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The relevant territorial scale for implementing circular economy

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Abstract:
The circular economy (CE) has emerged as a compelling alternative to traditional linear economic models that aims to promote sustainability through the principles of reduction, reuse, and recycling. This transition is crucial in tackling the unsustainable consumption of natural resources and the production of non-recyclable waste, which are characteristic of linear models. Academic discussions on the CE mostly focus on macroscopic aspects such as policies and global value chains, as well as microscopic aspects like company-level strategies and innovations. However, recent research has shed light on the significance of the meso level. Local and regional dimensions play a vital role in implementing CE initiatives, highlighting the importance of geographic and scale-specific analyses. This article explores the essential roles of local and regional scales, including municipalities and broader areas like provinces, in the implementation of CE. By adopting a multiscalar perspective, the chapter argues for the integration of territorial dimensions into CE strategies to improve resource efficiency, reduce environmental impacts, and promote sustainable development. The analysis demonstrates that the effectiveness and environmental benefits of the CE are greatly influenced by the spatial dynamics of resource circulation, stakeholder cooperation, and the localization of economic activities. The chapter advocates for a nuanced understanding of the CE that acknowledges the interplay between different levels of governance, from local to international, emphasizing the importance of coordinated policies that cater to specific regional and local contexts. By highlighting the central role of local and regional levels in CE practices, this discussion contributes to a more comprehensive approach to sustainability, emphasizing the need to incorporate spatial considerations into CE policies and strategies.

Keywords: Circular economy, meso-level, local level, regions, cities, territorial governance

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Introduction

In current sustainability discourses and policies, the circular economy (CE) is often presented as an alternative to the linear economic models that have long dominated the industrial world. These linear models, based on a logic of "extract, manufacture, throw away", are increasingly perceived as unsustainable in the long term (Millar et al., 2019), as they present an exaggerated consumption of natural resources, while producing polluting waste that proves impossible to recycle. In response, the circular economy proposes an alternative based on reduction, reuse and recycling, aimed at minimising the ecological footprint and maximising resource efficiency (Geissdoerfer et al., 2017).

In the academic literature, the CE is often analysed through two main approaches: one macroscopic, and the other microscopic. At the macroscopic level, studies focus on how national or supranational policies (Heshmati, 2019), as well as global value chains (Meherishi et al., 2019) can be reconfigured to foster the adoption of circular principles. This level of analysis addresses broad issues such as international regulation, trade agreements and global fiscal or legal incentive mechanisms (Vence & López Pérez, 2021) to encourage a more CE.

At the same time, at the microscopic level, studies focus on companies, examining circular business models (Lüdeke-Freund et al., 2019), organisational obstacles to recycling (Nujen et al., 2022), the implementation of virtuous approaches (Mirata, 2005), or innovation in production processes to minimise waste (Suchek et al., 2021). This level highlights specific solutions, often within immediate reach, that can be applied by individual economic players.

In addition to this broad focus in the literature on the macro and micro levels, research has begun to emerge on the meso level. In fact, several studies have shown that local and regional players play a key role in implementing CE initiatives. From waste management at municipal level, to clusters of businesses committed to the CE, to regional policies on energy and resources, the local level is where the principles of the CE take on life and form (Arsova et al., 2022).

This chapter endeavours to show the extent to which the local and regional dimensions are important in the CE. The regional dimension addresses broader areas, encompassing for example provinces (NUTS 2 level), and focuses on meso-scale initiatives and policies. In contrast, the local dimension pertains to specific, smaller areas such as municipalities (LAU 1 & 2 levels), emphasizing community-specific strategies and decision-making by local governments or councils. We argue that these dimensions are crucial because CE is based (i) on the interdependencies, complementarity and cooperation relations between various stakeholders that are evolving at different scales and more specifically the regional and local ones; and (ii) on the circulation of flows and materials between various companies and organisations. Moreover, the local or regional scales appear crucial, in order to minimize the costs of transactions between actors, and the costs of transport between technical stages within industrial webs or value chains.

It is not simply a matter of adding another scale of analysis, but of redefining the way we understand and implement the principles of the CE by recognising the interactions and synergies possible at different territorial scales: local, regional, national and even international.

