

Sustainable Urban Policies Through Zero Waste and Circular Economy Strategies: An Integrated Framework from International Climate Commitments to Local Action

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ABSTRACT: The governance of the urban climate transition increasingly demands integrated policy architectures capable of connecting binding international climate commitments with the concrete operational capacities of municipal authorities. This article advances the argument that zero waste and circular economy strategies, when embedded within coherent sustainable urban policies, constitute one of the most tractable and scalable instruments available to cities for reducing greenhouse gas emissions, improving resource productivity, and strengthening systemic resilience. Adopting a qualitative integrative review of a defined and verified reference corpus, supplemented by foundational scholarship in circular economy theory and urban climate governance, the study synthesizes governance theory, international frameworks, and documented municipal practice into a single analytical framework. The analysis demonstrates that municipalities are uniquely positioned to translate the obligations arising from the Paris Agreement and the Sustainable Development Goals into measurable reductions in emissions and material intensity, provided that multi-level governance, innovative financing, and robust data infrastructures are established in concert. The study further establishes that the persistence of structural barriers, notably financing deficits, governance fragmentation, and inadequate measurement systems, continues to constrain implementation, and that the contextual asymmetries between developed and developing economies require differentiated rather than uniform policy prescriptions. By integrating policy instruments, comparative regional evidence, case-based insights, and staged implementation roadmaps, the article offers a comprehensive and practically oriented framework intended to inform both scholarship and municipal decision-making.

KEYWORDS: zero waste; circular economy; urban climate governance; sustainable urban policy; waste management; multi-level governance; just transition.

1. INTRODUCTION

Urban areas occupy a singular position in the contemporary climate predicament. They are simultaneously the principal sites of resource consumption and emission generation and the arenas in which the most consequential mitigation and adaptation measures must ultimately be enacted. This duality establishes the analytical premise of the present study: that the credibility of global climate ambition rests, to a considerable degree, on the institutional and operational capacity of cities to convert abstract commitments into durable programs of action. Within this context, the management of materials and waste, long regarded as a peripheral municipal service, has acquired a strategic significance, for the manner in which a city handles its material flows is inseparable from its emissions trajectory, its resource security, and its long-term resilience.

Zero waste and circular economy strategies have emerged as the conceptual and practical vehicles through which this transformation may be pursued. The circular economy, understood as a regenerative system that retains the value of products, components, and materials within the economy for as long as possible, provides the overarching paradigm (Geissdoerfer et al., 2017; Kirchherr et al., 2017). Zero waste, in turn, furnishes the operational discipline through which circular principles are translated into the daily routines of collection, sorting, reuse, and recovery that constitute the material metabolism of the city (Zaman & Lehmann, 2013). When these orientations are integrated into sustainable urban policy, they offer cities tangible means to lower emissions, improve resource efficiency, and strengthen resilience against climate-related and economic shocks.

A rigorous synthesis of governance theory, international frameworks, and documented local practice reveals how cities can translate global commitments into actionable and scalable programs. The scholarship is consistent in its emphasis that effective urban climate governance is constituted not by a single instrument but by the alignment of multi-level coordination, transparency, financing, and adaptive learning (Bulkeley, 2010; Ali, 2024; Awino & Apitz, 2023; Georgiev et al., 2023). It is the contention of this article that

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the integration of zero waste and circular economy strategies within such governance arrangements represents a coherent and evidence-based pathway through which municipalities can contribute meaningfully to climate objectives.

Accordingly, this article examines the conceptual and practical connections among zero waste, the circular economy, and sustainable urban policy, and proposes an integrated framework that extends from international climate agreements through to local green procurement and waste management. Throughout, each substantive claim is substantiated by current literature drawn from a defined reference corpus, and areas of scholarly consensus are distinguished explicitly from points of tension. The overlapping intersection of these three domains, and the central place of urban climate governance within it, is summarized in Figure 1.



Figure 1. Intersection of zero waste, circular economy, and sustainable urban policy, with the central role of urban climate governance.

The remainder of the article is organized as follows. It first establishes its aim, scope, and methodological foundations, before developing an extended theoretical treatment of the circular economy and urban metabolism. It then examines the international frameworks that condition municipal action, the roles and responsibilities of local government, and the specific strategies and instruments associated with zero waste and the circular economy at the city scale. A comparative regional analysis and a set of case-based insights follow, after which the article addresses barriers, articulates staged policy pathways, and offers an extended discussion and a research agenda before concluding.

2. AIM, SCOPE, AND SIGNIFICANCE

2.1. Aim and Objectives

The principal aim of this study is to establish, within a single integrated framework, the manner in which zero waste and circular economy strategies contribute to climate mitigation and adaptation objectives through the medium of sustainable urban policy. The framework is intended to be at once theoretically grounded and practically oriented, such that it serves both as a contribution to scholarship and as a reference for municipal practitioners. In pursuit of this aim, the study addresses the following objectives:

- To define and delimit the concepts of urban climate governance, zero waste, and the circular economy, and to specify their points of intersection with the wider field of urban policy.
- To examine the implications of the principal international frameworks, namely the Paris Agreement, Nationally Determined Contributions, and the Sustainable Development Goals, for the scope and direction of municipal action.
- To assess the roles of local governments, the policy instruments at their disposal, the infrastructure they require, and the modalities of stakeholder engagement upon which implementation depends.
- To analyze the technical, financial, political, and institutional barriers to implementation, together with the mitigation strategies documented in the literature, and to propose staged short, medium, and long-term implementation roadmaps.
- To compare developed and developing country contexts in order to identify both transferable lessons and the limits of policy transfer.

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2.2. Research Questions

The objectives above are operationalized through three guiding research questions. First, how do international climate commitments cascade through multi-level governance arrangements to shape the policy space available to municipal authorities? Second, which combinations of policy instruments, financing mechanisms, and governance structures are most consistently associated in the literature with durable progress toward zero waste and circular outcomes? Third, to what extent are the findings of the literature contingent upon context, and what does this imply for the transfer of policy between jurisdictions of differing institutional and economic capacity?

2.3. Significance and Contribution

The contribution of the study is threefold. Conceptually, it integrates three literatures that are frequently treated in isolation, namely urban climate governance, the circular economy, and waste management policy, into a unified framework centered on the city. Empirically, it synthesizes evidence drawn from a geographically diverse corpus encompassing both developed and developing economies, thereby counterbalancing the tendency of the field to generalize from a narrow set of high-capacity cities. Practically, it converts this synthesis into staged roadmaps and instrument typologies that municipal authorities may adapt to their own circumstances. The scope of the study is deliberately confined to the urban scale and to the policy and governance dimensions of the transition; detailed engineering and life-cycle assessment methodologies, while acknowledged, lie beyond its remit.

The conceptual positioning of the study in relation to these three established fields of scholarship, and the integrative contribution that it seeks to make, is depicted in Figure 2.

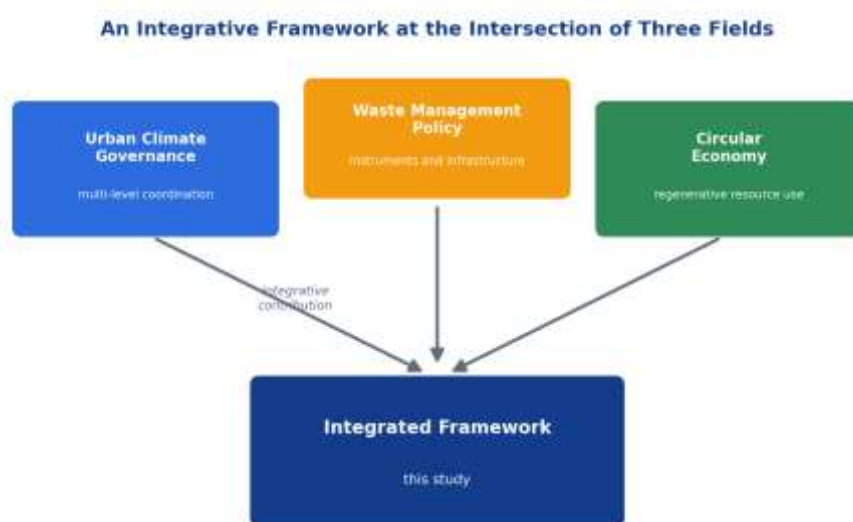


Figure 2. Conceptual map situating the study at the intersection of urban climate governance, the circular economy, and waste management scholarship, with the integrative contribution of the framework.

