likewise, 45 participants completed the structured survey associated with the Community Composting Islands case study. In both case studies, respondents were approached directly at the respective initiative sites during fieldwork.

The structured surveys included short open-ended questions designed to capture participants' and non-participants' perceptions in their own terms. Open-ended questions were selected because the objective was not to quantify predetermined attitudes, but to identify how respondents described their motivations, perceived benefits, barriers, and relationships with public space. After data collection, responses to these questions were treated as qualitative empirical material and analyzed through thematic coding, whereby recurring responses were grouped into thematic categories.

For the Good Food Hubs, the questionnaire asked: (1) Why do you consume organic products? (2) How did you hear about Good Food Hubs? (3) Are you a student/member of the academic community? (4) Do you consider the price paid for organic and regional food fair?

For the Community Composting Islands, the questionnaire asked participants: (1) Do you use the community composter? (2) What is your opinion of the community composter? (3) Do you use the compost produced? Non-participants were asked: (1) Do you use the community composter? (2) Why do you not use it? (3) What is your opinion of the initiative, even though you do not use it?

The responses presented in the results section are not treated as statistically representative of Porto's population. They are used to identify recurring perceptions, motivations, and barriers that help interpret the sociocultural conditions under which circular practices become embedded in public space.

Open Access Journal

Documentary data and material flows

To contextualize material flows, the study relied on: official reports from the CityLoops project (CityLoops, 2022; CityLoops – Metabolism of Cities); institutional data from LIPOR (Observatório de Resíduos Lipor, 2023), Porto Ambiente (2023), and Câmara Municipal do Porto (2021); primary records produced during fieldwork. This data allowed for the quantitative contextualization of the circular practices examined, without shifting the focus of the study towards an exhaustive measurement of circularity.

Data analysis

Data analysis followed a qualitative and interpretative logic, structured around the three analytical dimensions proposed by Verga and Khan (2022): space (typology, scale, use and appropriation of public space); flows (nature and volume of circular flows involved); actors (diversity, roles, and interactions among actors). Empirical data were organized into case-based synthesis tables, enabling transversal comparative analysis. Through this comparison, recurring patterns were identified that underpin the conceptualization of circular public space as a sociocultural indicator.

Methodological considerations and limitations

This study presents limitations inherent to qualitative comparative research based on two cases. Its purpose is not statistical generalization, but analytical transferability. The findings identify socio-spatial patterns that may be examined and refined in other contexts rather than universally generalized.

Methodological rigor is supported through transparency in the research design and analytical procedures. The survey questions, case selection criteria, analytical dimensions, and coding logic are made explicit to allow future researchers to apply the same framework to other circular initiatives. Triangulation between observation, survey responses, material-flow data, and documentary sources further strengthens the internal consistency of the analysis.

Results: findings from the case studies

This section presents the empirical results obtained from the analysis of the two case studies: Good Food Hubs and Community Composting Islands. The findings are organized according to the three analytical dimensions proposed by Verga and Khan (2022): space-flows-actors. No in-depth theoretical interpretation is provided here; this will be developed in the Discussion section.

Good Food Hubs

Space

The Good Food Hubs markets operate as temporary (pop-up) structures installed in public or semi-public spaces associated with two higher education institutions, Porto School of Engineering (ISEP) and Faculty of Engineering University of Porto (FEUP), located in the Asprela area of Porto. Each producer uses, on average, four tables (60 X 80 cm), corresponding to approximately 3.2 linear meters of public space per producer.

During the events observed, public space was temporarily reconfigured to accommodate selling, meeting, and social interaction functions, without any permanent physical alterations. Spatial occupation amounted to 6.4 linear meters at the 41st market and 9.6 linear meters at the 42nd market. Examples of the temporary spatial configuration adopted by Good Food Hubs are presented in Figures 2 and 3.