We argue that to realise the full potential of the CE, it is essential to integrate a territorial and multiscalar perspective that embraces the complexity and specificity of different geographical and institutional levels. Only such an approach will enable the CE to be implemented effectively and realistically, and to reap its environmental benefits.

The multiple definitions of the CE and the omission of the local dimension

The concept of the CE is a rich and multidisciplinary field, approached from a variety of angles by different schools of thought. Initially inspired by ecological principles, the CE quickly attracted the attention of environmental science researchers, who focused on the implications of sustainability, waste reduction and recycling (Winans et al., 2017; Hachaichi & Bourdin, 2023). At the same time, the field of economics has approached the concept from the angle of resource efficiency and the creation of added value, particularly with regard to reuse and extending the life of products (Andersen, 2007). Management science, for its part, has focused on how companies can integrate circular principles into their business models (Lüdeke-Freund et al., 2019). This approach often goes beyond simply reducing costs to include factors such as building customer loyalty through sustainable practices, reducing the risks associated with volatile commodity prices, and innovating products and services (Pecorari & Lima, 2021; Nikolaou et al., 2021).

As a result of this diversity of approaches, the CE is characterised by a wealth of definitions that vary depending on the focus (Kirchherr et al., 2023). Some focus on minimising waste and optimising recycling, others look at designing products that are sustainable, have a long lifespan or can be easily disassembled and reassembled, while still others focus on maximising resource efficiency, even going as far as pooling resource needs within industrial clusters (Millar et al., 2019). However, one constant remains: the definitions proposed by researchers forget the territorial dimension. At best, this focus has relegated the local dimension to the status of a mere variable rather than a central, structuring factor.

It is common to think that the fundamental principles of the CE are universally applicable, regardless of geographical context. This perspective can be attributed to the tendency to conceptualise the CE as a set of best practices or technologies that can be deployed everywhere in a standardised way. For example, recycling, reuse and reduction are often presented as global strategies for minimising waste and carbon emissions, with no particular regard for the territory in which these activities take place. Yet this perspective omits a crucial element: the impact of the local context on the success of these initiatives (Petit-Boix & Leipold, 2018). The paradox lies in the fact that the CE, with its central aim of minimising the ecological footprint and managing resources sustainably, is intrinsically linked to the specificities of the places where these resources are extracted, transformed, consumed and finally recycled or reused.

Bourdin et al (2022) explain that each territory has its own environmental, socio-cultural and economic characteristics, which can significantly influence how CE principles are implemented. For example, the types of resources (tangible and intangible) available, the characteristics of the eco-system, local skills, cultural norms around consumption and waste, and even local regulations can all play a role in the success or failure of a CE initiative. This is also what Niang et al (2022) show in the context of the implementation of green and circular energy production projects (biogas). Therefore, we argue that by neglecting these local specificities, we run the

risk of promoting solutions that are ill-suited to the unique challenges and opportunities of each territory. This can lead to inefficient use of resources and even thwart the original goals of sustainability and efficiency that the CE seeks to achieve.

Industrial and territorial ecology (ITE), which is a subfield of the CE, explicitly integrates the local dimension into the CE (Dumoulin & Wassenaar, 2014; Veyssière et al., 2022). This is an approach that aims to optimise the use of resources within clusters or networks of businesses located in the same region. The most famous case is undoubtedly the so-called Kalundborg symbiosis, in Denmark, where various industries have created a symbiotic industrial ecosystem (Chertow & Ehrenfeld, 2012). Waste from one company becomes input for another, creating a local value loop. This model is a perfect example of how territorial anchoring can amplify the benefits of the CE (Cerceau et al., 2018). In TIS approaches, stakeholders intuitively understand that geographical proximity can minimise transport costs, reduce carbon emissions and facilitate closer partnerships for sharing resources (Torre & Dermine-Brullot, 2021). Support systems can then be put in place to help stakeholders exchange tangible and intangible resources (Jambou et al., 2022).