3. MATERIALS AND METHODS

3.1. Research Design

The study employs a qualitative integrative review design. The integrative review is the appropriate methodological instrument where the objective is to synthesize theoretical and empirical sources originating from diverse methods, disciplines, and geographic contexts into a coherent conceptual framework, rather than to estimate a pooled quantitative effect. Given that the subject of inquiry, the intersection of multi-level governance with zero waste and circular economy practice, is intrinsically interdisciplinary and resistant to reduction to a single metric, the integrative review offers both analytical breadth and the capacity to accommodate methodological heterogeneity. The review proceeded through four sequential phases: the identification and verification of sources, the thematic coding of their content, the systematic matching of analytical claims with supporting evidence, and the synthesis of findings into the framework presented herein.

3.2. Source Corpus and Selection Criteria

The analysis draws upon a predefined and verified corpus of nineteen primary sources, supplemented by a set of foundational works in circular economy theory and urban climate governance that establish the conceptual lineage of the field. Sources were assessed against three criteria: direct relevance to waste management, the circular economy, urban governance, or climate policy; representation of the contemporary literature, with the primary corpus drawn from the period between 2018 and 2024; and the joint representation of developed and developing country contexts so as to mitigate the geographic bias that characterizes much of the

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field. The resulting corpus comprises peer-reviewed journal articles, critical reviews, comparative policy analyses, and institutional reports issued by international organizations. The composition of the primary corpus by source type is presented in Table 1.

Table 1. Summary of the primary source corpus used in the integrative review.

Source type	Count	Example sources and geographic coverage
Peer-reviewed journal article	9	Awino & Apitz (2023, international); Georgiev et al. (2023); Magrini et al. (2020, six EU countries); Marks et al. (2023, Thailand); Mmereki (2018, Botswana); Ortiz et al. (2020, Pacific Alliance); Leclerc & Badami (2023, Canada); Agiamoh (2020, Russia); Clube & Hazemba (2024, Zambia)
Critical review and commentary	2	Jones & Comfort (2018, circular cities); Circular Approaches: The Future of Public Procurement (2024)
Comparative policy analysis and case study	3	Ali (2024, Switzerland and Canada e-waste); Re (2024, Toronto and Vancouver); Vrieze et al. (2022, Amsterdam Metropolitan Region)
International organization report	5	OECD (Hungary, 2023; Czech Republic, 2021; cost of ocean plastic, Soos et al., 2022); UN (Building Material and the Climate, 2023); World Bank (China, 2019)

Source: Compiled by the author from the reference corpus. Foundational conceptual works are cited additionally throughout the text.

3.3. Analytical Approach

The sources were first subjected to thematic coding under six analytical headings: theoretical concepts, international frameworks, local government roles, policy instruments, barriers and risks, and implementation pathways. Within each theme, findings supported by multiple independent sources were distinguished from those resting upon a single study, and points of divergence among sources were recorded with equal care. The analysis adheres throughout to the principle of evidential correspondence: every substantive claim is associated, using the author-year convention, with the source or sources that warrant it, and, wherever the literature permits, claims are corroborated across more than one study. Contextual qualifications, in particular the distinction between developed and developing country settings and between governance scales, are made explicit rather than suppressed, in recognition of the fact that the external validity of any given finding is conditioned by the institutional environment in which it was generated.

3.4. Conceptual Lens

The synthesis is conducted through a conceptual lens that combines the multi-level governance perspective on urban climate action (Bulkeley, 2010) with the systems-oriented understanding of the circular economy articulated in the foundational literature (Ghisellini et al., 2016; Geissdoerfer et al., 2017). This lens directs analytical attention simultaneously to the vertical relationships among governance scales and to the horizontal integration of material flows across urban sectors. It thereby allows the study to interpret municipal waste and resource policy not as a discrete technical domain but as a constitutive element of a broader sociotechnical transition.

3.5. Limitations

Several limitations qualify the findings. As a qualitative synthesis bounded by a defined corpus, the study does not constitute a systematic quantitative meta-analysis, and its conclusions should be understood as analytically rather than statistically generalizable. The corpus, although geographically diverse, cannot claim exhaustive representation of all urban contexts, and the transfer of its conclusions to settings markedly different from those it documents requires deliberate contextual judgment. Finally, the rapidly evolving character of the field means that the most recent policy experiments may not yet be reflected in the peer-reviewed record upon which the study principally relies.

4. THEORETICAL AND CONCEPTUAL FOUNDATIONS

4.1. Definitions and Concepts

In the urban context, climate governance denotes the multi-scalar arrangements, spanning the global, national, regional, and local levels, through which climate objectives are aligned with governance instruments, incentives, and institutions in order to manage emissions and resource flows. The literature consistently identifies multi-level coordination, transparency, and adaptive governance as the constitutive features of effective climate governance at the city scale (Bulkeley, 2010; Ali, 2024; Awino & Apitz, 2023; Georgiev et al., 2023; Towards a National Strategic Framework for the Circular Economy in the Czech Republic, 2021).

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Zero waste is a policy and practice orientation directed at minimizing waste generation and at retaining materials within productive circulation through reduction, reuse, recycling, and recovery, frequently complemented by redesign and waste-prevention incentives. It is most usefully understood as the operational instantiation of circular principles at the municipal scale, and as a lever for the deliberate redesign of urban metabolism (Awino & Apitz, 2023; Zaman & Lehmann, 2013; Circular Approaches: The Future of Public Procurement, 2024; Mmereki, 2018).

The circular economy envisions a regenerative system in which products, materials, and resources are retained within the economy for as long as possible, waste generation is designed out, and resources are continually cycled (Ellen MacArthur Foundation, 2013; Geissdoerfer et al., 2017). It underpins municipal strategy by linking design, procurement, and waste management to the broader objectives of urban planning and industrial ecology (Awino & Apitz, 2023; Jones & Comfort, 2018; Marks et al., 2023; Ortiz et al., 2020). The definitions of the core concepts and their respective connections to urban policy are compared in Table 2.

Table 2. Definitions of core concepts and their connections to urban policy.

Concept	Concise definition	Connection to urban policy
Climate governance	Multi-level arrangements aligning climate goals with institutions, incentives, and instruments	Multi-level coordination, transparency, adaptability
Zero waste	Minimizing waste through reduction, reuse, recycling, and recovery	Redesign of urban metabolism, waste infrastructure
Circular economy	A regenerative system keeping resources in use for as long as possible	Integration with design, procurement, and industrial ecology
Sustainable urban policy	Policy aligning land use, mobility, and housing with resource efficiency	Material loops and city-scale market transformation

Source: Prepared by the author based on Awino & Apitz (2023), Jones & Comfort (2018), Geissdoerfer et al. (2017), and Bulkeley (2010).

4.2. The Conceptual Evolution of the Circular Economy

The circular economy is not a novel invention but the contemporary synthesis of several older intellectual traditions, including industrial ecology, cradle-to-cradle design, and ecological economics. The foundational review literature locates the origins of the concept in these traditions and traces its consolidation into a coherent paradigm during the past two decades (Ghisellini et al., 2016). A defining characteristic of the field, however, is definitional plurality. A systematic analysis of one hundred and fourteen distinct definitions found that the term is frequently and erroneously equated with recycling alone, and that its linkage to the wider goals of sustainable development, and to social equity in particular, remains comparatively weak (Kirchherr et al., 2017). This conceptual ambiguity is of more than academic interest, for it conditions the design of policy: where the circular economy is understood narrowly as recycling, municipal effort tends to concentrate on downstream treatment, whereas a systemic understanding directs attention upstream toward design, procurement, and the prevention of waste.