Open Access Journal

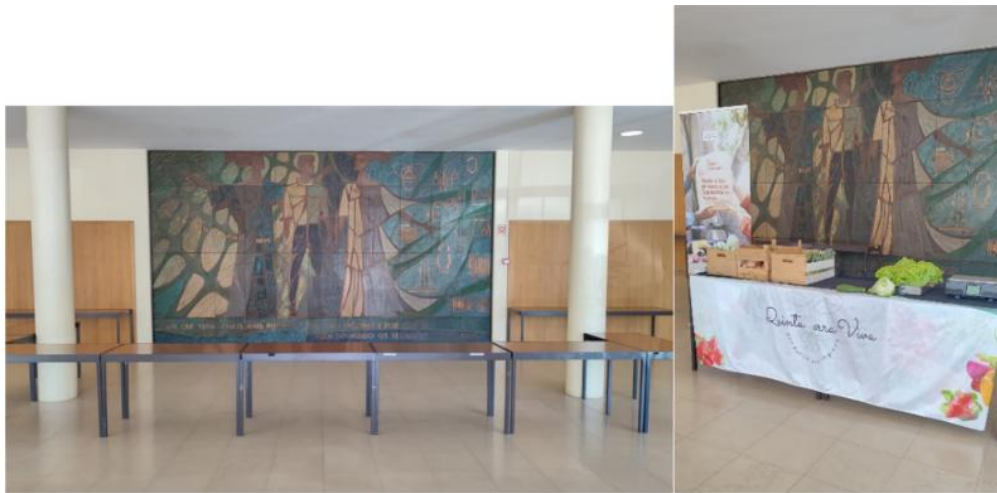


Figure 2. Stands of the 41st Good Food Hubs Market, ISEP. Source: author

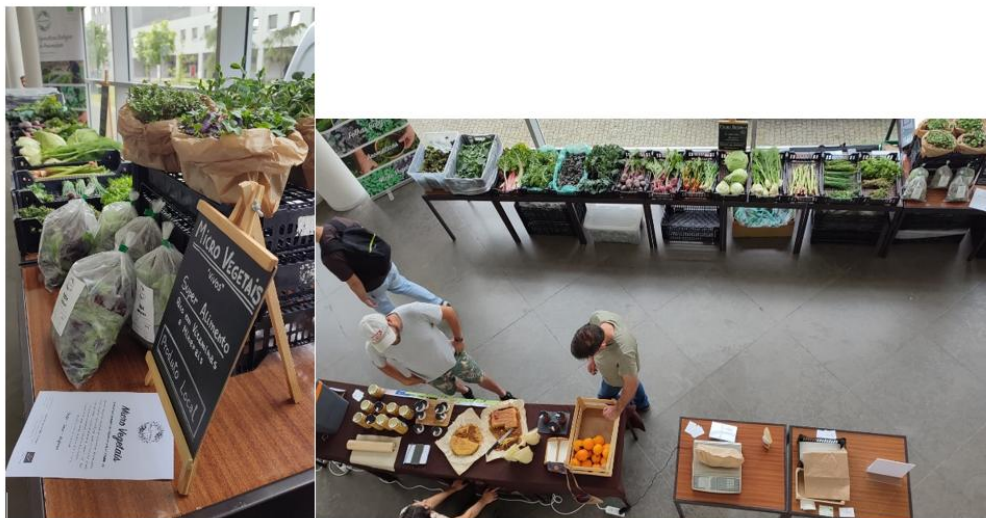


Figure 3. Stands of the 42nd Market Good Food Hubs, FEUP. Source: author

Flows

Between October 2022 and March 2023, a total of 1,438 kg of food products were sold, predominantly vegetables (780 kg) and roots and tubers (603 kg). A total of 55 kg of mushrooms were excluded from the categorized material-flow analysis because mushrooms are not included among the 12 representative biomass material categories defined by the CityLoops SCA method: cereals, dairy products, fish, fodder crops, fruits, garden and park materials, live animals, oil-bearing crops, roots and tubers, sugar crops, timber, and vegetables (CityLoops – Metabolism of Cities, 2021).

Actors

A total of 55 participants completed the structured survey associated with the Good Food Hubs initiative: 18 at the 41st market, held at ISEP, and 37 at the 42nd market, held at FEUP. The

Open Access Journal

survey focused on four questions: motivations for consuming organic products; channels through which participants became aware of the initiative; relation to the academic community; and perceptions of price fairness.

Regarding motivations, the most frequent responses were associated with health and environmental concerns. At ISEP, health-related motivations were dominant, while at FEUP both health and ecological motivations appeared strongly. This suggests that participation in Good Food Hubs is primarily driven by normative and value-based motivations rather than by convenience alone. The initiative therefore functions not only as a food retail space, but also as a site where ideas of healthy, local, and ecologically responsible consumption are made visible in everyday academic environments.