With this in mind, it is striking that academic research and public decision-makers are struggling to catch up with this intuitive understanding of the local as a lever of efficiency for the CE. We need to carefully examine the different dimensions of this approach, in order to identify the pros and cons of CE relations at local and regional level, and compare them with those implemented at other levels. Of course, it is important not to fall in the so-called “local trap”, sometimes identified in food systems (Born et al., 2006), where it is considered rather quickly that all actions must be carried out at the local level, to the detriment of global relations, often essential.

This way of thinking raises important questions about how public policies are developed and how they could be better aligned with the specific realities and needs of the territories they claim to serve, in particular through the implementation of tailored CE approaches.

The value of a local and regional approach to implementing the CE

When it comes to implementing CE approaches, geographical proximity between economic players offers several operational and ecological advantages. Firstly, it facilitates the exchange of information in real time, enabling better coordination and a rapid response to fluctuations in the demand for and supply of resources (Niang et al., 2022). Proximity also reduces the need for complex and costly logistics infrastructures, as raw materials, finished products or waste can be transported over short distances (Kiss et al., 2019).

Moreover, by prioritizing proximity, we can greatly minimize the carbon footprint linked to transportation of resources, especially in the case of local resources. Every kilometre travelled by lorries, planes or ships not only generates CO2 emissions, but also leads to energy consumption and often economic costs (Weetman, 2016). This is the reason why the emphasis must be placed above all on (ii) the consumption of local resources, which obviously avoids any transport costs and especially any associated pollution to these transport ; (ii) the maintenance and lengthening of the life of the products, which avoids not only the use of new local

resources, but also the import of new products or resources and related costs. In the context of the CE, local sourcing significantly impacts emissions reduction. For example, a study by the Ellen MacArthur Foundation reported that by localizing food production and adopting regenerative agricultural practices, greenhouse gas emissions could be reduced by as much as 20% in certain regions (Ellen MacArthur Foundation, 2021). Furthermore, in the textile industry, a shift towards local production and closed-loop recycling systems has been shown to decrease water consumption and pollution, with one case study indicating a reduction of water use by approximately 50% for locally recycled cotton compared to traditionally sourced cotton (Green Textile Solutions, 2022). While the 'last mile' of delivery can indeed be carbon-intensive, overall environmental benefits of local sourcing in a circular economy framework are clear. A report by Circular Economy Institute (2023) highlighted that local sourcing of building materials in the construction industry could reduce transportation-related emissions by up to 30%, depending on the region and materials used.

Local, as a dimension of the CE, simply transcends the question of geographical proximity. It evokes a strategic integration of the resources and capabilities of stakeholders within a limited space defined to maximise economic efficiency and minimise environmental impact. As explained by Hartley et al. (2024), it can have the advantage of ensuring that economic actors are less dependent of geopolitical instability, economic protectionism or external resources. Geographical proximity is not simply a question of physical distance; it has a relational and dynamic dimension that is essential to effective collaboration (Torre & Rallet, 2005). When players such as businesses, local authorities and governments, and not-for-profit organisations are geographically close, they benefit from a framework that is conducive to the establishment of collaborative relationships and even trust (Veyssière et al., 2022; Niang et al., 2022). Firstly, proximity facilitates communication, making exchanges more frequent, direct and transparent (Torre & Gallaud, 2022). This is crucial for coordinating joint actions, particularly in CE projects, which require fine-tuned and permanent synchronisation between the various players to manage resource flows. Proximity, in this context, facilitates these elements by enabling more efficient collaboration, quicker adaptation to local needs, and the development of symbiotic relationships between various stakeholders.

In addition, the mutual knowledge between local players is an asset. By being close to each other, they are better able to anticipate each other's needs and expectations. They can also develop a better understanding of local constraints, be they specific regulations, cultural preferences, technical constraints or socio-economic challenges. This mutual understanding is the cornerstone of the co-construction of solutions adapted to local challenges (Schiller et al., 2014). Finally, geographical proximity reinforces the feeling of belonging to a territory. This can encourage stakeholders to adopt a long-term vision, where the success of one is intrinsically linked to that of the territory as a whole. In this way, collaborative CE initiatives become integrated strategies within a sustainable territorial vision (Tapia et al., 2021).