The relationship between the circular economy and sustainability is itself contested. The seminal conceptual literature distinguishes the two notions, observing that circularity is best regarded as a condition that may serve sustainability rather than as its equivalent, and cautioning against the uncritical assumption that circular interventions are invariably sustainable (Geissdoerfer et al., 2017). For municipal policy, the implication is that circular strategies must be appraised against their actual environmental and social outcomes rather than presumed to be beneficial by definition. This caution is reinforced by the recognition, prominent in the waste hierarchy, that recycling occupies an intermediate rather than a privileged position, and that prevention and reuse are systematically preferable (Zaman & Lehmann, 2013).

4.3. Urban Metabolism and the City as a System

A productive theoretical foundation for the integration of zero waste and the circular economy into urban policy is the concept of urban metabolism, which conceives of the city as a system that ingests materials, water, and energy and excretes wastes and emissions. Under the prevailing linear configuration, this metabolism is characterized by a unidirectional flow from extraction through production and consumption to disposal. The circular reconfiguration of urban metabolism seeks to close these flows, so that the outputs of one process become the inputs of another and the demand for virgin materials is correspondingly reduced. The contrast between the linear and circular configurations of urban resource flows is depicted in Figure 3, which situates the design, production, use, collection, and recovery stages within a closed loop of minimized virgin input.

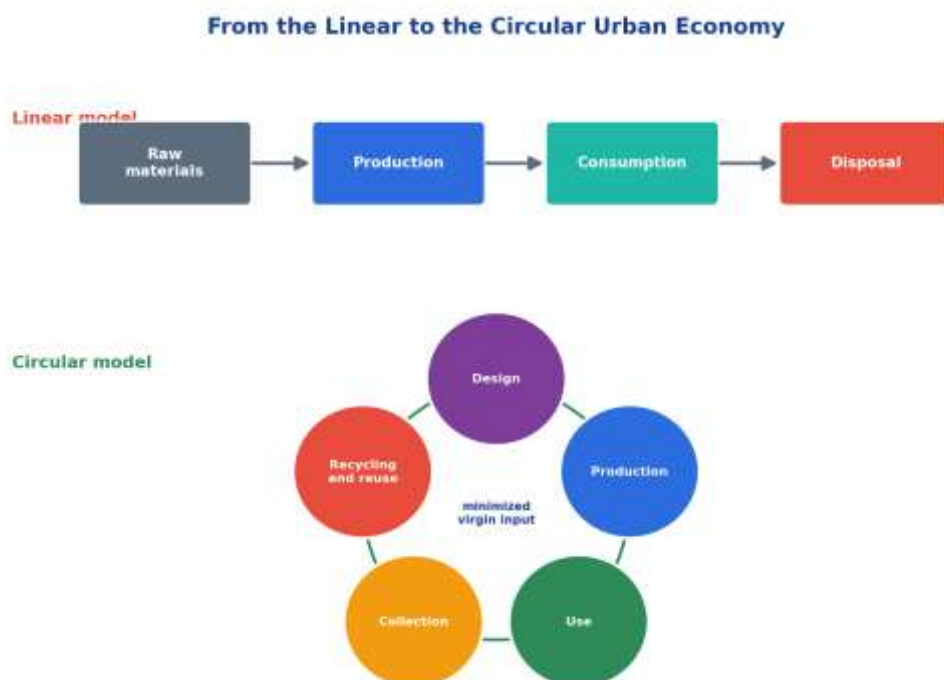


Figure 3. From the linear to the circular urban economy: the reconfiguration of urban resource flows from a unidirectional model into a closed loop.

The metabolic perspective carries direct implications for governance. Because material flows traverse the conventional boundaries of municipal departments and administrative jurisdictions, their circular management requires horizontal coordination across planning, environment, finance, and transport, as well as vertical coordination with regional and national authorities. It is for this reason that the literature treats institutional integration, rather than any single technology, as the decisive determinant of success (Awino & Apitz, 2023; Vrieze et al., 2022).

A schematic representation of urban metabolism, identifying the principal material, energy, and water inputs and the waste and emission outputs of the urban system together with the points at which circular interventions may be introduced, is provided in Figure 4.

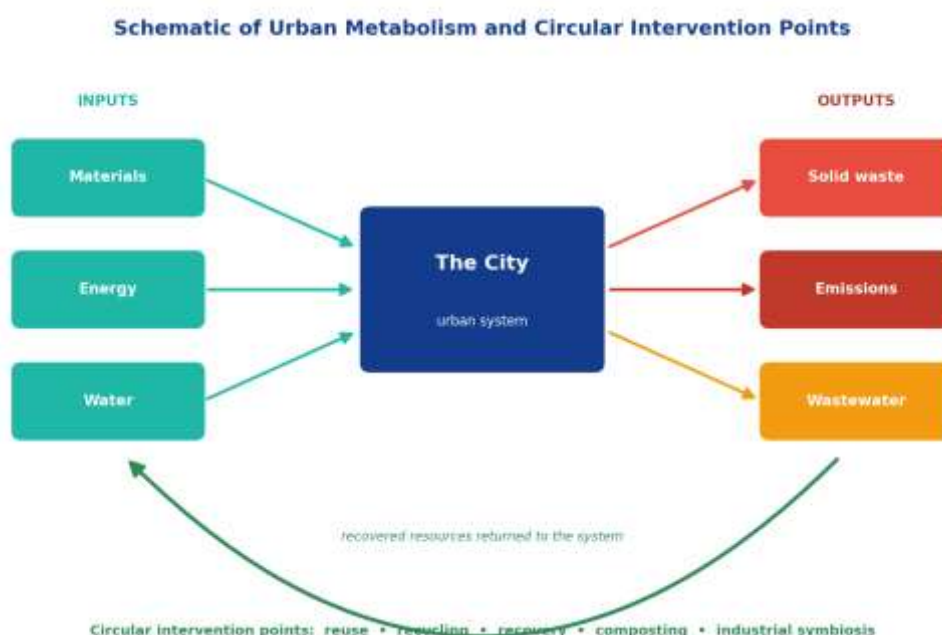


Figure 4. Schematic of urban metabolism, showing the inputs and outputs of the urban system and the principal circular intervention points.

4.4. Intersections of Zero Waste, Circular Economy, and Urban Policy

With respect to policy convergence, cities pursuing zero waste and the circular economy characteristically fuse the waste hierarchy with the objectives of urban planning, drawing upon design-for-circularity principles in building codes, public procurement, and local industrial ecosystems. This convergence is evident in governance frameworks that connect material flows to urban infrastructure planning and to the development of markets for secondary materials (Awino & Apitz, 2023; Jones & Comfort, 2018). With respect to economic instruments and governance, a recurrent theme in the literature is the deployment of market-based instruments, including pay-as-you-throw fees, extended producer responsibility, deposit-refund schemes, and public procurement criteria, to steer behavior and to finance circular infrastructure. Evidence drawn from European and international contexts indicates that the design of such instruments must be sensitive to context if it is to achieve meaningful reductions in waste generation and to sustain the financing of circular infrastructure (Circular Approaches: The Future of Public Procurement, 2024; Magrini et al., 2020; Ortiz et al., 2020; Soos et al., 2022).

With respect to data and transparency, reliable information on material flows, recycling rates, and product life cycles, together with clear and standardized indicators, is critical for tracking progress, communicating outcomes, and enabling adaptive governance. The development of performance measurement tools specific to the zero waste city, which estimate the degree to which recovered resources substitute for virgin materials, represents an important advance in this regard (Zaman & Lehmann, 2013). The emphasis on data stewardship recurs across the circular economy and zero waste literature in urban settings (Awino & Apitz, 2023; Building Material and the Climate, 2023; Jones & Comfort, 2018).

5. INTERNATIONAL CLIMATE AGREEMENTS AND THEIR IMPLICATIONS FOR MUNICIPAL ACTION

The translation of global commitments into local action proceeds through a process of cascading alignment across governance scales. This multi-level logic, which flows downward from global agreements to municipal implementation and feeds back upward through monitoring and data, is illustrated in Figure 5 and provides the structural context for the discussion that follows.

Multi-Level Climate Governance: From Global Commitments to Local Action



Figure 5. Multi-level climate governance: alignment and feedback flows from global commitments to local action.