The second question revealed a strong dependence on institutional communication channels. At ISEP, most respondents reported having heard about the market through the institution's communication office, while at FEUP most referred to the university community email. This indicates that the publicness of the initiative is not produced only by physical accessibility, but also by institutional mediation. In planning terms, circular public spaces require not only spatial availability but also communication infrastructures capable of activating participation.

The third question showed differences between the two locations. At ISEP, respondents were mainly non-students, whereas at FEUP a significant share of respondents were students, professors, or staff. This difference is relevant because it suggests that the same circular practice may activate different publics depending on location, institutional context, and the social composition of the surrounding space.

The fourth question concerned price fairness and revealed a tension between sustainability and accessibility. Some respondents considered the prices fair because of health, environmental, and local-production benefits. Others, particularly students, perceived organic products as expensive or difficult to justify economically. This finding is important for the argument of the article because it shows that circular public space may promote sustainable consumption while still facing barriers of social inclusion. In other words, the spatial presence of a circular initiative does not automatically guarantee equitable access in terms of affordability.

Community composting islands

Space

The Community Composting Islands occupy a total of 44.1 m² of public space, distributed across two locations: Praça do Cávado (14.7 m²) and Amial Children's Park (29.4 m²). The infrastructure consists of standardized composting modules permanently installed in urban green areas. Examples of the Community Composting Islands infrastructure are presented in Figures 4 and 5.

Open Access Journal



Figure 4. Community Composting Island of the Amial Children's Park. Source: author



Figure 5. Community Composting Island of Praça do Cávado. Source: author

Flows

Between August 2021 and February 2023, a total of 7.6 tonnes of biowaste were treated, resulting in 2.05 tonnes of compost (Porto Ambiente, 2023). The compost produced was distributed free of charge to participants. According to CityLoops data, this amount corresponds to approximately 210 kg of CO₂ emissions avoided per tonne of biowaste treated (CityLoops, 2021).

Actors

A total of 45 respondents completed the structured survey associated with the Community Composting Islands initiative: 18 users of the initiative and 27 non-users. The questionnaire distinguished between users and non-users in order to identify both motivations for participation and barriers to involvement in the initiative.

Participants were first asked whether they used the community composter and how they evaluated the initiative. Most participant responses expressed positive evaluations, emphasizing environmental benefits, waste separation, and the practical value of having a local place to dispose organic waste. These responses indicate that, for active users, the Composting Islands operate as more than waste-management equipment: they support new domestic routines and connect individual household practices to a visible collective infrastructure in public space.

Open Access Journal

Participants were also asked whether they used the compost produced. Responses differed between the two locations. At Parque Infantil do Amial, most participants reported using the compost, while at Praça do Cávado most reported not using it. This difference suggests that circularity is not completed only by installing composting infrastructure; it also depends on whether participants are able or willing to reintroduce the resulting compost into everyday practices, such as gardening or domestic plant care.

Non-users were asked why they did not use the community composter. The most frequent barriers included lack of time, lack of waste-separation habits, lack of knowledge about the initiative, and physical accessibility constraints. These responses show that non-participation cannot be interpreted simply as lack of environmental concern. It is also shaped by practical, informational, and spatial barriers.

Non-users were also asked for their opinion of the initiative. Several respondents had no opinion or were unfamiliar with the composter, while others recognized its environmental relevance despite not using it. One response also criticized the lack of prior consultation. This finding is particularly significant for urban planning: the legitimacy and effectiveness of circular infrastructures depend not only on environmental performance, but also on participatory implementation, accessibility, and communication with residents.

Comparative synthesis of results

The comparative analysis reveals three main differences between the cases. First, Good Food Hubs are temporary and event-based, whereas the Community Composting Islands are permanent infrastructures. Second, participation in Good Food Hubs is mainly consumption-based, while participation in the Composting Islands depends on repeated household routines. Third, access to Good Food Hubs is mediated mainly by institutional communication and purchasing interest, whereas access to the Composting Islands is shaped by awareness, proximity, physical accessibility, and domestic waste-separation habits.