To gain a deeper understanding of the significance of the local level in implementing Circular Economy (CE) strategies, we propose analyzing the "3Rs" principle (Reduce, Reuse, Recycle) from a regional or local perspective. Table 1 presents a comprehensive examination of how each aspect of the 3Rs principle manifests itself at the local and regional levels, accompanied by relevant implications and examples for each dimension. At the local level, efforts to "reduce" primarily concentrate on conserving natural resources, utilizing local resources, and

diminishing waste generation. On the regional scale, the focus shifts to promoting more efficient and sustainable production practices. Regarding "re-use," local initiatives are primarily aimed at optimizing the utilization of local resources and traditions, as well as prolonging the lifespan of products. This approach helps reduce the strain on transportation, production, and waste treatment infrastructures. At the regional level, the emphasis lies in encouraging the adoption of sustainable alternatives and fostering interest in the circular dimension of the economy. Lastly, in terms of "recycling," local efforts focus on minimizing the amount of waste sent to landfills and reducing associated disposal costs. Meanwhile, on the regional level, the objective is to optimize the value chain by transforming waste into valuable resources. Overall, local actions tend to be more directly implemented and oriented towards engaging stakeholders, while regional initiatives concentrate on broader structural transformations and integrated solutions among various stakeholders across larger territories.

Table 1: The 3Rs principle applied at local and regional level

Principle	Sector	Level	Example
Reduce	Food	Local	Encouraging restaurants and canteens to reduce food waste by giving smaller serving sizes.
		Regional	Implementing educational programs for farmers and producers to reduce post-harvest losses.
	Energy	Local	Creating positive energy districts. These urban zones produce more energy than they consume, typically through a combination of energy-efficient buildings and local renewable energy generation.
		Regional	Allocating regional funds for investing in building insulation.
	Textile	Local	Clothing sharing initiatives, such as lending programs, encourage the reuse of garments, reducing the need for new clothing production and minimizing textile waste.
		Regional	Investing in long-lasting textiles for hotels and hospitals enables these institutions to reduce their environmental footprint by minimizing the frequency of textile replacements, thereby saving resources and reducing waste.
Reuse	Food	Local	Establishing community kitchens where surplus food from restaurants, supermarkets, and households is collected, cooked, and served to people facing social difficulties.
		Regional	“Food for feed”: it involves collecting organic waste materials—such as unsold fruits, vegetables, and other food scraps—from grocery stores, markets, and food processing facilities, and then distributing this waste as feed to local farmers for use in livestock feeding
	Energy	Local	Sharing of heat to create systems where excess thermal energy from one building, such as waste heat from industrial processes or power plants, is captured and distributed through a network to provide heating for other buildings or homes.
		Regional	Developing regional renewable energy cooperatives. These cooperatives bring together various stakeholders, including residents, local businesses, and governments, to invest in and manage renewable energy projects such as large-scale solar farms or wind turbine installations.

	Textile	Local	Organizing clothing fairs for local citizens to buy, sell, or exchange apparel, often including handcrafted or vintage items.
		Regional	Developing regional programs that facilitate the repair and upcycling of textiles, providing workshops and resources for citizens to learn how to extend the life of their clothing and turn old textiles into new products.
Recycle	Food	Local	Developing local composting facilities for citizens, to reduce landfill usage and to support local gardening and farming with sustainable fertilizer.
		Regional	Implementation of regional biowaste-to-energy facilities that convert food scraps and organic waste into renewable energy and biofertilizers, serving multiple municipalities.
	Energy	Local	Setting up local collection points for used batteries and electronic waste to be recycled and repurposed into new energy storage solutions.
		Regional	Establishing a regional program for the refurbishment and recycling of solar panels to recover valuable materials and ensure their lifecycle is extended.
	Textile	Local	Establishing textile collection points to encourage citizens to recycle unwanted clothing and fabrics, which can then be sorted and repurposed.
		Regional	Creating regional partnerships to develop advanced textile recycling facilities that chemically break down fibers from mixed or contaminated fabrics, enabling the recovery and regeneration of high-quality fibers for producing new textiles. This effectively reduces the need for virgin materials and decreases environmental impact.