5.1. The Paris Agreement and Nationally Determined Contributions

The Paris Agreement establishes a framework of Nationally Determined Contributions that increasingly presupposes subnational and municipal alignment for its realization (United Nations Framework Convention on Climate Change, 2015). Local governments are central to the delivery of the mitigation and adaptation actions associated with these contributions, including the circular economy strategies that reduce material throughput and the emissions embodied within it (Agiamoh, 2020; Georgiev et al., 2023; Marks et al., 2023; Towards a National Circular Economy Strategy for Hungary, 2023).

Nationally Determined Contributions thereby open policy windows through which cities may mainstream circularity into climate action plans, infrastructure investment, and the urban services that lower energy demand, improve waste management, and advance low-carbon material cycles. The national circular economy strategies developed within several jurisdictions illustrate the manner in which subnational implementation may be anchored within a coherent national framework (Agiamoh, 2020; Towards a National Circular Economy Strategy for Hungary, 2023; Towards a National Strategic Framework for the Circular Economy in the Czech Republic, 2021).

5.2. The Sustainable Development Goals and Urban Targets

The Sustainable Development Goals provide a global reference frame for urban sustainability, articulating explicit targets concerning sustainable cities, responsible consumption and production, and climate action (United Nations, 2015). Cities that implement zero waste and circular economy strategies are able to advance several of these goals concurrently, most directly Goal 11 on sustainable cities and communities, Goal 12 on responsible consumption and production, and Goal 13 on climate action (Ali, 2024; Awino & Apitz, 2023; Georgiev et al., 2023). The contribution of zero waste and circular strategies to these three goals is represented schematically in Figure 6.



Figure 6. Contribution of zero waste and the circular economy to Sustainable Development Goals 11, 12, and 13.

5.3. Mechanisms for Local Implementation and Funding

The financial mechanisms available for municipal action include national grants, dedicated funds for circular infrastructure, and public-private partnerships. The international literature is emphatic that financing deficits constitute a persistent and frequently decisive barrier to local circular economy and zero waste programs, and that their resolution requires innovative financing, blended finance, and explicit budgetary allocations for waste-to-resource initiatives (Awino & Apitz, 2023; Clube & Hazemba, 2024; Towards a National Strategic Framework for the Circular Economy in the Czech Republic, 2021; Urban and Rural Municipal Solid Waste in China and the Circular Economy, 2019).

Beyond domestic resources, international networks and city-led platforms provide technical assistance, knowledge exchange, and potential co-funding that can catalyze local implementation, particularly where municipal capacity is constrained (Circular Approaches: The Future of Public Procurement, 2024; Re, 2024; Vrieze et al., 2022).

6. LOCAL GOVERNMENT ROLES AND RESPONSIBILITIES

6.1. Policy Design and Governance Structures

Cities function as governance laboratories in which zero waste and circular economy policies are piloted, scaled, and institutionalized. Effective governance presupposes cross-departmental coordination across planning, environment, finance, and transport, together with inclusive stakeholder engagement sufficient to confer legitimacy upon policy and to ensure that legitimacy is converted into sustained action (Agiamoh, 2020; Ali, 2024; Awino & Apitz, 2023; Bulkeley, 2010).

Considerations of multi-level governance further require that municipal policies be aligned with national regulatory frameworks, such as those governing extended producer responsibility and waste management, while preserving the latitude for flexible local experimentation and rapid adaptation. The tension between alignment and autonomy is a recurring theme, and its resolution is a central task of institutional design (Leclerc & Badami, 2023; Soos et al., 2022; Towards a National Strategic Framework for the Circular Economy in the Czech Republic, 2021).

6.2. Infrastructure, Resource Flows, and Waste Management

The urban infrastructure required for zero waste and circularity comprises systems for collection, sorting, and recycling, together with composting, anaerobic digestion, and material recovery facilities. The literature observes that the effectiveness of such infrastructure is determined by its scale, by the precision of the material-flow data that informs its operation, and by its integration

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with local markets for the materials it recovers (Awino & Apitz, 2023; Building Material and the Climate, 2023; Mmereki, 2018; Vrieze et al., 2022).

Local markets and procurement policies, in turn, condition the demand for secondary materials and thereby the commercial viability of circular supply chains. Procurement criteria established by municipal authorities can stimulate demand for recycled content and for repair and reuse services, reinforcing the circular loops upon which the wider strategy depends (Building Material and the Climate, 2023; Circular Approaches: The Future of Public Procurement, 2024; Jones & Comfort, 2018).

6.3. Stakeholder Engagement and Behavioral Change

Behavioral change constitutes a central mechanism for the reduction of waste and the advancement of circularity. Cities deploy information-based instruments, educational campaigns, and conveniently designed collection systems in order to reshape consumption patterns and to elevate participation in source separation. The informal sector and local entrepreneurs frequently perform a significant share of recycling and material recovery, particularly in developing economies, and the literature indicates that policy incentives are required to formalize their participation and to improve both their working conditions and the outcomes they produce (Awino & Apitz, 2023; Clube & Hazemba, 2024; Mmereki, 2018; Re, 2024).

7. ZERO WASTE STRATEGIES IN URBAN CONTEXTS

Zero waste strategies are organized around the waste hierarchy, which ranks the available options from the most environmentally preferable to the least. The order of priority, extending from prevention and reduction through to disposal, is depicted in Figure 7 and provides the normative structure within which specific instruments are situated.



Figure 7. The waste hierarchy: decreasing environmental priority from prevention and reduction to disposal.

7.1. Waste Reduction, Reuse, and Recycling Programs

The foundational zero waste strategy is the reduction of waste generation at source, coupled with widespread reuse and high-quality recycling. Market-based instruments, including pay-as-you-throw schemes, deposits, and recycling targets, are commonly deployed in pursuit of these ends, although the evidence indicates that their effectiveness is contingent upon context, enforcement, and complementary measures such as public education and the provision of accessible collection systems (Circular Approaches: The Future of Public Procurement, 2024; Magrini et al., 2020; Ortiz et al., 2020). The development of measurement tools such as the zero waste index has enabled cities to assess their performance against these objectives with greater rigor than the conventional reliance upon diversion rates permits (Zaman & Lehmann, 2013).

The literature further documents that city-level zero waste programs are most effective when they are linked to broader circular economy transitions, a finding that underscores the importance of integrating waste prevention with urban design and product stewardship rather than treating it as an isolated downstream activity (Awino & Apitz, 2023; Mmereki, 2018).

7.2. Industrial Symbiosis and Resource Recovery

Industrial symbiosis emerges as a key circular economy mechanism at the scale of the city-region, whereby the waste or by-products of one urban or industrial process are converted into inputs for another. The realization of such material loops presupposes formalized governance, the sharing of data among participants, and the development of local markets sufficient to absorb the materials exchanged (Awino & Apitz, 2023; Building Material and the Climate, 2023; Vrieze et al., 2022).

7.3. Policy Instruments: Bans, Fees, and Incentives

Regulatory bans upon problematic items, pay-as-you-throw pricing, extended producer responsibility, and deposit-refund schemes number among the instruments most consistently associated with improved waste prevention and elevated recycling rates. The success of these instruments is context-dependent and is frequently enhanced by accompanying measures, in particular infrastructure investment and sustained public engagement (Circular Approaches: The Future of Public Procurement, 2024; Magrini et al., 2020; Ortiz et al., 2020). The principal policy instruments, their operating logic, and their expected effects are summarized in Table 3.

Table 3. Principal policy instruments in urban zero waste and the circular economy.

Instrument	Operating logic	Expected effect and source
Pay-as-you-throw (PAYT)	Charges that vary with the quantity of waste generated	Encourages reduction at source (Magrini et al., 2020)
Extended producer responsibility	Places end-of-life responsibility on the producer	Incentivizes circularity in product design (Leclerc & Badami, 2023)
Deposit-refund scheme	Refunds a fee upon the return of packaging	Raises collection and recycling rates (Ortiz et al., 2020)
Product bans	Restrictions on problematic single-use items	Strengthens waste prevention (Ortiz et al., 2020)
Green public procurement	Recycled-content and repairability criteria	Stimulates demand for secondary materials (Circular Approaches, 2024)

Note: The effectiveness of all instruments is conditioned by context, enforcement, and the presence of complementary measures.

