

Measuring to transform: a proposal of indicators to support urban circularity policies

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Executive Summary

The transition to a circular economy in Portuguese cities faces a structural challenge: the lack of adequate instruments to measure and monitor circularity at the municipal level. Despite the growing prominence of the topic in European and national policy agendas, municipalities still operate with limited, fragmented and poorly adapted data, constraining their ability to make informed decisions.

This policy brief presents the main findings of a research project that developed a set of urban circularity indicators tailored to the Portuguese context, based on a participatory, modular and implementation-oriented approach.

The results highlight that existing monitoring systems are insufficient to support local action. They tend to prioritise environmental indicators (particularly waste management) while failing to capture social and institutional dimensions, and often rely on data that are unavailable at the municipal scale. Significant territorial disparities are also evident, largely driven by differences in institutional capacity across municipalities.

In response, the project proposes a three-tiered indicator framework, comprising core, adaptable and advanced indicators, designed to balance comparability with territorial flexibility. This structure enables municipalities to monitor circularity according to their specific context and capabilities.

However, effective implementation requires a set of critical conditions, including strengthening municipal technical capacity, improving local data systems, enhancing multi-level governance, and fostering greater stakeholder engagement. Without these conditions, urban circularity is unlikely to evolve from a strategic objective into an operational reality.

Key Policy Recommendations

- **Develop an integrated urban circularity data system**, linking national and municipal levels to ensure consistency, availability and comparability of data.
- **Implement the indicator framework through a modular, multi-level approach**, allowing different levels of complexity while ensuring both comparability across municipalities and adaptability to local contexts.
- **Strengthen the technical and institutional capacity of municipalities**, through targeted training, methodological support and the creation of dedicated support structures.
- **Promote intermunicipal and regional cooperation**, enabling knowledge sharing and helping overcome scale and resource constraints, particularly in smaller municipalities.
- **Integrate circularity indicators into planning, monitoring and public decision-making processes**, ensuring their effective use in the design, implementation and evaluation of policies.
- **Engage citizens and economic actors within a multi-level governance framework**, fostering participation, behavioural change and coordination across different levels of decision-making.

Target Audience

National policymakers (Environment, Territorial Cohesion and Economy), Directorate-General for Territory (Direção-Geral do Território), Portuguese Environment Agency (Agência Portuguesa do Ambiente – APA), Municipalities, Intermunicipal communities Urban service providers and management entities



Introduction and Problem Statement

Urban areas play a central role in the transition to a circular economy, concentrating the majority of natural resource consumption, waste generation and emissions associated with human activities. Cities are estimated to account for around 75% of global resource consumption and a significant share of greenhouse gas emissions, positioning them simultaneously as major sources of environmental pressure and as key territories for the implementation of innovative solutions (OECD, 2020; European Commission, 2020).

In this context, the circular economy has been increasingly integrated into European and national policy agendas, particularly through the European Green Deal and the Portuguese Circular Economy Action Plan, both of which explicitly recognise the strategic role of cities in operationalising this paradigm.

Despite this favourable policy framework, the transition towards urban circularity remains constrained by significant structural barriers. One of the main challenges identified in the literature is the absence of monitoring systems tailored to the urban scale. Most existing frameworks have been designed for national or supranational levels, prioritising statistical comparability but showing clear limitations when applied to municipal contexts characterised by high territorial, institutional and socio-economic diversity (Kopp et al., 2024; Vanhuysse, 2024).

This mismatch reduces the effectiveness of indicators as operational tools for local decision-making. Furthermore, existing systems tend to focus primarily on environmental aspects, particularly material flows, recycling rates and waste management. While essential, this focus limits the understanding of circularity to a biophysical perspective, overlooking equally important dimensions such as the economic dimension (innovation, employment, business models), the social dimension (equity, behaviour, well-being), and the operational dimension (governance, administrative capacity, policy coordination) (OECD, 2020; Circle Economy Foundation, 2024; Kirchherr et al., 2023; Saidani et al., 2019).