These differences are analytically important because they show that circular public space is not a single spatial form. It may emerge through temporary markets, permanent infrastructures, consumption practices, or community-based routines. However, across both cases, three common patterns are visible: localized circular flows, multi-actor coordination, and the appropriation of public or semi-public space for regenerative practices.

The comparison also shows that the sociocultural indicator proposed in this article does not simply register the existence of circular infrastructure. Rather, it indicates whether a circular practice becomes socially embedded: whether people know about it, use it, value it, and integrate it into everyday routines. This is why circular public space should be understood as a qualitative indicator of the social and spatial conditions that enable urban circularity.

Taken together, these findings provide the empirical basis for interpreting circular public space not merely as a spatial setting, but as a socio-spatial configuration in which circularity becomes observable through everyday practices, interactions, and territorial embedding.

Discussion

Interpreting circular public space through spatial flows and actors

The comparative analysis of the two cases shows that, despite differences in scale, duration, and flow intensity, they share a common configuration: circular economy practices that materialize through the use and appropriation of public space and the activation of local social networks. This empirical convergence supports the conceptualization of circular public space as an emergent socio-spatial configuration observed across the cases analyzed.

Open Access Journal

In light of the space-flows-actors approach (Verga & Khan, 2022), the findings indicate that: (i) space ceases to function merely as a physical substrate and instead assumes an active role in organizing circular practices; (ii) flows (food, biowaste) become territorialized and socially visible; (iii) actors (citizens, producers, institutions) form hybrid networks that sustain the continuity of these practices. This articulation confirms arguments in the literature advocating a relational and territorial reading of urban circularity, moving beyond isolated material efficiency (Marin & De Meulder, 2018; Williams, 2021; Dąbrowski et al., 2024).

Circular public space as a sociocultural indicator of urban circularity

A central contribution of this study is the proposal of circular public space as a transversal cross-sectoral sociocultural indicator, addressing the gap identified in the literature on monitoring urban circularity (Paoli et al., 2022). This indicator does not seek to measure circularity directly, but rather to indicate, indirectly and qualitatively, how circularity manifests within the territory.

Based on the empirical findings, circular public space indicates the simultaneous presence of: territorially anchored circular practices; citizen participation; multi-actor cooperation (institutions, individuals, enterprises); and collective appropriation of public space for regenerative purposes. In this sense, it functions as a signal of the incorporation of circularity into urban life.

Conceptually, the proposed indicator is structured around three interrelated dimensions derived from the analytical framework adopted in this study: space, flows, and actors. Rather than measuring circularity through material quantities alone, circular public space assesses whether circular practices become socially and territorially embedded within urban environments.

Within the space dimension, the indicator captures the extent to which circular practices are anchored in public or semi-public spaces and collectively appropriated by users. Within the flows dimension, it identifies the presence and visibility of localized circular flows, such as food redistribution or biowaste valorization, and their connection to everyday urban life. Within the actors dimension, it captures citizen participation, multi-actor cooperation, and institutional involvement in sustaining circular practices.

Taken together, these dimensions do not generate a quantitative score. Instead, they provide qualitative evidence of the degree to which circularity is socially produced, territorially embedded, and collectively reproduced through everyday practices. Circular public space should therefore be understood as a sociocultural indicator that makes visible dimensions of circularity that are often absent from conventional monitoring systems focused primarily on material efficiency and resource flows. The conceptual structure of circular public space as a sociocultural indicator is synthesized in Figure 6.