8. ADVANCING THE CIRCULAR ECONOMY AT THE CITY SCALE

8.1. Material Circuits and Local Market Development

At the city scale, the circular economy requires the construction of material circuits, the cultivation of local markets for secondary materials, and the support of reuse-oriented enterprises. The transformation of local markets is facilitated by procurement rules, by standardization, and by the establishment of marketplaces or material banks capable of mobilizing supply chains for recycled content (Circular Approaches: The Future of Public Procurement, 2024; Jones & Comfort, 2018). A schematic representation of the urban material loop, extending from design through to recovery, is presented in Figure 8.

Urban Material Loop in the Circular Economy



Figure 8. The urban material loop in the circular economy, including smaller loops such as repair, sharing, and remanufacturing.

8.2. Product Design, Procurement, and City-Led Market Transformation

Municipal procurement can operate as a powerful driver of the circular economy where it specifies design for circularity, durable materials, reparability, and defined end-of-life pathways. By aggregating demand around these criteria, the public sector generates market signals that incentivize producers to adopt circular design, to establish repair networks, and to implement take-back schemes (Building Material and the Climate, 2023; Jones & Comfort, 2018).

8.3. Data, Metrics, and Transparency

Transparent metrics and reliable data concerning material flows, recycling rates, and pollution risks are indispensable for monitoring progress, benchmarking performance, and communicating impact to residents and stakeholders. The literature is consistent in identifying the need for standardized indicators and consistent reporting as a precondition for adaptive governance and policy learning (Awino & Apitz, 2023; Building Material and the Climate, 2023; Jones & Comfort, 2018).

8.4. Enablers of the Circular City

The transition to a circular city is rarely the product of any single intervention. It depends, rather, upon the simultaneous mobilization of several enabling domains, each of which conditions the effectiveness of the others. Four such domains may be distinguished: governance and policy, encompassing multi-level coordination, regulatory frameworks, and procurement; finance and business models, encompassing blended finance, volume-based charging, and product-service systems; digital and data infrastructure, encompassing material-flow accounting, standardized indicators, and monitoring platforms; and the social dimension, encompassing behavioral change, the integration of the informal sector, and the principles of a just transition. The interdependence of these enablers is represented in Figure 9.

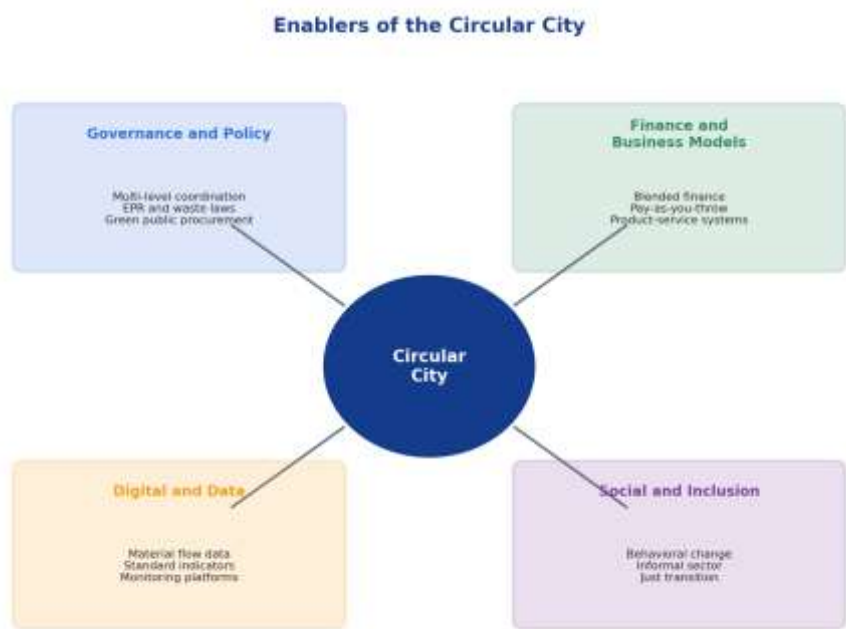


Figure 9. The four interdependent enabling domains of the circular city.

Among these domains, the financial and business-model dimension merits particular attention, for it is frequently the point at which otherwise sound strategies founder. The literature documents a range of mechanisms through which the financing gap may be addressed and through which circular activity may be rendered commercially sustainable. These mechanisms, together with their characteristic features and illustrative applications, are summarized in Table 7.

Table 7. Financing mechanisms and business models for the circular city.

Mechanism or model	Characteristic features	Illustrative application and source
Blended finance	Combines public and concessional capital with private investment to reduce risk	Recovery and processing facilities (Clube & Hazemba, 2024)
Volume-based charging	Aligns the cost borne by users with the waste they generate	Municipal collection systems (Magrini et al., 2020)

Mechanism or model	Characteristic features	Illustrative application and source
Extended producer responsibility funds	Channels producer fees toward collection and recycling systems	End-of-life electronics and packaging (Leclerc & Badami, 2023)
Product-service systems	Shifts value from ownership of goods to provision of services	Reuse and repair enterprises (Jones & Comfort, 2018)
Material banks and marketplaces	Aggregate supply and demand for secondary materials	Local secondary-material markets (Circular Approaches, 2024)

Source: Compiled by the author from the reference corpus.

8.5. Digital Infrastructure and the Smart Circular City

The capacity of a city to operate circular material loops is increasingly mediated by its digital and informational infrastructure. The management of secondary materials, the coordination of industrial symbiosis, and the verification of recycled content all presuppose the systematic collection, exchange, and analysis of data concerning material flows. The literature accordingly identifies the development of standardized indicators and consistent reporting as a precondition for adaptive governance, and the construction of performance measurement instruments specific to the zero waste city as an important methodological advance (Zaman & Lehmann, 2013; Awino & Apitz, 2023; Building Material and the Climate, 2023). Digital platforms that render material flows visible to administrators, enterprises, and citizens serve a dual function: they furnish the evidential basis for the calibration of policy, and they constitute an instrument of transparency through which public trust and participation may be cultivated.

It would be imprudent, however, to regard digitalization as a panacea. The benefits of data infrastructure accrue only where the institutional capacity exists to interpret and act upon the information generated, and the asymmetry in such capacity between high-income and lower-income jurisdictions risks reproducing, within the digital domain, the very inequalities that the circular transition aspires to redress. The deployment of digital instruments must therefore proceed in concert with investment in the human and institutional capacity required to exploit them (Jones & Comfort, 2018; Georgiev et al., 2023).

9. SUSTAINABLE URBAN POLICIES: INTEGRATION AND COHERENCE

9.1. Urban Planning, Mobility, and Land Use

Sustainable urban policies integrate zero waste and the circular economy with land-use planning, transportation systems, and housing policy. Compact and mixed-use development, multimodal transport, and shared mobility reduce energy consumption and, by concentrating activity, facilitate the efficient collection of waste and the recovery of materials within the urban system (Building Material and the Climate, 2023; Jones & Comfort, 2018).

9.2. Infrastructure Financing and Resilience

The financing of sustainable urban infrastructure for the circular economy and zero waste constitutes a recurrent challenge. The literature emphasizes blended finance, the development of municipal revenue streams, and the mobilization of private capital as means of closing the funding gaps that afflict recycling, composting, and material recovery facilities. Considerations of resilience further counsel the reduction of exposure to price volatility in secondary-material markets and the construction of durable infrastructure capable of withstanding climate stressors (Clube & Hazemba, 2024; Towards a National Strategic Framework for the Circular Economy in the Czech Republic, 2021; Urban and Rural Municipal Solid Waste in China and the Circular Economy, 2019).

9.3. Social Equity and the Just Transition

A just transition requires sustained attention to social equity, ensuring that cost-sharing mechanisms are fair in their incidence, that informal waste workers are integrated into formal systems on equitable terms, and that access to recycling and circular services is distributed equitably across neighborhoods. The literature emphasizes the imperative of addressing environmental justice within circular transitions and of designing inclusive policies that confer tangible benefit upon marginalized communities, lest the transition reproduce or intensify existing inequalities (Awino & Apitz, 2023; Clube & Hazemba, 2024; Soos et al., 2022).