Another critical constraint relates to the availability and quality of data at the municipal level. Many relevant indicators rely on information that is not systematically collected locally, is not territorially disaggregated, or depends on qualitative data regarding practices, behaviours, barriers and institutional capacities. This limitation often leads to the use of proxies or estimations, compromising the accuracy of results and hindering comparability across territories (Moraga et al., 2019; Saidani et al., 2019; ESPON, 2024).

In the Portuguese context, these challenges are particularly pronounced due to the high territorial and institutional diversity of municipalities. Differences in size, administrative capacity, technical resources and economic structure translate into varying levels of readiness for implementing circular economy strategies. Recent empirical evidence shows that urban circularity does not follow a uniform pattern, but is strongly shaped by territorial and institutional conditions (Liepa & Atstaja, 2025; Arnold et al., 2026).

At the same time, the literature highlights the importance of multi-level governance and stakeholder participation in advancing the circular economy. Urban circularity depends on coordination between different levels of government and on collaboration among public authorities, businesses and civil society actors, making purely top-down approaches insufficient (OECD, 2020; European Commission, 2022; Kujala et al., 2023; Rodriguez & Komendantova, 2022).

In summary, there is a significant gap between the policy ambition surrounding the circular economy and the actual capacity to monitor and implement it at the local level. Without appropriate tools, urban circularity risks remaining a strategic objective with limited impact on planning, monitoring and territorial management practices. This gap underscores the need for approaches that combine conceptual robustness with practical feasibility, tailored to municipal realities and capable of supporting evidence-based decision-making.

Key findings

The research identified four key findings:

1. Existing indicator systems provide a fragmented view of urban circularity

Current frameworks tend to offer partial and sectoral perspectives, focusing predominantly on waste management while neglecting other critical dimensions such as economic value creation, social inclusion and governance. This narrow approach limits the understanding of circularity as a systemic and multi-dimensional phenomenon.

2. Limited municipal data and integration capacity represent a critical barrier

Many relevant indicators depend on data that are not collected at the local level, are fragmented across institutions, or are not regularly updated. The challenge is not only the availability of data, but also the capacity of municipalities to collect, integrate and transform data into actionable knowledge. As a result, municipalities often rely on proxies, estimates or complementary data collection methods, which may affect accuracy and comparability.

3. Urban circularity is territorially uneven

The empirical analysis reveals distinct municipal profiles, including:

- municipalities with more consolidated circularity performance,
- municipalities under pressure, particularly due to high levels of waste generation,
- and municipalities in transition, with lower institutional capacity.

These differences highlight the need for a modular indicator framework, combining core indicators for comparability with adaptable indicators tailored to local specificities.

4. Institutional capacity is a key determinant of circularity implementation

Differences across municipalities are not only technical or economic, but fundamentally institutional. The availability of resources, technical skills and organisational structures plays a decisive role in transforming indicators into effective policies and concrete actions. Institutional capacity therefore emerges as a central factor linking measurement, governance and implementation.

Resposta do projeto: Um painel de indicadores de circularidade urbana modular e adaptável

In response to the limitations identified in existing monitoring systems, the project developed an urban circularity indicator framework tailored to the Portuguese context, conceived as an operational tool to support municipal decision-making. This framework represents the main output of the project.

The proposal is based on an innovative approach that combines conceptual robustness with practical feasibility, addressing a key challenge identified in the literature: how to balance comparability across territories with adaptation to local specificities.

The framework is structured around four key dimensions—environmental, economic, social and institutional—reflecting the systemic nature of the circular economy and overcoming the predominantly environmental focus of existing systems. This approach enables the integration, within a coherent structure, of

dimensions such as resource management, economic innovation, social well-being and governance capacity.