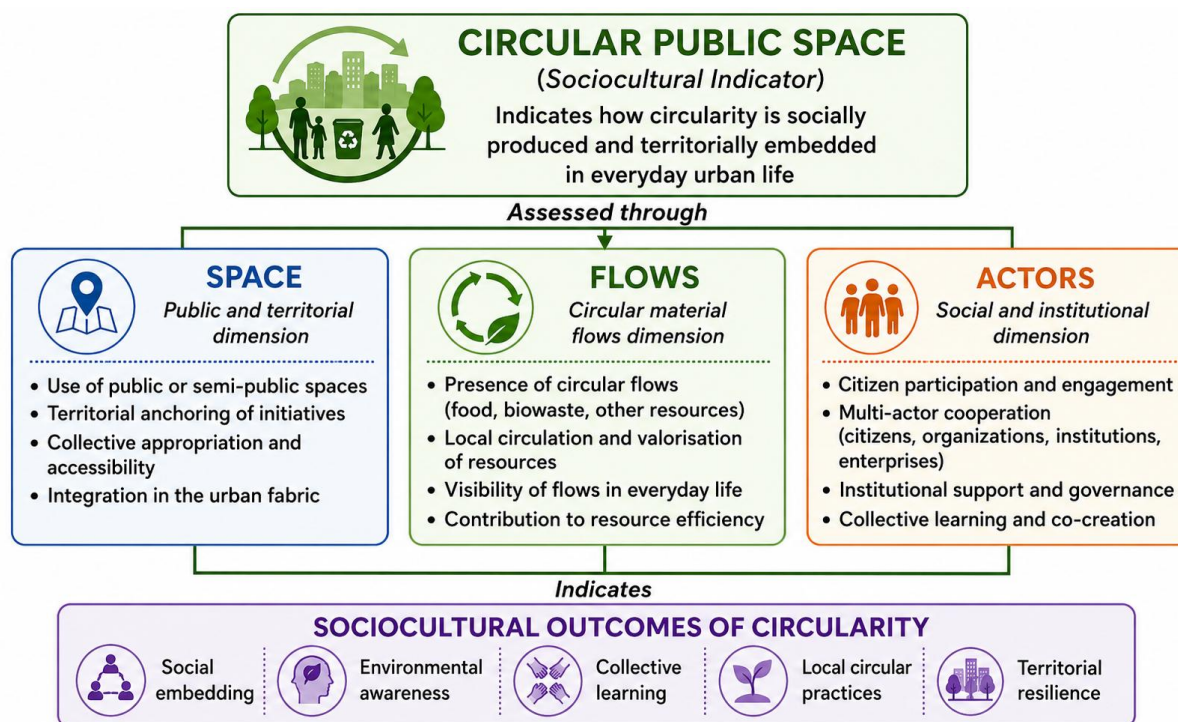


Figure 6. Conceptual structure of circular public space as a sociocultural indicator. Source: author

Socio-spatial resilience, inclusion, and environmental health

The results also allow for a discussion of the transformative potential of the practices analyzed, particularly in terms of a qualitative assessment of socio-spatial resilience, environmental health, inclusion and social cohesion, collective learning, and the activation of local social networks in urban circularity. They contribute to understanding how circularity is socially produced, appropriated, and expressed in the city of Porto. Although the observed metabolic impacts are modest in absolute terms, the two cases demonstrate the capacity to strengthen short and solidarity-based food chains (Good Food Hubs) and promote the local valorisation of biowaste (Community Composting Islands).

However, the findings also reveal tensions and limitations. In the case of the Community Composting Islands, physical accessibility barriers and deficits in participatory decision-making processes prior to infrastructure installation limit the initiative's inclusive potential. These findings corroborate arguments in the literature warning that circular initiatives may reproduce forms of exclusion if not accompanied by robust participatory processes (Loorbach et al., 2017; Bono et al., 2024). This demonstrates that the mere presence of circular infrastructure in public space does not automatically translate into inclusive circularity.

Validity and limitations of the indicator

Following Bryman's (2016) distinction between measures and indicators, circular public space is treated as an indirect indicator of a complex concept rather than as a direct metric. Its validity therefore depends on whether the empirical observations plausibly represent the sociocultural dimensions of urban circularity that the concept is intended to capture. Face validity is supported by the correspondence between the theoretical concept and the observed practices, while construct validity is reinforced by the coherence between the empirical patterns identified and conceptual frameworks on territorial circularity, collaborative governance, and social innovation.

Open Access Journal

The proposed indicator nevertheless presents important limitations. Because it relies on context-dependent qualitative evidence concerning participation, spatial appropriation, and multi-actor cooperation, it does not generate standardized numerical outputs and therefore does not allow direct quantitative comparisons across cities or over time. Its value lies primarily in its analytical and heuristic capacity to make visible sociocultural and spatial dimensions of circularity that are often absent from conventional monitoring frameworks. Further comparative applications across different urban contexts will be necessary to refine and validate the indicator.

Transferability and implications for policy and research

Despite the contextual nature of the cases, the identified patterns suggest that the concept of circular public space holds analytical transferability to other urban and regional contexts. Initiatives such as local markets or shared composting systems are observable in several European cities (Circular Cities Declaration, 2024), opening pathways for future comparative applications.