9.4. Coherence across Policy Domains

A persistent obstacle to the realization of circular objectives is the incoherence that arises when the several domains of urban policy pursue divergent or contradictory aims. Waste policy that promotes recycling may be undermined by procurement practices indifferent to recycled content, and ambitious circular targets may be frustrated by land-use decisions that disperse activity and render collection inefficient. The literature accordingly emphasizes that the integration of zero waste and the circular economy is not merely a matter of adding new instruments but of securing coherence across planning, procurement, finance, transport, and environmental regulation (Awino & Apitz, 2023; Building Material and the Climate, 2023; Jones & Comfort, 2018). Such coherence is institutional in character: it requires mechanisms of coordination capable of reconciling the priorities of distinct departments and

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of aligning municipal action with regional and national frameworks. The pursuit of coherence, rather than the proliferation of instruments, may therefore constitute the more consequential task of municipal leadership.

10. COMPARATIVE AND REGIONAL PERSPECTIVES

The evidence assembled in this study spans contexts of markedly different institutional and economic capacity, and the comparison of these contexts is itself analytically instructive. A central finding is that the determinants of success differ systematically between developed and developing economies, with consequences for both diagnosis and prescription. The principal contrasts are summarized in Table 6.

Table 6. Comparative characteristics of circular economy and zero waste transitions across developed and developing country contexts.

Dimension	Developed country contexts	Developing country contexts
Dominant instruments	Extended producer responsibility, procurement, deposit systems	Informal recovery, basic collection expansion, selective bans
Principal constraint	Cost, behavioral inertia, market saturation	Financing, institutional capacity, infrastructure deficits
Role of informal sector	Limited and largely formalized	Substantial and central to recovery
Data and monitoring	Comparatively mature indicator systems	Frequently fragmented or absent
Illustrative evidence	Ali (2024); Magrini et al. (2020); Vrieze et al. (2022)	Mmereki (2018); Clube & Hazemba (2024); Marks et al. (2023)

Source: Synthesized by the author from the reference corpus; contrasts are indicative rather than absolute.

10.1. Developed Country Contexts

In developed economies, the instruments of the circular economy are comparatively mature. Extended producer responsibility, sophisticated procurement criteria, and well-established deposit-refund systems operate within institutional environments of relatively high capacity (Ali, 2024; Leclerc & Badami, 2023; Magrini et al., 2020). The salient constraints in these settings tend to be the cost of further marginal improvement, the inertia of established consumption patterns, and the saturation of existing markets for secondary materials. The experience of metropolitan regions such as Amsterdam illustrates the manner in which experimental governance and the deliberate cultivation of secondary markets can extend the frontier of circularity beyond the limits of conventional waste management (Vrieze et al., 2022).

10.2. Developing Country Contexts

In developing economies, by contrast, the decisive constraints are more frequently those of financing, institutional capacity, and basic infrastructure. The informal sector commonly performs a substantial share of material recovery, and its integration into formal systems represents both a significant opportunity and a delicate policy challenge (Mmereki, 2018; Clube & Hazemba, 2024). The political economy of circular transitions in these settings is, moreover, distinctive: the case of marine plastic management demonstrates that circular policies may reproduce existing inequalities where the distribution of costs and benefits is not deliberately addressed (Marks et al., 2023). These observations counsel against the uncritical transfer of instruments designed for high-capacity contexts.

10.3. Cross-Cutting Lessons for Policy Transfer

The comparative evidence yields a clear and consequential lesson: the transfer of circular economy and zero waste instruments between jurisdictions must be mediated by careful attention to context. The combination of extended producer responsibility, volume-based charging, and city-led procurement tends to produce durable outcomes where it is supported by adequate financing and aligned with urban planning and equity objectives (Awino & Apitz, 2023; Georgiev et al., 2023; Ortiz et al., 2020; Soos et al., 2022). Where these enabling conditions are absent, the same instruments may underperform or generate perverse effects. Effective policy transfer therefore consists not in the importation of instruments but in the adaptation of principles.

11. CASE STUDIES AND COMPARATIVE INSIGHTS

11.1. Leading Cities in Zero Waste Transitions

Case studies of cities that have adopted ambitious zero waste targets demonstrate that successful transitions rest upon integrated policy platforms, sustained political leadership, and coordinated governance across sectors. The literature identifies cities that have

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pursued near-zero waste outcomes through the combined use of bans, pay-as-you-throw schemes, and robust recycling and composting programs, while observing that the attainment of such outcomes requires substantial investment and long-term political commitment (Awino & Apitz, 2023; Circular Approaches: The Future of Public Procurement, 2024; Mmereki, 2018).

11.2. Circular Economy Pilots and Urban Policies

Circular economy pilots conducted within metropolitan regions demonstrate the value of stakeholder collaboration, urban-rural linkages, and experimental governance. Amsterdam and other European cities are frequently cited as cases in which circular economy governance combines bottom-up experimentation with top-down policy instruments in order to effect systemic change (Awino & Apitz, 2023; Marks et al., 2023; Vrieze et al., 2022). Comparable initiatives in food waste prevention illustrate the manner in which targeted municipal policy can address specific waste streams while contributing to broader circular objectives (Re, 2024).

11.3. Lessons Learned for Policy Transfer

The lessons drawn from these cases emphasize the tailoring of instruments to local conditions, the importance of constructing data systems and local markets, and the necessity of coherent policy packages that combine regulation, economic incentives, and information-based instruments. Cross-jurisdictional learning indicates that the most durable outcomes arise where such packages are aligned with the goals of urban planning and social equity rather than pursued in isolation (Awino & Apitz, 2023; Georgiev et al., 2023; Ortiz et al., 2020; Soos et al., 2022).

12. BARRIERS, RISKS, AND MITIGATION STRATEGIES

Technical, financial, political, and institutional barriers arise in combination throughout the urban circular economy and zero waste transition, and their interaction frequently compounds their individual effects. The principal barriers and the mitigation strategies proposed in the literature are compiled in Table 4.

Table 4. Principal barriers, risks, and mitigation strategies.

Barrier type	Description	Mitigation strategy and source
Technical	Difficulty of separation and value recovery from mixed streams	Sorting infrastructure and data systems (Awino & Apitz, 2023)
Financial	High upfront costs and revenue uncertainty for infrastructure	Blended finance and predictable tariffs (Clube & Hazemba, 2024)
Political and institutional	Governance fragmentation and overlapping jurisdictions	Clear roles and interagency coordination (Georgiev et al., 2023)
Monitoring and evaluation	Inconsistent indicators and data gaps	Standard indicators and feedback loops (Ali, 2024; Zaman & Lehmann, 2013)

Source: Compiled by the author from relevant studies in the reference corpus.

12.1. Technical and Financial Barriers

The technical challenges encompass the establishment of robust waste separation and sorting capabilities and the recovery of value from mixed and contaminated streams. The financial barriers encompass the high upfront costs of circular economy infrastructure and the requirement for stable revenue streams sufficient to sustain recycling and composting facilities over their operational lives. The policy responses documented in the literature include dedicated funding, blended finance, predictable tariffs, and risk-sharing instruments capable of attracting private participation (Awino & Apitz, 2023; Clube & Hazemba, 2024; Urban and Rural Municipal Solid Waste in China and the Circular Economy, 2019).

12.2. Political and Institutional Obstacles

Governance fragmentation, overlapping jurisdictions, and inconsistent enforcement can impede progress upon the circular economy and zero waste. Their resolution requires the clear allocation of roles, effective interagency coordination, performance-based mechanisms of accountability, and the stakeholder engagement necessary to sustain political will across electoral cycles (Agiamoh, 2020; Georgiev et al., 2023; Soos et al., 2022).

12.3. Monitoring, Evaluation, and Adaptive Governance

Ongoing monitoring and adaptive governance are indispensable for the refinement of policy in response to data, market developments, and technological change. The requisite practices include the establishment of feedback loops, the regular updating

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of indicators, and the deliberate design of programs that are resilient to economic and climate shocks (Ali, 2024; Awino & Apitz, 2023; Building Material and the Climate, 2023; Zaman & Lehmann, 2013).