The main innovation of the framework lies in its modular and hierarchical structure, organised into three levels of application (see Figure 1):

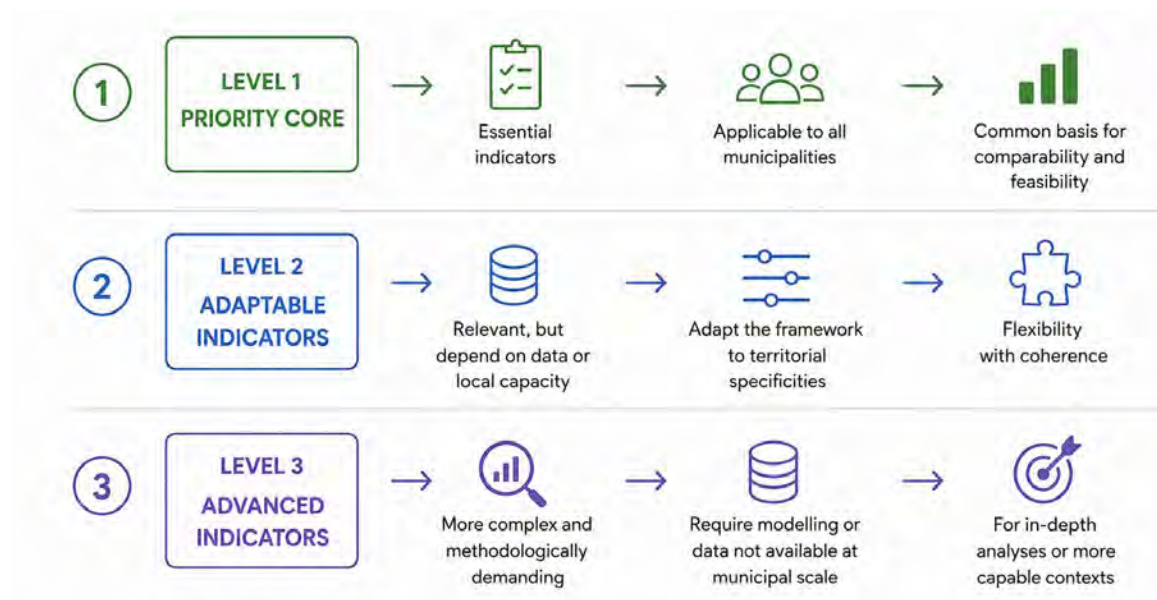
Level 1 – Core indicators: a reduced set of essential indicators, selected based on their relevance, data availability and cross-municipal applicability. This level ensures a minimum common reference framework, enabling comparability and operational feasibility.

Level 2 – Adaptable indicators: relevant indicators whose application depends on data availability and local technical capacity. These indicators allow the framework to be adjusted to territorial specificities, promoting flexibility without compromising overall coherence.

Level 3 – Advanced indicators: more complex indicators, often based on methodologies such as material flow analysis or environmental footprinting, whose application requires modelling or data not available at the municipal

level. These indicators are particularly useful for in-depth analysis or in more advanced institutional contexts.

Figure 1 – Modular and hierarchical structure of the indicator framework



Source: authors' elaboration based on project findings.

The core set of indicators is illustrated in Figure 2, highlighting the essential variables that ensure comparability and operational applicability across municipalities.

This architecture allows the framework to overcome the common trade-off between simplified systems that provide limited insights and complex systems that are difficult to operationalise in practice. At the same time, it strengthens municipalities' ability to adopt a progressive, step-by-step approach to monitoring circularity.