From a public policy perspective, circular public space may function as a complementary monitoring indicator, enabling municipalities to identify not only how much is recycled or recovered, but how circularity is socially produced and appropriated. For urban planners, this implies a shift from purely infrastructure-based approaches towards strategies that recognize the role of social practices and collective spatial appropriation in enabling circular transitions. For academic research, the concept offers a bridge between circular economy studies, urban planning, and the sociology of space.

In sum, the discussion demonstrates that circular public space constitutes a relevant analytical lens for understanding urban circularity as a socio-territorial process. The following section synthesizes the main contributions of the study, presents practical and academic implications, and identifies directions for future research.

Implications for urban planning practice

The findings have direct implications for urban planning, particularly regarding the integration of circular economy principles into spatial planning, governance, and public space management.

First, the cases demonstrate that circular practices depend not only on material infrastructures but also on the flexible use of public space. Temporary markets and community composting infrastructures illustrate how public space can function as a platform for circular activities. This suggests the need for planning approaches that move beyond rigid zoning frameworks and support temporary, hybrid, and adaptive uses of urban space.

Second, the results highlight the importance of participatory governance. Barriers related to awareness and limited involvement in decision-making processes indicate that the success of circular initiatives depends on early and continuous community engagement. Urban planning should therefore incorporate participatory mechanisms that enhance accessibility, legitimacy, and long-term adoption.

Third, different circular practices require distinct planning approaches. Consumption-based initiatives are more sensitive to affordability and location, whereas community-based initiatives depend more strongly on proximity, awareness, and social networks. Planning strategies for circular cities should therefore be context-specific and responsive to local socio-spatial conditions.

Open Access Journal

Finally, circular public space can serve as a qualitative monitoring indicator, complementing conventional indicators focused on material flows and efficiency. The Porto cases suggest that circular economy principles remain only partially embedded in mainstream planning instruments, relying largely on pilot projects and localized experimentation. Strengthening their integration into public-space policy, neighbourhood planning, accessibility standards, and participatory design processes may contribute to more inclusive and territorially grounded circular transitions.

Conclusion

The transition towards circular cities and regions requires more than technical solutions or metrics focused exclusively on material flows. It also demands conceptual instruments capable of capturing how circularity is territorially produced, socially appropriated, and institutionally sustained. Based on this premise, the present article aimed to conceptualize circular public space and assess its potential as a transversal cross-sectoral sociocultural indicator of urban circularity, drawing on the analysis of two initiatives—Good Food Hubs and Community Composting Islands.

In this sense, the article advances the field by positioning circular public space as an analytical bridge between circular economy, urban planning, and socio-spatial theory. Through the application of the integrated analytical framework developed in this study, combining the space-flows-actors approach, material-flow analysis, participant observation, and structured surveys, the study demonstrated that circular practices anchored in public space share common patterns: the territorialization of circular flows, citizen participation, the activation of multi-actor networks, and the collective appropriation of space for regenerative purposes.

Moreover, the analysis of practices implemented within these circular public spaces enabled a qualitative assessment of socio-spatial resilience, environmental health, inclusion and social cohesion, collective learning, and the activation of local social networks in urban circularity. This contributes to a deeper understanding of how circularity is socially produced, appropriated, and expressed in the city of Porto.

Most importantly, the findings provide a direct answer to the research question. The analysis suggests that public spaces can be conceptualized as circular public spaces when four conditions are simultaneously present. First, circular material flows must be territorially anchored and visibly connected to everyday urban practices. Second, citizens must actively participate in the operation, use, or reproduction of the circular practice. Third, the initiative must involve forms of multi-actor cooperation, bringing together public institutions, community members, civil society organizations, or economic actors. Fourth, public or semi-public space must be collectively appropriated as a platform for circular activities, enabling the social embedding of circularity within the territory.

When these conditions converge, circularity becomes observable not only through material outputs, but also through social relations, spatial practices, and forms of collective organization. Under such circumstances, circular public space may be employed as a sociocultural indicator capable of revealing dimensions of urban circularity that remain largely invisible in conventional monitoring systems.