13. POLICY PATHWAYS AND IMPLEMENTATION ROADMAPS

Implementation at the municipal scale requires a staged roadmap that commences with immediately actionable measures and extends, through successive phases, toward structural transformation. This staged architecture is summarized in Figure 10 and in Table 5, which together specify the priorities appropriate to the short, medium, and long term.

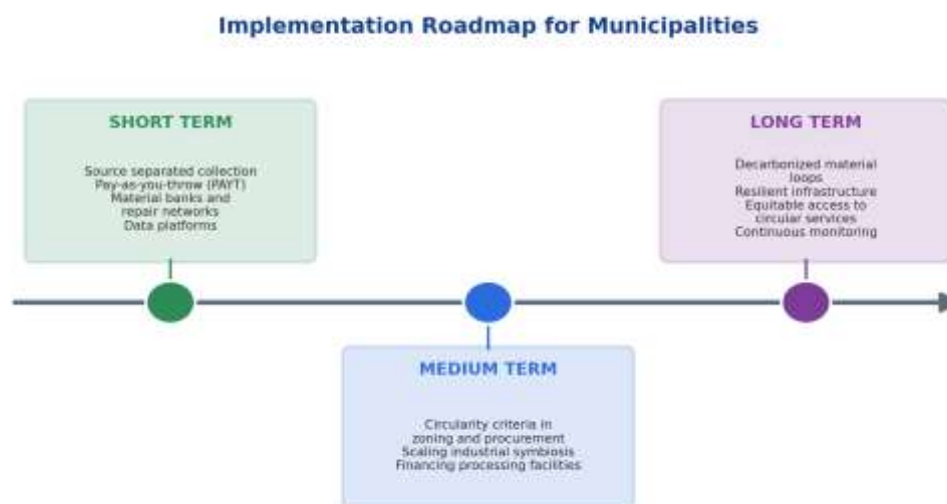


Figure 10. Short, medium, and long-term implementation roadmap for municipalities.

Table 5. Short, medium, and long-term implementation steps.

Term	Priority steps	Expected outcome
Short term	Source-separated collection, pay-as-you-throw, material banks and repair networks, data platforms	Rapid waste reduction and data infrastructure
Medium term	Circularity criteria in zoning and procurement, scaling of industrial symbiosis, financing of processing facilities	Structural circularity and market development
Long term	Decarbonized material loops, resilient infrastructure, equitable access to circular services, continuous monitoring	Durable, equitable, and resilient urban systems

Source: Prepared by the author based on Awino & Apitz (2023), Magrini et al. (2020), and OECD reports.

13.1. Short-Term Actions for Municipalities

The measures that may be undertaken immediately include the expansion of source-separated collection, the implementation of pay-as-you-throw or an equivalent scheme, the piloting of municipal programs linked to extended producer responsibility, and the establishment of material banks and repair networks. Concurrently, cities should develop the data platforms required to track material flows and the emissions reductions achieved through circular initiatives, for it is upon such data that all subsequent refinement depends (Awino & Apitz, 2023; Circular Approaches: The Future of Public Procurement, 2024; Magrini et al., 2020; Zaman & Lehmann, 2013).

13.2. Medium-Term Transformation Plans

Plans for the medium term should integrate circular economy design criteria into building codes and public procurement, scale up the opportunities for industrial symbiosis, and secure financing for dedicated waste processing facilities. The strengthening of multi-level governance and the alignment of municipal effort with national strategies and international funding streams are critical to the maintenance of momentum across this phase (Towards a National Circular Economy Strategy for Hungary, 2023; Towards a National Strategic Framework for the Circular Economy in the Czech Republic, 2021; Vrieze et al., 2022).

13.3. Long-Term Vision and Oversight

The long-term vision emphasizes the decarbonization of urban material cycles, the construction of resilient infrastructure, and the equitable distribution of access to circular services. Oversight in this phase should privilege ongoing performance evaluation, transparent reporting, and a capacity for learning-enabled policy evolution sufficient to respond to technological advance and to the evolution of markets (Ali, 2024; Awino & Apitz, 2023; Building Material and the Climate, 2023).

14. DISCUSSION

The synthesis presented in the preceding sections permits a structured discussion of the principal findings, their interpretation, and their implications. The discussion is organized around the points of consensus that the literature sustains, the tensions and contradictions that it reveals, and the theoretical and practical conclusions that follow. It is offered in the recognition that the value of an integrative review lies less in the accumulation of individual findings than in the disciplined interpretation of their collective import.

14.1. Points of Consensus

Three propositions command broad support across the corpus. The first is that multi-level governance and cross-departmental coordination constitute a precondition, rather than a mere facilitator, of successful zero waste and circular economy programs. The recurrence of this finding across contexts as diverse as the Czech Republic, Amsterdam, and Botswana suggests that it reflects a structural feature of the transition rather than an artifact of any particular setting (Bulkeley, 2010; Vrieze et al., 2022; Towards a National Strategic Framework for the Circular Economy in the Czech Republic, 2021). The second proposition is that the effectiveness of market-based instruments is profoundly conditioned by context, enforcement, and complementary measures, and that no single instrument constitutes a universal remedy (Magrini et al., 2020; Ortiz et al., 2020). The third is that data and transparency form the common foundation upon which adaptive governance and policy learning depend, a conclusion reinforced by the development of dedicated measurement tools for the zero waste city (Zaman & Lehmann, 2013; Awino & Apitz, 2023).

14.2. Tensions and Contradictions in the Literature

Alongside these consensual propositions, the corpus reveals tensions that resist easy resolution. The most fundamental concerns the relationship between circularity and sustainability. The foundational literature cautions that the two are not equivalent, and that circular interventions are not invariably sustainable in their net effect (Geissdoerfer et al., 2017). This caution sits uneasily with the tendency of policy discourse to treat circularity as a self-evident good. A related tension concerns the definitional plurality of the circular economy itself: where the concept is understood narrowly as recycling, policy gravitates toward downstream treatment, whereas a systemic understanding directs effort upstream toward prevention and design (Kirchherr et al., 2017; Ghisellini et al., 2016). The persistence of these definitional disagreements within the scholarly literature is mirrored by inconsistency in the framing of municipal policy, and the resolution of the former would materially assist the coherence of the latter.

14.3. The North-South Divide and the Limits of Generalization

A further tension, and one of considerable practical consequence, concerns the asymmetry between developed and developing country contexts. The instruments that dominate the literature, and that achieve documented success, were largely designed within and for high-capacity institutional environments. Their transfer to settings characterized by financing deficits, constrained institutional capacity, and a substantial informal sector is far from straightforward (Mmereki, 2018; Clube & Hazemba, 2024). The political economy of circular transitions in such settings is, moreover, distinctive, and the evidence indicates that inattention to the distribution of costs and benefits may cause circular policies to widen rather than to narrow existing inequalities (Marks et al., 2023). This finding constitutes a significant qualification of the optimistic generalizations that pervade much of the policy literature, and it counsels a posture of contextual humility in the formulation of recommendations.

14.4. Governance and the Limits of Instruments

The recurrent emphasis upon governance, rather than upon any particular instrument, invites theoretical reflection. The evidence is consistent with the proposition, advanced in the urban climate governance literature, that the city is best understood not as a passive recipient of national policy but as an active site of experimentation and the reconfiguration of political authority (Bulkeley, 2010). It follows that the principal constraint upon circular transitions is frequently not technical but institutional, and that investment in governance capacity may yield returns commensurate with, or exceeding, investment in physical infrastructure. This proposition has been insufficiently examined in the empirical literature, and its further investigation constitutes a priority for research.

14.5. Equity, the Informal Sector, and the Just Transition

The treatment of equity within the corpus is uneven. While the imperative of a just transition is widely acknowledged, the operational mechanisms through which equity is to be secured receive comparatively limited attention. The integration of the informal sector is a case in point: it is recognized as both an opportunity and a challenge, yet the literature offers few rigorously evaluated models for its accomplishment (Mmereki, 2018; Clube & Hazemba, 2024). The risk, documented in the marine plastic case, that circular

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transitions may reproduce existing inequalities lends urgency to this lacuna (Marks et al., 2023). A circular economy that is efficient but inequitable would represent, at best, a partial success, and the explicit incorporation of distributional considerations into policy design is therefore not an optional refinement but a constitutive requirement.