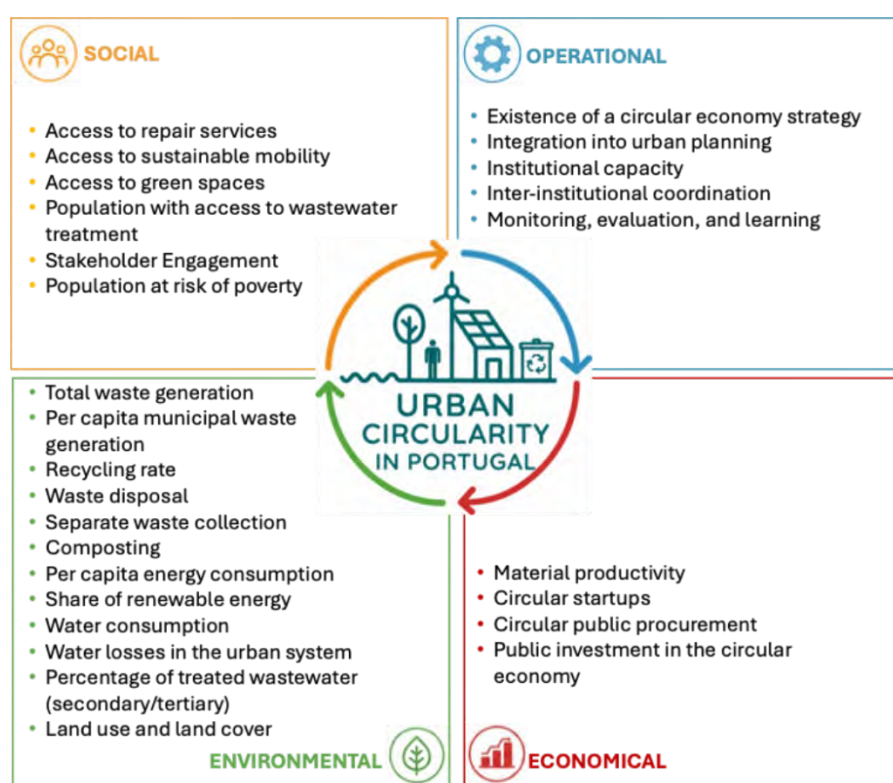
The framework also integrates both quantitative and qualitative indicators, including dimensions that are often overlooked, such as governance, citizen participation and social behaviour. This

reflects the understanding that the transition to a circular economy depends not only on material flows, but also on institutional and socio-cultural factors.

In addition, the framework was developed and validated through a participatory process involving municipal technical staff and local stakeholders, enhancing its relevance, ownership and practical applicability.

In this sense, the framework goes beyond a mere measurement tool, functioning instead as a strategic instrument to support planning, priority-setting and policy evaluation in the field of urban circularity.

Figure 2 – Core indicators of the modular framework



Source: authors' elaboration based on project findings.

Policy Options and Recommendations

The implementation of effective urban circularity monitoring systems requires an integrated approach, combining action across four key areas:

1. Strengthen data and monitoring systems

Develop a national urban circularity data platform, integrating information across multiple sources and governance levels;

Establish methodologies for the territorial disaggregation of national indicators, ensuring relevance at the municipal scale;

Integrate administrative, statistical and digital data sources already available (e.g. smart city systems);

Define common methodologies for the use of proxies and estimations, ensuring transparency, consistency and comparability.

2. Build municipal capacity

Invest in technical training on circular economy and data analysis;

Create technical support structures at regional and national levels;

Promote intermunicipal learning networks to share knowledge and best practices;

Support the allocation of specialised human resources dedicated to monitoring and implementing circular economy policies.

3. Adapt indicators to local realities

Define a core set of indicators, applicable to all municipalities and comparable at the national level;

Enable a modular structure, with adaptable indicators aligned with local capacities, priorities and territorial profiles;

Avoid overly complex systems that are difficult to operationalise in practice.

4. Promote social engagement and behavioural change

Develop awareness and circular literacy campaigns, in collaboration with local actors;

Establish citizen participation mechanisms to identify practices, barriers and opportunities for circularity;

Encourage circular behaviours (e.g. Pay-As-You-Throw schemes, reuse, sharing and repair practices);

Engage businesses and local stakeholders in collaborative networks.

5. Integrate circularity into territorial governance

Incorporate indicators into municipal planning, monitoring and evaluation processes;

Strengthen coordination between municipal departments, public service providers and governance levels;

Align public policies with clear circularity objectives and targets.

Conclusion

The transition to a circular economy in Portuguese cities depends, to a large extent, on the ability to measure and monitor progress in a consistent, comparable and territorially adapted way. At present, this capacity remains limited, constituting a key barrier to effective public policymaking.

The proposed indicator framework offers an innovative solution, based on modularity, stakeholder participation and territorial adaptation. However, its successful implementation requires a clear and sustained investment in data systems, as well as in institutional and technical capacities, alongside the active engagement of local stakeholders.

Without these enabling conditions, urban circularity risks remaining a strategic ambition rather than an operational reality.

In this context, the indicator framework developed represents a practical tool to support municipalities in advancing the circular transition, provided it is accompanied by public policies aimed at improving data availability and quality, strengthening institutional capacity, and fostering coordination across governance levels, including municipalities, regional bodies and central government.

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