The principal contribution of this article lies in conceptualizing circular public space as a qualitative sociocultural indicator that reveals how circularity is enacted, spatialized, and socially embedded in urban contexts, complementing conventional quantitative metrics of circularity. In this sense, the concept shifts attention from measuring circularity exclusively through material outputs towards understanding how circularity becomes embedded within everyday urban life.

Open Access Journal

This approach addresses gaps identified in the literature on monitoring circular cities and regions, which tend to prioritize sectoral and quantitative indicators at the expense of sociocultural dimensions. From a theoretical perspective, the study contributes to advancing debates on the territorialization of the circular economy by reinforcing the need to integrate space, actors, and practices into the analysis of urban circularity. In doing so, it establishes a bridge between circular economy research, urban planning, and socio-territorial studies, offering an analytical lens complementary to dominant metabolic approaches.

From a public policy perspective, the concept of circular public space presents potential as a qualitative monitoring indicator, enabling municipalities to identify and value circular practices that strengthen social cohesion, collective learning, and collaborative governance. Although it does not replace existing quantitative indicators, it may function as a complementary monitoring indicator within local circular economy strategies, contributing to a more integrated and democratic assessment of the transition. For urban planning practice, this implies the need to design and manage public spaces not only as physical infrastructures, but as enabling environments for circular practices, social interaction, and community-based resource management.

Nevertheless, this study presents limitations that must be acknowledged. The analysis is based on two cases located within a single city, which limits the transferability of empirical findings to other contexts without further comparative research. Furthermore, as a qualitative indicator, circular public space does not allow for direct performance comparisons across cities or over time. This limitation stems from the absence of standardized numerical outputs, as the indicator relies on context-dependent qualitative evidence related to participation, spatial appropriation, and multi-actor cooperation. Its value lies primarily in its heuristic and interpretative capacity rather than in metric standardization.

Future research should prioritize comparative applications of the proposed indicator across different cities and circular initiatives. Such studies would allow researchers to examine whether the socio-spatial conditions identified in Porto remain relevant in different institutional, cultural, and territorial contexts, thereby contributing to the refinement and validation of the concept.

Recognizing circular public space as a sociocultural indicator contributes to a more comprehensive, territorially grounded, and practice-oriented understanding of circular cities and regions, bridging the gap between material flows and lived urban experience. In this sense, circular public space offers a sociocultural lens through which the territorial realization of circular economy principles can be observed, interpreted, and monitored.

References

- Bono, F., Wuyts, W., & Willems, E. (2024). Towards a care-full circular economy. *Regional Studies Policy Impact Books*, 6(1), 43–59.
<https://doi.org/10.1080/2578711X.2024.2418230>
- Bourguignon, D. (2016). *Closing the loop: New circular economy package*. European Parliament.
- Bryman, A. (2016). The nature of quantitative research. In A. Bryman, *Social research methods* (4th ed., pp. 150–176). Oxford University Press.
- Câmara Municipal do Porto. (2017). *Roadmap para a cidade do Porto circular em 2030*. Câmara Municipal do Porto.
- Câmara Municipal do Porto. (2021). *Relatório de desenvolvimento sustentável*. Câmara Municipal do Porto.