14.6. Data, Measurement, and the Knowledge Gap

The dependence of adaptive governance upon data is matched by the inadequacy of the data presently available in many jurisdictions. Conventional reliance upon diversion rates provides an incomplete picture of zero waste performance, and the development of more comprehensive indicators, such as the zero waste index, represents a necessary corrective (Zaman & Lehmann, 2013). Yet the diffusion of such indicators remains limited, particularly in developing economies, where monitoring systems are frequently fragmented or absent. The resulting knowledge gap impedes both the evaluation of policy and the cumulative learning upon which the field depends, and its closure should be regarded as a precondition for evidence-based circular policy rather than as a subsequent embellishment.

14.7. Theoretical Implications

Considered together, these findings carry theoretical implications that extend beyond the immediate subject of waste and resource policy. They suggest that the integration of the circular economy into urban policy is best theorized as a sociotechnical transition in which institutional, financial, social, and technical elements are co-constitutive, and in which the alignment of these elements, rather than the perfection of any one, determines the outcome. This conception aligns the study with the broader literature on sustainability transitions and on urban climate governance, and it implies that the analytical separation of waste management from climate policy, long characteristic of both scholarship and practice, is no longer tenable (Bulkeley, 2010; Geissdoerfer et al., 2017).

14.8. Practical Implications for Policymakers

For municipal policymakers, the practical implications are correspondingly clear. The evidence counsels against the search for a single decisive instrument and in favor of coherent packages that combine regulation, economic incentives, and information-based measures, sequenced according to the staged roadmap articulated in this study. It counsels, further, the early establishment of data infrastructure, the deliberate cultivation of governance capacity, and the explicit incorporation of equity considerations from the outset rather than as a subsequent adjustment. Above all, it counsels the recognition that circular and zero waste strategies are not a discrete municipal service but a central instrument of urban climate policy, and that their integration into the wider apparatus of governance is the condition of their success.

14.9. Reflexivity and the Limits of the Present Synthesis

It is incumbent upon any integrative review to reflect upon the boundaries of its own authority. The conclusions advanced here are conditioned by the composition of the corpus upon which they rest, and that corpus, although deliberately diverse, is finite and weighted toward contexts in which the scholarly documentation of circular practice is most developed. The relative scarcity of rigorously evaluated evidence from the lowest-capacity settings means that the present synthesis speaks with greater confidence of the conditions of success than of the conditions of failure. Moreover, the rapidity with which the field is evolving entails that the most recent municipal experiments, particularly those concerning digital instruments and novel financing models, may not yet have entered the peer-reviewed record. These considerations do not vitiate the findings, but they qualify them, and they reinforce the argument, advanced throughout, for contextual humility in the formulation and transfer of policy.

15. FUTURE RESEARCH DIRECTIONS

The analysis identifies several priorities for future inquiry. First, the relationship between governance capacity and circular outcomes, frequently asserted yet seldom measured, warrants systematic empirical investigation, ideally through comparative study of cities differing principally in their institutional arrangements. Second, the operational mechanisms of a just transition, and in particular rigorously evaluated models for the integration of the informal sector, constitute an urgent and underdeveloped field. Third, the diffusion and standardization of comprehensive performance indicators, extending beyond diversion rates to capture the substitution of virgin materials and the associated emissions, would materially strengthen the evidential basis of the field (Zaman & Lehmann, 2013). Fourth, the contextual determinants of successful policy transfer, especially between developed and developing economies, merit dedicated study so that the limits of generalization may be specified with greater precision. The pursuit of these directions would advance the field from the documentation of practice toward the explanation of outcomes.

The relationship between the identified knowledge gaps, the methodological approaches suited to addressing them, and the contributions that may thereby be anticipated is summarized in Figure 11.

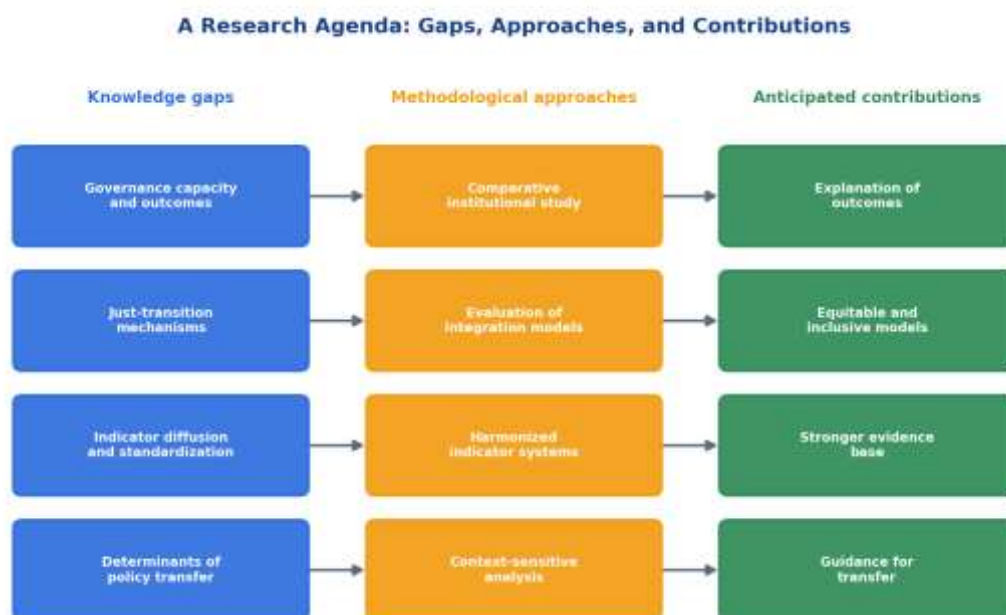


Figure 11. A research agenda mapping the identified knowledge gaps against proposed methodological approaches and anticipated contributions.

16. CONCLUSION

This article has advanced an integrated framework through which the contribution of zero waste and circular economy strategies to urban climate objectives may be understood and pursued. Extending from international climate agreements through to local green procurement and waste management, the framework demonstrates that these strategies furnish a coherent theoretical and practical basis upon which cities may contribute meaningfully to climate mitigation and adaptation. The evidence assembled indicates that integrated urban policies, encompassing governance, infrastructure, finance, and stakeholder engagement, are indispensable to the translation of the commitments embodied in the Paris Agreement and the Sustainable Development Goals into tangible reductions in emissions and material intensity (United Nations, 2015; United Nations Framework Convention on Climate Change, 2015).

The study has equally insisted, however, upon the persistence of substantial barriers, namely financing deficits, governance fragmentation, and inadequate measurement, and upon the contextual asymmetries that render uniform prescription inappropriate. By leveraging multi-level governance, innovative financing, and data-driven decision-making, and by attending deliberately to equity, municipalities may nonetheless implement scalable zero waste and circular economy programs that harmonize climate action with urban resilience and social justice (Ali, 2024; Awino & Apitz, 2023; Bulkeley, 2010; Geissdoerfer et al., 2017; Georgiev et al., 2023; Jones & Comfort, 2018; Kirchherr et al., 2017; Marks et al., 2023; Ortiz et al., 2020; Soos et al., 2022). The framework offered here is intended to assist that endeavor, and to provide a foundation upon which both scholarship and practice may build.

Ethics Statement

Ethics Committee Approval

This study is an integrative review based exclusively upon secondary literature. As it involves no experimentation with human or animal participants and no collection of primary data, it does not require the approval of an ethics committee.

Conflict of Interest

The author declares that no conflict of interest exists in relation to this study.

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Author Contribution

The conception and design of the study, the synthesis of the literature, the analysis, and the preparation of the manuscript were carried out by the sole author, Özge Tenlik, Ph.D.

Data Availability

All sources upon which the study relies are listed in full in the references section and are accessible through their respective digital object identifiers.

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