The multi-scalar dimension of public policies linked to the CE

While the local dimension plays a crucial role in activating the CE, the development of public policies to encourage its deployment requires a multi-scalar approach. CE initiatives often involve players operating at different geographical levels. Several levels of governance, from local to international, are often necessary to ensure the relevance and effectiveness of the measures adopted (Bahn-Walkowiak & Wilts, 2017).

The local level, in particular towns and cities, is an ideal place to implement public policies that promote the CE. At this level, decision-makers are closer to the realities on the ground, which means that initiatives can be tailored to suit. Needs and specific cultural, social and economic characteristics can be addressed with a degree of finesse that higher levels are often unable to achieve. This gives local policies the responsiveness and flexibility that are essential to their success. This is what Bolger & Doyon (2019) show, highlighting how decision-makers are well positioned to understand and address the specific needs and characteristics of their stakeholders.. From this point of view, the chapter on circular food systems (van Leeuwen and Bob Meinardi, 2024, in this book) serves as a concrete example of how local-level policies and actions, informed by on-the-ground experiences and challenges, are integral to advancing the circular economy, particularly in sectors that are as essential and complex as food production and distribution. It highlights the necessity of responsive and flexible policy-making at the local level, which is crucial for the mobilization of specific local resources and the acceleration of circular initiatives.

For their part, regional policies, by providing a bridge between the local level and the macro level (national, international), play a pivotal role. This scale makes it possible to harmonise local efforts, establish standards and guidelines (which often take the form of regional CE strategies), while leaving room for flexibility (Arsova et al., 2022; Arauzo-Carod et al., 2022). In this way, regions can capitalise on local successes, promote best practice and ensure territorial cohesion, while promoting the creation of circular jobs within their boundaries. In their article, Niang et al (2023) show that there is a strong regional effect in terms of CE activities, suggesting that regional strategies facilitate the structuring of initiatives for more local levels. In addition, the regional level is able to create synergies between different municipalities, pooling resources and skills for common regional objectives. By playing the role of coordinator (Torre and Bourdin, 2023), the regions are able to drive forward policies that respond to the specific challenges of the territory, from a more sustainable perspective.

The national level plays a decisive role in structuring and guiding CE policies. First of all, it is at this level that a large proportion of the major strategic guidelines are established, as well as the legislation and regulations that guide local and regional actions (Cramer, 2022). Indeed, these legal and regulatory texts can stimulate or guide the CE, by giving a clear framework to local actors (Heshmati, 2017). In addition, the national level guarantees harmonisation between different regional policies, thus avoiding discrepancies that could hinder the implementation of this economy. This level also enables the mobilisation of substantial financial, human and technical resources, making it easier to carry out large-scale projects and support research and innovation. From this point of view, the Chinese example is often used in the literature to highlight the key role played by the State in deploying the resources needed to implement the CE (Su et al., 2013; Zhu et al., 2019). Finally, it is often at the national level that large-scale awareness campaigns are launched, thus reaching a large portion of the population and accentuating the importance of the CE (Kirchherr et al., 2018).

Finally, in order to "globalise the CE" (Geng et al., 2019), coordination between states is necessary. From this point of view, the international or supranational scale is paramount to address the cross-border challenges of the CE and ensure harmonisation of efforts on a global scale. Environmental challenges, such as climate change, know no borders and require joint action by nations (Schröder et al., 2020). This scale provides a platform for the exchange of knowledge, best practice and innovative technologies, enabling countries to benefit from each other's advances (Heshmati, 2017). Thus, supranational organisations, such as the United Nations or the European Union, can develop normative and regulatory frameworks that guide national policies and promote consistent implementation of the CE (Martinho & Mourão, 2020, Mhatre, 2021). These entities also play a crucial role in mobilising financial resources, often via dedicated funds, to support CE initiatives in developing countries or in regions facing particular challenges (Zeng et al., 2022). In addition, the international scale makes it possible to create strategic partnerships between countries, encouraging the establishment of sustainable supply chains and cross-border collaboration. It also helps to establish global standards that ensure that circular products and services meet high standards, regardless of where they are produced (Kyriakopoulos, 2021). A good example of these practices can be found at EU level, with two complementary CE initiatives. One is the Hélène MacArthur Foundation, which has proposed

operational definitions of the CE (Ellen MacArthur Foundation, 2013). On the other, the CE strand of the Green Deal, which aims to implement at EU level production methods and relations between businesses that are conducive to the development of the CE (European Commission, 2019).