Open Access Journal

- Circle Economy Foundation. (2024). *The circularity gap report 2024*. Circle Economy Foundation.
- Circular Cities Declaration. (2024). *CCD report 2024*. Circular Cities Declaration.
- CityLoops. (2021). *Optimised implementation plan – Biowaste*. CityLoops.
- CityLoops. (2022). *Evaluation plan: Biowaste sector, Porto*. CityLoops.
- CityLoops – Metabolism of Cities. (2020). *Metabolism of Cities sector-wide circularity assessment (SCA) method (Deliverable D4.3, Version 2.0)*. CityLoops.
- CityLoops – Metabolism of Cities. (2021). *Sector-wide circularity assessment for the biomass sector – Porto*. CityLoops.
- Dąbrowski, M., & Wandl, A. (2024). Assessing circular economy transitions. *Regional Studies Policy Impact Books*, 6(1), 81–98. <https://doi.org/10.1080/2578711X.2024.2418234>
- Dąbrowski, M., Williams, J., van den Berghe, K., & Van Bueren, E. (2024). Circular regions and cities: Towards a spatial perspective on circular economy. *Regional Studies Policy Impact Books*, 6(1), 13–28. <https://doi.org/10.1080/2578711X.2024.2418227>
- Ellen MacArthur Foundation. (2015). *Growth within: A circular economy vision for a competitive Europe*. Ellen MacArthur Foundation.
- Ellen MacArthur Foundation. (2017). *Cities in the circular economy: An initial exploration*. Ellen MacArthur Foundation.
- Ellen MacArthur Foundation. (2019). *Cities and circular economy for food*. Ellen MacArthur Foundation.
- Ellen MacArthur Foundation. (2021). *The butterfly diagram: Visualising the circular economy*. Ellen MacArthur Foundation.
- European Commission. (2023). *Circular economy monitoring framework*. European Commission.
- Ferreira, A. C., & Fuso-Nerini, F. (2019). A framework for implementing and tracking circular economy in cities: The case of Porto. *Sustainability*, 11(6), 1813. <https://doi.org/10.3390/su11061813>
- Flanders. (2023). *Circular economy monitor Flanders*. Government of Flanders.
- Good Food Hubs. (2022). *Muda a tua alimentação. Transforma o mundo*. Good Food Hubs.
- IPCC. (2023). *Climate change 2023: Synthesis report*. Intergovernmental Panel on Climate Change.
- Lakatos, E. M., & Marconi, M. A. (2003). *Fundamentos de metodologia científica*. Atlas.
- Lefebvre, H. (1974). *La production de l'espace*. Anthropos.
- Loorbach, D., Frantzeskaki, N., & Avelino, F. (2017). Sustainability transitions research: Transforming science and practice for societal change. *Annual Review of Environment and Resources*, 42, 599–626. <https://doi.org/10.1146/annurev-environ-102014-021340>
- Marin, J., & De Meulder, B. (2018). Interpreting circularity: Circular city representations concealing transition drivers. *Sustainability*, 10(5), 1420. <https://doi.org/10.3390/su10051420>
- PBL – Netherlands Environmental Assessment Agency. (2023). *Integral circular economy report 2023: Assessment for the Netherlands*. PBL.
- Observatório de Resíduos Lipor. (2023). *Indicadores de redução e reutilização Lipor*. LIPOR.
- Organisation for Economic Co-operation and Development. (2020). *The OECD inventory of circular economy indicators*. OECD.
- Paiho, S., Mäki, E., Wessberg, N., Paavola, M., Tuominen, P., Antikainen, M., Heikkilä, J., Rozado, C., & Jung, N. (2020). Towards circular cities: Conceptualizing core aspects. *Sustainable Cities and Society*, 59, 102143. <https://doi.org/10.1016/j.scs.2020.102143>

Open Access Journal

- Paoli, F., Pirlone, F., & Spadaro, I. (2022). Indicators for the circular city: A review and a proposal. *Sustainability*, 14(19), 12588. <https://doi.org/10.3390/su141911848>
- PORDATA. (2025). *População Porto 2025*. Fundação Francisco Manuel dos Santos.
- Porto Ambiente. (2021). *Ilhas de compostagem comunitária*. Porto Ambiente.
- Porto Ambiente. (2023). *Mais de sete toneladas de biorresíduos valorizados nos espaços de compostagem comunitária da cidade*. Porto Ambiente.
- Prendeville, S., Cherim, E., & Bocken, N. (2018). Circular cities: Mapping six cities in transition. *Environmental Innovation and Societal Transitions*, 26, 171–194. <https://doi.org/10.1016/j.eist.2017.03.002>
- van den Berghe, K., & Dąbrowski, M. (2024). The window of opportunity for circular economy in Europe in the wake of the geopolitical turmoil: Connecting scales and principles. *Regional Studies Policy Impact Books*, 6(1), 29–42. <https://doi.org/10.1080/2578711X.2024.2418228>
- Verga, G., & Khan, A. (2022). Space matters: Barriers and enablers for embedding urban circularity practices in the Brussels capital region. *Frontiers in Built Environment*, 8, 810049. <https://doi.org/10.3389/fbuil.2022.810049>
- Williams, J. (2021). *Circular cities: A revolution in urban sustainability*. Routledge.
- Williams, J. (2024). Implementing the circular bioeconomy in metropolitan regions. *Regional Studies Policy Impact Books*, 6(1), 61–79. <https://doi.org/10.1080/2578711X.2024.2418233>