All in all, it is clear that each scale, whether local, regional, national or international, plays a specific role in the deployment of the CE. However, orchestrating effective policy coordination across these different strata is proving to be a daunting task, but one that represents a major challenge to ensuring the success of the CE (Geng et al., 2019). However, the political architecture and the way in which the levels of governance interact vary considerably from one national context to another. For example, while states such as China tend to centralise their decisions, others, like many European countries, favour subsidiarity and encourage local initiative. In all cases, whether the strategy adopted is driven "top-down" or emerges "bottom-up", the crux of the matter is the ability to coordinate these different levels of governance to facilitate the implementation of the CE.

Conclusion and outlook

Having explored the implications of the CE on various scales of analysis, it is clear that the CE goes beyond the simple technical paradigm of substituting more virtuous practices for our traditional linear economic models. On the contrary, it implies a systemic change that has two major characteristics. Firstly, the very principle of circularity and the circulation of flows and materials implies interdependence and complementarity of actions and relationships between players, which cannot be thought of in terms of individual action or entrepreneurial policies at the level of the firm alone. Secondly, and for the same reason, the spatial dimension is present in all the operations and practices of circular economies that are both profitable from an economic point of view and virtuous from an ecological point of view, whether at the local level, or at broader levels that are just as important, at the national or wider scale. In particular, the local or regional level may be a factor in reducing transaction or transport costs.

For all these reasons, in our article, rather than focusing in the traditional way on macro- or microeconomic approaches, we have identified the crucial importance of the spatial dimension, and particularly the meso level, where the local and regional become privileged fields of action for putting circular principles into practice. The success and relevance of the CE depend very much on the scale at which it is implemented. While the local scale seems essential, both for the geographical proximity between the players it implies and for its ability to take account of specific territorial characteristics and resources, the fact remains that a link between the different scales of governance is necessary, from the local to the global and vice versa.

As with the energy transition, the complexity of implementing the CE lies in this interdependence between different scales. Whether it is implemented via “top-down” or “bottom-up” initiatives, the effectiveness of this economy depends on a harmonious articulation between these scales, each contributing its own stone to the edifice. Unlike traditional linear economies, the CE is inherently complex and interconnected. It relies on the effective circulation of resources across various stages and scales of production, consumption, and waste management. Hence, in the context of CE, the concept of multi-scale

interdependence takes on a specific significance due to the cyclical and systemic nature of the economy it aims to create. Each level of governance plays a role in the implementation of CE but also relies on other levels to address the systemic challenges of transitioning to a circular model. This interconnected approach is important for moving beyond isolated efforts and achieving a sustainable and efficient circular economy.

This circularity requires a seamless integration of activities at different levels, from local to global. At the local and regional levels, CE initiatives often involve stakeholders' engagement in recycling programs, local sourcing of materials, and small-scale circular practices tailored to specific regional needs. These efforts are crucial for creating immediate environmental impacts and fostering a culture of sustainability. However, without coordination and support from higher levels of governance, these local initiatives may struggle to scale or integrate into broader systems. At the national level, the formulation of policies and frameworks that support circular practices is critical. These levels of governance are responsible for creating the infrastructural and regulatory environment in which local initiatives can thrive. They also play a pivotal role in addressing larger-scale challenges such as cross-regional waste management, standardization of recycling processes, and fostering markets for circular products. Internationally, the circular economy requires collaboration across borders to manage the global flow of materials and products. This level of governance is essential for addressing transboundary environmental challenges, aligning global standards for circular practices, and facilitating the exchange of knowledge and technology. From this point of view, European Union lays the foundations for international cooperation on EC through its Action Plan.

Two avenues of research therefore seem important to explore. Firstly, the analysis of local actions, highlighting the levels of synergy in production methods, but also the involvement of the various local stakeholders, such as local populations or associations defending interests or landscapes, for example. On the other hand, the definition of global policies, at national or supranational level, which take these dimensions into account by defining a general and binding framework for the implementation of these actions, as well as the necessary flexibility of adaptations taking into account the different levels of subsidiarity.

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